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## HEXAGON SENSOR SUBSYSTEM

SV-8 (SN-011)

## FLIGHT READINESS REPORT

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FEBRUARY 1974

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This report consists of 103 pages.

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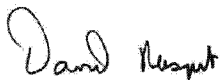
FLIGHT READINESS REPORT  
SV-8 (SN-011)

## PUBLICATION REVIEW

This report has been reviewed and is approved.



DAVID F. BERGANINI  
Major, USAF  
Chief, Payload Division



DAVID RASPET  
Major, USAF  
1208 Ass't Vehicle Manager

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

## FOREWORD

This report has been prepared for and by direction of the Office of Secretary of the Air Force,  
Director of Special Projects.

The preparation, collection, and reduction of the data contained within were accomplished by the  
Air Force Special Projects Production Facility, Westover Air Force Base, Massachusetts. We are  
indebted for the continued excellent support provided by Colonel Clark E. Davison, Commander, and his  
staff.

Contributors to this report included:

PRS STAFFSSC

J. Garrish

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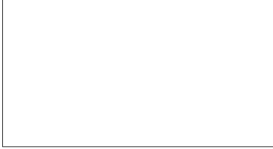
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## FLIGHT READINESS REPORT

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## SECTION I

## INTRODUCTION

## 1.1 SUMMARY

Flight focus should be set at 68 microns and 25 microns for the Forward and Aft Cameras respectively for 1414 Film. In addition to 1414, the Aft Camera contains both conventional Color (SO-255) and Infrared (FE-3916) Films. When using SO-255 and FE-3916 Films, the Aft Camera should be set at 55 microns. The vacuum test data is summarized in Table 1-1.

TABLE 1-1

## VACUUM TEST EVENT SUMMARY

| Chamber A                                    | Test Results   |            |
|----------------------------------------------|----------------|------------|
|                                              | Forward Camera | Aft Camera |
| Cross-Track (inch/second)                    | -.002          | .015       |
| In-Track (inch/second)                       | .013           | .024       |
| 1414 Film                                    |                |            |
| PBF (microns)                                | 72             | 34         |
| Peak Resolution (cycles/mm)                  | 192            | 200        |
| Cross-Track (inch/second)                    | -.014          | -.006      |
| In-Track (inch/second)                       | .007           | .022       |
| SO-255 Film                                  |                |            |
| PBF (microns)                                | 114            | 69         |
| Peak Resolution (cycles/mm)                  | 121            | 104        |
| Inter Test Events                            |                |            |
| Servo Inhibit Assembly (SIA) Retrofit        |                |            |
| SCC Box Replaced (13A1)                      |                |            |
| OOAA Box Replaced (1A7)                      |                |            |
| Aft Camera 3A1-2 Output Drive Servo Replaced |                |            |
| PDS 14A1 Refurbished                         |                |            |
| Four inch roller preload retrofit            |                |            |
| A-2 Test                                     |                |            |
| 1414 Film {                                  |                |            |
| Cross-Track (inch/second)                    | -.019          | .039       |
| In-Track (inch/second)                       | .034           | .033       |
| PBF (microns)                                | 68             | 25         |
| Peak Resolution (cycles/mm)                  | 194            | 185        |

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- NOTES: 1. Mean smear values and peak resolution were taken from the 0° collimators at a Vx/h of .052 radian/second, at 70° F.
2. Mean smear cross-track data for SO-255 Color Film from Chamber A is the residual after a .200 inch/second decrease in film speed correction was made for both the Forward and Aft Cameras.
3. All best focus (PBF) data is based on tribar data.
4. The Aft Camera will be launched with a mixed load of 1414, SO-255, and IR Films.
5. Chamber A focus data is normalized for infinity focus.

OOAA adjustments recommended for flight are summarized in Table 1-2.

TABLE 1-2

## RECOMMENDED OOAA ADJUSTMENTS

(counts)

| Motion Component | Film Type      | Forward Camera | Aft Camera |
|------------------|----------------|----------------|------------|
| In-Track         | 1414           | -4             | -2         |
| Cross-Track      | 1414           | 1              | -3         |
| Cross-Track      | SO-255/FE-3916 | N/A            | -17        |

## 1.2 SYSTEM IMPROVEMENTS

The following lists the improvements and changes on SV-8:

- A. The Servo Inhibit Assembly (SIA) has been incorporated on all systems effective with SV-8.

The SIA inhibits the drive servos from dithering when the RPG is at pause. The SIA function is commandable as follows:

- (1) Reset, inhibit the servos at pause.
- (2) Override, does not inhibit the servos at pause.

- B. The metering capstan settling time improvement was incorporated for the first time on SV-8.

This change decreases the FBS error which existed in the first few degrees of photo mode on previous systems. The improvement was achieved by modifying the optical bar, drive capstan, and metering capstan servos. In addition, the MCSE signal resonance, characteristic of previous systems, was shifted and attenuated.

- C. The Supply Unit Fences improvement prevents the Supply stack from telescoping during rewind operations.

- D. The Supply Unit Accelerometers modification. This change consisted of removing the two vibration sensors from the Supply reel of SV-8. These were the same type of vibration sensors which were mounted on the Supply reel of SV-7.

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## 1.3 AREAS OF CONCERN

The assembly and testing cycle of SV-8 (SN-011) at SVIC was accomplished without any major incidents. There were some anomalies which should be noted. None of the following concerns are significant enough to preclude the launching of SV-8, nor should they impact the system's optical performance.

1.3.1 Ground Test Skin Current

The design improvement that provided Backup Film Transport-Off with Camera Power-Off inadvertently interconnects vehicle ground point to SSTC ground when the SSTC ESD is activated. The interconnection of these ground sources resulted in a 100 milli-amp skin current on the vehicle. The skin current is the result of a design error which does not affect the electrical ground isolation of the flight configuration. For this reason, the Government will use as is.

1.3.2 Improper Command Sequence ESDs

During Chamber A-1 testing at SVIC, the SS had two emergency shutdowns (ESDs) that were caused by improper command sequences. The ESDs resulted in non-uniform stacking of the film on the Take-up. When the film was retrieved, the off-stacking caused ripping, tearing, and finally, complete separation of the film. Inspections and tests subsequent to the ESDs indicated no damage to the Sensor System; therefore, the Government will use as is.

1.3.3 Chamber A-1 Contamination

During Chamber A-1 testing, outgassing of some substance occurred. The specific contaminant (Dimethyl Terephthalate) has been identified and is not injurious to the optical coatings. The quantity of contaminant was about one fourth that found on SV-7. Based on the successful performance of 1207, the Government will use as is.

1.3.4 Film Drive Dither

During a constant velocity run after Chamber A-2 testing, the input and output film drive summed error dithered for about .5 second at 23 cycles. The dither occurred just before ramp-down. Because this dither occurred only once and then just before ramp-down, the Government will use as is.

1.3.5 Platen Tilt

The initial evaluation of the Chamber A-2 Forward Camera data indicated a need for 13 to 20 microns of tilt across the slit. Chamber A data from SSC indicated no need for tilt. The concern is that in the past four SVs, Chamber A-2 testing has indicated a need for additional tilt on the Forward side. The orbital data for these four SVs has not supported the tilt indication based on Chamber A-2 data. The Government is therefore concerned about any tilt indications, especially on the Forward side, arising from Chamber A-2 testing. The Government and SSC are currently studying the

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collimator configuration to determine if there is any problem inherent in the collimator design or implementation.

1.3.6 Fluted Film

The 47' closest to the TU core showed fluted edges on both sides after Chamber A-1 testing. The edges of the film were not nicked, broken, or torn. The fluting appeared to be caused by the pulling of film at high tension over a sharp edge. The damage occurred simultaneously on both sides of the film. The pattern of damage is not typical of Sensor Subsystem film damage, but appears to be a manufacturing defect. For this reason, the Government will use as is.

1.3.7 Motor Encoder Phasing Test

A special Motor/Encoder Phasing Test was run on TUA-021A at SSC/WCFO to determine if a potential stator winding separation from the core existed. This potential problem was identified on TUA-026A.

The Motor/Encoder Phasing Test in the field was devised for recycled/refurbished TUAs to stress the epoxy bond between the stator winding and core in both rotational directions to determine the presence of a shift in the motor/encoder phase relationship.

The test indicated no evidence of a shift in the motor/encoder phase relationship to TUA-021A. Based on the test results and a worst case analysis, it was concluded by the Government that TUA-021A is satisfactory for flight.

1.3.8 Contamination

Contamination continues to be a concern even though this system has not experienced any anomalies directly resulting from contamination.

All cleaning techniques and preventative measures previously used were incorporated in this system. The final RV and TUA inspection process has been modified because a connector dust cap was recovered in the 1207-3 RV. These modified procedures resulted in finding a small piece of lens tissue, a 1/4" long piece of safety wire, and a connector dust cap in RV-4.

1.4 WCFO FACTORY TEST FLOW

The overall test flow for SV-8 at WCFO is shown in Figure 1-1. The following paragraphs provide brief descriptions of the activities during each of the major tests. Table 1-3 provides the schedule information for the factory flow.

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ASSEMBLY AND TEST FLOW AT SVIC

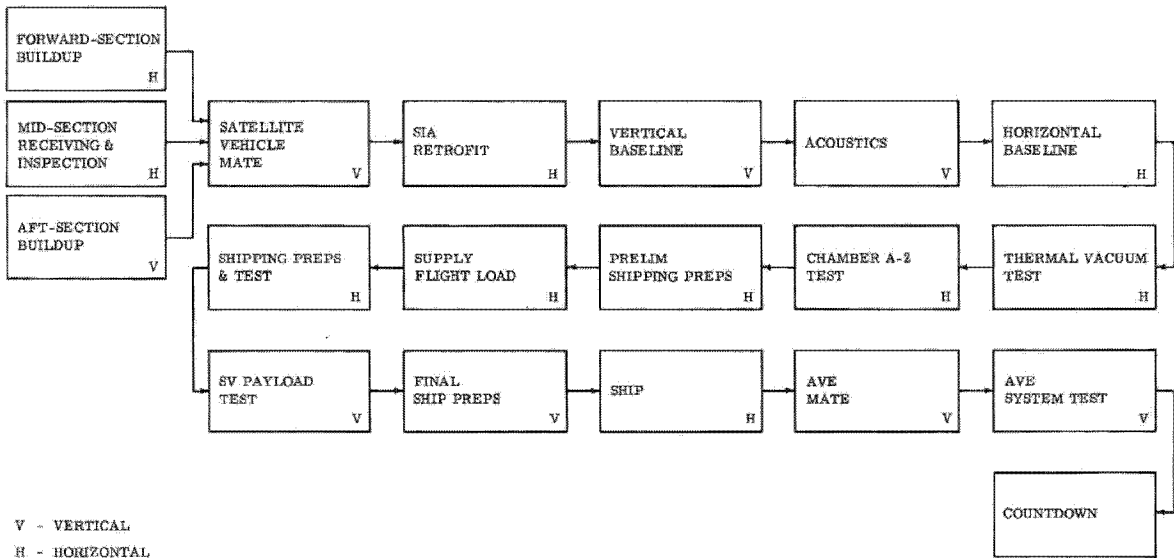


FIGURE 1-1

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TABLE 1-3

## SV-8 MILESTONE SCHEDULE

| <u>Activity</u>                     | <u>Date Completed</u> |
|-------------------------------------|-----------------------|
| 1. Mid-section R&I                  | 25 April 1973         |
| 2. Forward-section Buildup          | 27 June 1973          |
| 3. SV Mate                          | 9 July 1973           |
| 4. Vertical Baseline                | 10 September 1973     |
| 5. Acoustic Test                    | 21 September 1973     |
| 6. Horizontal Baseline              | 26 September 1973     |
| 7. Chamber A Test                   | 24 October 1973       |
| 8. Chamber A-2 Test                 | 3 November 1973       |
| 9. Preliminary Shipping Preparation | 7 January 1974        |
| 10. Final Shipping Preparation      | 28 January 1974       |
| 11. Ship                            | 27 February 1974      |
| 12. AVE Mate                        | 27 February 1974      |
| 13. AVE Systems Test                | 3 March 1974          |
| 14. Countdown                       | 13 March 1974         |

NOTE: Items 9-14 show projected dates for completion of those activities.

1.4.1 Forward-section Buildup

Buildup and testing were completed on 27 June 1973. During functional testing of the Forward-section film path the carriage position TM of the Aft Steerer was observed to be noisy. Replacement of the Carriage Pot Assembly resolved this problem. Take-up No. 29 (Position No. 2) was replaced with Take-up No. 21A. This replacement was due to a failure of the Aft Camera brake during the wrap-cut-wrap sequence into Position 3. Retest of Take-up 21A was performed satisfactorily.

1.4.2 Mid-section Receiving and Inspection

The Mid-section was received at the West Coast Facility on 16 January 1973. The period from 16 January thru 12 March was devoted to SBAC R&I assembly work. The SSC R&I testing commenced on 16 March 1973 and was concluded on 30 March. Data analysis revealed a DC offset on the Aft Camera FBS signal (P-452). The problem was traced to a broken wire in cable 2W173, P13. The cable was repaired and verification of this fix was completed on 12 April 1973.

The Mid-section was placed in vertical storage on 1 May 1973 awaiting the availability of its Aft-section.

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1.4.3 Satellite Vehicle Mate

The mechanical mating of the Mid-section and Forward-section was completed on 9 July 1973.

No problems were encountered.

1.4.4 Servo Inhibit Assembly (SIA) Retrofit & Retest

Due to an ECS failure during the SBA test, it was decided to move the vehicle to the R&I area for performance of the SIA retrofit. During the post retrofit confidence test, it was discovered that the SU brake verify signals were shorted together in the SCC Box.

The vehicle was returned to the VIS on 31 August 1973.

1.4.5 Vertical Baseline Test

The SCC Box (SN-1011) was replaced with SN-1017 from SV-9 prior to performance of the Vertical Baseline Test, which was completed 10 September 1973. Data analysis revealed an offset in the Forward Camera Airborne FBS signal which subsequently resulted in the replacement of the OOAA Box.

1.4.6 Acoustic Environment

The vehicle was erected in the Acoustics Chamber on 20 September 1973 and subjected to the acoustic environment on 21 September 1973. No problems were encountered.

1.4.7 Horizontal Baseline Test

The Horizontal Baseline Test was completed on 26 September 1973. A twisted quad ring in the Looper A cover caused a failure of the film path pneumatic leak test. The ring was replaced and retest of the film path was successful.

1.4.8 Thermal Vacuum Chamber Test

The vehicle was installed in Chamber A-1 for the first time on 8 October 1973. Leaks in the chamber required removal of the vehicle for welding of the chamber wall. The chamber testing was completed on 24 October 1973. Two command timing errors in nested pair sequences resulted in ESDs to the Sensor System. Subsequent testing and investigations revealed no degradation to the hardware resulting from either of these occurrences.

1.4.9 Chamber A-2 Photographic Tests

The Chamber A-2 in-air tests were completed on 29 October 1973. Pumpdown began 31 October 1973. Vacuum and post vacuum runs were completed 3 November 1973. No significant data anomalies were encountered during this test.

Table 1-4 lists the hardware changes at the SVIC Facility.

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TABLE 1-4  
HARDWARE CHANGES AT SVIC FACILITY

| <u>CHANGE</u>                                                                 | <u>DATE</u> | <u>REASON</u>                                          | <u>REVERIFICATION</u>                                        |
|-------------------------------------------------------------------------------|-------------|--------------------------------------------------------|--------------------------------------------------------------|
| 1. TUA-029, AFT<br>(MR 64420).                                                | 6/15/73     | AFT BRAKE SEIZED.                                      | FEWO T21A-002<br>TUA-021A WAS<br>REPLACEMENT FOR<br>TUA-029. |
| 2. CARRIAGE POT (AFT OR ACTIVE<br>MECHANICAL ART STEERER 5102)<br>(MR 64377). | 4/18/73     | AFT CARRIAGE POT<br>SIGNAL EXTREMELY<br>NOISY.         | FEWO FAK 8-012.                                              |
| 3. FS CABLE 3W160 CONNECTOR<br>P3 (MR 64322).                                 | 2/23/73     | PIN NO. 73 RECESSED.                                   | RETEST PER FTI-<br>WVT-10016.                                |
| 4. ART SN 5101 AFT ENC<br>(MR 64326).                                         | 2/23/73     | "R" ALIGNMENT W/<br>CHUTE IS OUT-OF-<br>SPECIFICATION. | FTI-WVT-10015<br>REALIGNMENT CHECK.                          |
| 5. TUA-045, AFT "R" E/O<br>(MR 64347).                                        | 3/29/73     | SPIN DOWN TESTS<br>OUT-OF-SPECIFI-<br>CATION.          | FEWO T45-004.                                                |
| 6. TUA-045, FWD & AFT, A-15<br>ELECTRONICS.                                   | 5/23/73     | REPLACE PER RETRO-<br>FIT TUA-026, REV A.              | FEWO T45-009.                                                |
| 7. TUA-045 AFT DRIVE<br>ASSEMBLY.                                             | 6/1/73      | CONFIGURATION<br>CHANGE PER RETRO-<br>FIT SV8-1.       | FEWO T45-008.                                                |
| 8. TUA-045A, FWD, CH A-2<br>ELECTRONICS (MR 64408).                           | 5/30/73     | RESISTANCE READINGS<br>OUT-OF-SPECIFICATION.           | FEWO T45-010.                                                |
| 9. TUA-044 D/O SOLENOID<br>ASSY-RETROFIT TUA-022A,<br>FWD & AFT.              | 2/19/73     | ECO 9542.                                              | FORWARD-SECTION<br>BUILDUP.                                  |
| 10. TUA-044, FWD C/A "R" MR.                                                  | 3/15/73     | EXCESSIVE SPIN-<br>DOWN.                               | FEWO T44-008.                                                |
| 11. TUA-044, AFT "R" O/E MR.                                                  | 3/15/73     | BAD NICK IN ONE END.                                   | FEWO T44-010.                                                |
| 12. TUA-044, FWD & AFT A-15<br>ELECTRONICS RETROFIT<br>TUA-026A.              | 5/14/73     | ECO 8402 & 9846.                                       | FEWO T44-013.                                                |

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TABLE 1-4 (CONT'D)

| <u>CHANGE</u>                                              | <u>DATE</u> | <u>REASON</u>                                           | <u>REVERIFICATION</u>    |
|------------------------------------------------------------|-------------|---------------------------------------------------------|--------------------------|
| 13. TUA-044, FWD & AFT DRIVE ASSEMBLY RETROFIT SV8-1.      | 6/1/73      | ECO 10150.                                              | FORWARD-SECTION BUILDUP. |
| 14. TUA-042, FWD & AFT D/O PIN ASSEMBLY RETROFIT TUA-022A. | 1/24/73     | ECO 9542.                                               | FORWARD-SECTION BUILDUP. |
| 15. TUA-042, FWD & AFT A-15 ELECTRONICS RETROFIT TUA-026A. | 5/21/73     | ECO 10427, 10145 & 10515.                               | FEWO T42-014.            |
| 16. TUA-042 DRIVE ASSEMBLIES.                              | 6/1/73      | ECO 10150.                                              | FORWARD-SECTION BUILDUP. |
| 17. 14A1 PDS.                                              | 5/19/73     | REFURBISH PLAN (PILOT MSG 0640).                        | FEWO SV8-009.            |
| 18. 13A1 SCC (MR 64471).                                   | 9/5/73      | SU BRAKE REL VERIFY ON FWD & AFT REGARD- LESS OF MODE.  | FEWO-SV8-017.            |
| 19. 14A1 PDS.                                              | 9/28/73     | REFURBISH PLAN PM-613.                                  | FEWO SV8-020.            |
| 20. 1A7 OAAA (MR 64501).                                   | 10/2/73     | FBS-A PROBLEM.                                          | FEWO SV8-022.            |
| 21. 3A1-2 D AFT SER OUT (MR 64529).                        | 11/7/73     | OPERATION ANOMALOUS DURING CREEP SEQ.                   | HORIZONTAL PRE-SHIP.     |
| 22. 3A1 D AFT SER OUT (MR 64529).                          | 11/29/73    | WRONG CONFIGURA- TION. ITEM 21 WAS AN INTERIM FIX ONLY. | HORIZONTAL PRE-SHIP.     |
| 23. 4" ROLLER PRELOAD.                                     | 11/19/73    | RETROFIT SV8-5.                                         | SU UPLOAD.               |
| 24. SUPPLY CAGE MECHANISM.                                 | 11/19/73    | RETROFIT SV8-6.                                         | SU UPLOAD.               |

NOTE: TUA-021A is a refurbished unit and replaced TUA-029. There have been no changes to TUA-021A since it was technically certified by the customer.

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## SECTION II

## CHAMBER A-2 TEST PLAN

## 2.1 INTRODUCTION

The purpose of Chamber A-2 testing is to evaluate the resolution performance, plane of best focus, platen tilt, and the adequacy of the image motion compensation (IMC) settings of the camera system prior to flight.

During the test flow, SV-8 was subjected to one Chamber A-2 test. The details of this test are discussed in Sections IV and V of this report.

A description of the standard sequences run in Chamber A-2 is presented in Table 2-1.

## 2.2 TEST IMPLEMENTATION

The Chamber A-2 tests are conducted in three parts. The first part consists of an in-air test that serves basically to verify the functionality of the test setup, to assure the alignment of the system to the collimators, and to establish the illumination levels required for proper film exposure.

The second portion of the test is conducted in soft vacuum. Resolution, platen tilt, plane of best focus, and film synchronization characteristics are determined during this test phase.

For the vacuum test, the image motion compensation (IMC) must be disabled from the flight configuration. This necessitates a configuration change; therefore, it is necessary to reverify system operation in the final flight configuration when vacuum testing is completed. For this reason, the third portion of the test is a second in-air test conducted after having reconfigured the sensor to the flight condition.

This system is equipped with in-flight changeable filters on both cameras. A special test was run to determine the repeatability of the filter response to position commands.

## 2.3 COLLIMATOR TARGETS

All collimator target reticles are the same, and collimators in Chamber A-2 are currently set to infinity focus. Figure 2-1 shows a photographic reproduction of the current Chamber A-2 target reticle configuration.

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 2-1  
CHAMBER A-2 TEST SEQUENCES

| Run | Seq | Vx/h<br>(rad/sec) | Slit Width<br>(inches) | Pitch Angle<br>(degrees) | Scan Angle<br>(degrees) | Scan Center<br>(degrees) | Frames | IMC | Illumination |
|-----|-----|-------------------|------------------------|--------------------------|-------------------------|--------------------------|--------|-----|--------------|
| 26  | K   | .052              | .303                   | -1.0                     | 30                      | 0                        | 144    | Dis | Continuous   |
| 29  | K   | .052              | .303                   | -2.0                     | 30                      | 0                        | 144    | Dis | Continuous   |
| 30  | K   | .052              | .303                   | -2.5                     | 30                      | 0                        | 144    | Dis | Continuous   |
| 37  | H   | .052              | .303                   | 2.0                      | 90                      | 0                        | 144    | Dis | Continuous   |
| 38  | K   | .052              | .303                   | 2.5                      | 30                      | 0                        | 144    | Dis | Continuous   |
| 34  | H   | .052              | .303                   | 1.0                      | 90                      | 0                        | 144    | Dis | Continuous   |
| 42  | H   | .052              | .303                   | 0                        | 90                      | 0                        | 144    | Dis | Continuous   |
| 43  | G   | .044              | .525                   | 0                        | 90                      | 0                        | 144    | Dis | Continuous   |
| 46  | L   | .044              | .259                   | 0                        | 90                      | 0                        | 53     | Dis | Continuous   |
| 45  | C   | .036              | .910                   | 0                        | 90                      | 0                        | 10     | Dis | Continuous   |
| 47  | W   | .044              | .910                   | 0                        | 90                      | 0                        | 104    | Ena | Flash        |
| 48  | Q   | .036              | .910                   | 0                        | 90                      | 0                        | 33     | Ena | Flash        |
| 49  | V   | .052              | .910                   | 0                        | 90                      | 0                        | 104    | Ena | Flash        |
| 51  | JA  | .052              | .615                   | 0                        | 60                      | 15                       | 144    | Dis | Continuous   |
| 52  | JB  | .052              | .615                   | 0                        | 60                      | -15                      | 143    | Dis | Continuous   |
| 53  | F   | .036              | .205                   | 0                        | 90                      | 0                        | 184    | Dis | Continuous   |
| 59  | M   | .044              | .910                   | 0                        | 90                      | 0                        | 23     | Ena | Flash        |
| 60  | R   | .052              | .910                   | 0                        | 90                      | 0                        | 33     | Ena | Flash        |
| 61  | R   | .052              | .910                   | 0                        | 90                      | 0                        | 33     | Ena | Flash        |
| 62  | Q   | .036              | .910                   | 0                        | 90                      | 0                        | 33     | Ena | Flash        |
| 63  | M   | .052              | .910                   | 0                        | 90                      | 0                        | 23     | Ena | Flash        |

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FLIGHT READINESS REPORT  
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## CHAMBER A-2 TARGET RETICLE

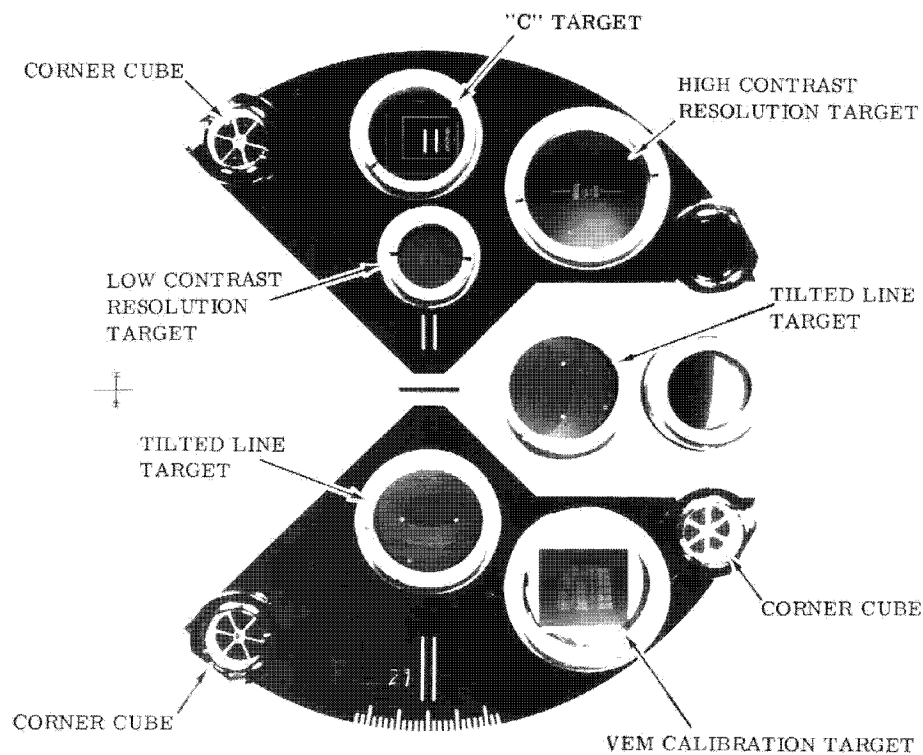


FIGURE 2-1

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

## SECTION III

## SYSTEM RESOLUTION PERFORMANCE

## 3.1 INTRODUCTION

During the Chamber A-2 test, resolution performance was determined for the 1414 Film. Based on the results of these tests, no further readiness testing was recommended. This section discusses the results of the following tests:

- A. Resolution as a function of field angle.
- B. Resolution as a function of slit width.
- C. Comparison between Chambers A and A-2 resolution performance.
- D. Resolution variability.

Resolution reported here is from AFSPPF readings of 2:1 contrast tribar targets located in the West Coast collimator reticles. The resolution data is processed by a computer program called RESOLUTE which, along with other output, provides a listing of the mean and standard deviation of the data as a function of platen position.

## 3.2 TEST PARAMETERS

The optical bar sets in SV-8 are: Set 035 on the Forward Camera and 037 on the Aft. Each camera has an in-flight changeable filter assembly (ICF) which incorporates the W-12 and W-2E3 Filters. All the test sequences run in Chamber A-2, with the exception of Seq L, used the W-12 Filter. Seq L was a test to determine if a focus shift results with the use of the W-2E3 Filter. The analysis of this test is recorded in Section V. Resolution tests analyzed in this section are summarized in Table 3-1. Sign conventions used for the pitch sequences are given in Table 3-2.

## 3.3 TEST RESULTS

3.3.1 Resolution as a Function of Field Angle

In-track and cross-track thru focus resolution data at the five field positions are given for both cameras in Figures 3-1 and 3-2. The test conditions used during the thru focus/thru pitch sequences, which made up this data base, were a  $V_x/h$  of .052 and a slit width of .303 inches. A single platen position representing peak resolution from each test was selected based on the 2:1 contrast tribar readings at each of the tested field locations. These frames were then microdensitometrically analyzed using the FOCMO Program to determine the position of best focus from the line arrays. These line determined PBFs are also

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TABLE 3-1  
CHAMBER A-2 RESOLUTION TEST SUMMARY

— Forward Camera —

| Run | Sequence | Scan Length<br>(degrees) | Vx/h<br>(radians/sec) | Slit Width<br>(inches) | Pitch<br>(degrees) | Platen Positions<br>(number/increment) | No. of<br>Frames |
|-----|----------|--------------------------|-----------------------|------------------------|--------------------|----------------------------------------|------------------|
| 26  | K        | 30                       | .052                  | .303                   | -1.0               | 9/6                                    | 144              |
| 29  | K        | 30                       | .052                  | .303                   | -2.0               | 9/6                                    | 144              |
| 30  | K        | 30                       | .052                  | .303                   | -2.5               | 9/6                                    | 144              |
| 34  | H        | 90                       | .052                  | .303                   | 1.0                | 9/6                                    | 144              |
| 37  | H        | 90                       | .052                  | .303                   | 2.0                | 9/6                                    | 144              |
| 38  | K        | 30                       | .052                  | .303                   | 2.5                | 9/6                                    | 144              |
| 42  | H        | 90                       | .052                  | .303                   | 0                  | 9/6                                    | 144              |
| 53  | F        | 90                       | .036                  | .205                   | 0                  | 13/6                                   | 183              |
| 51  | JA       | 60                       | .052                  | .615                   | 0                  | 8/6                                    | 144              |

— Aft Camera —

| Run | Sequence | Scan Length<br>(degrees) | Vx/h<br>(radians/sec) | Slit Width<br>(inches) | Pitch<br>(degrees) | Platen Positions<br>(number/increment) | No. of<br>Frames |
|-----|----------|--------------------------|-----------------------|------------------------|--------------------|----------------------------------------|------------------|
| 26  | K        | 30                       | .052                  | .303                   | -1.0               | 9/6                                    | 141              |
| 29  | K        | 30                       | .052                  | .303                   | -2.0               | 9/6                                    | 141              |
| 30  | K        | 30                       | .052                  | .303                   | -2.5               | 9/6                                    | 141              |
| 34  | H        | 90                       | .052                  | .303                   | 1.0                | 9/6                                    | 141              |
| 37  | H        | 90                       | .052                  | .303                   | 2.0                | 9/6                                    | 141              |
| 38  | K        | 30                       | .052                  | .303                   | 2.5                | 9/6                                    | 141              |
| 42  | H        | 90                       | .052                  | .303                   | 0                  | 9/6                                    | 141              |
| 53  | F        | 90                       | .036                  | .205                   | 0                  | 13/6                                   | 180              |
| 52  | JB       | 60                       | .052                  | .615                   | 0                  | 9/6                                    | 140              |

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SV-8 (SN-011)

TABLE 3-2

## PITCH/FIELD SIGN CONVENTIONS

(degrees)

| Vehicle<br>Pitch | Forward Camera |          | Aft Camera |          |
|------------------|----------------|----------|------------|----------|
|                  | 0° Scan        | 37° Scan | 0° Scan    | 37° Scan |
| -2.5             | 2.5            | NA       | -2.5       | NA       |
| -2.0             | 2.0            | NA       | -2.0       | NA       |
| -1.5             | 1.5            | NA       | -1.5       | NA       |
| -1.0             | 1.0            | NA       | -1.0       | NA       |
| -0.5             | 0.5            | 2.4      | -0.5       | -2.4     |
| 0                | 0              | 2.5      | 0          | -2.0     |
| 0.5              | -0.5           | 1.6      | 0.5        | -1.6     |
| 1.0              | -1.0           | 1.2      | 1.0        | -1.2     |
| 1.5              | -1.5           | 0.8      | 1.5        | -0.8     |
| 2.0              | -2.0           | 0.4      | 2.0        | 0.4      |
| 2.5              | -2.5           | 0.0      | 2.5        | 0.0      |

- NOTES:
1. Plus pitch means nose up.
  2. Plus field refers to the non-titled, time track edge of the format.
  3. NA means not acquired.

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

FORWARD CAMERA RESOLUTION AS A FUNCTION OF PLATEN POSITION  
FOR VARIOUS FIELD ANGLES

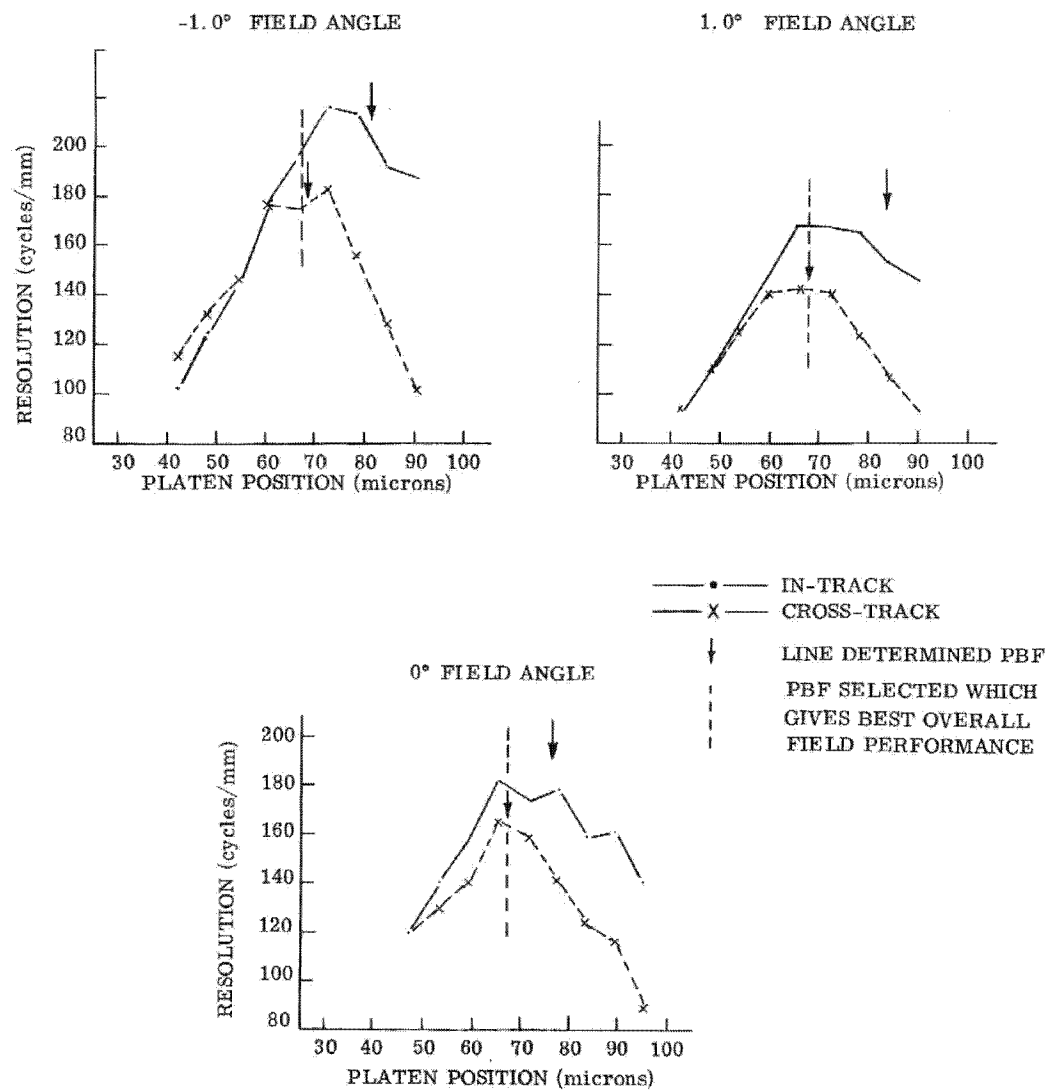


FIGURE 3-1

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3-4

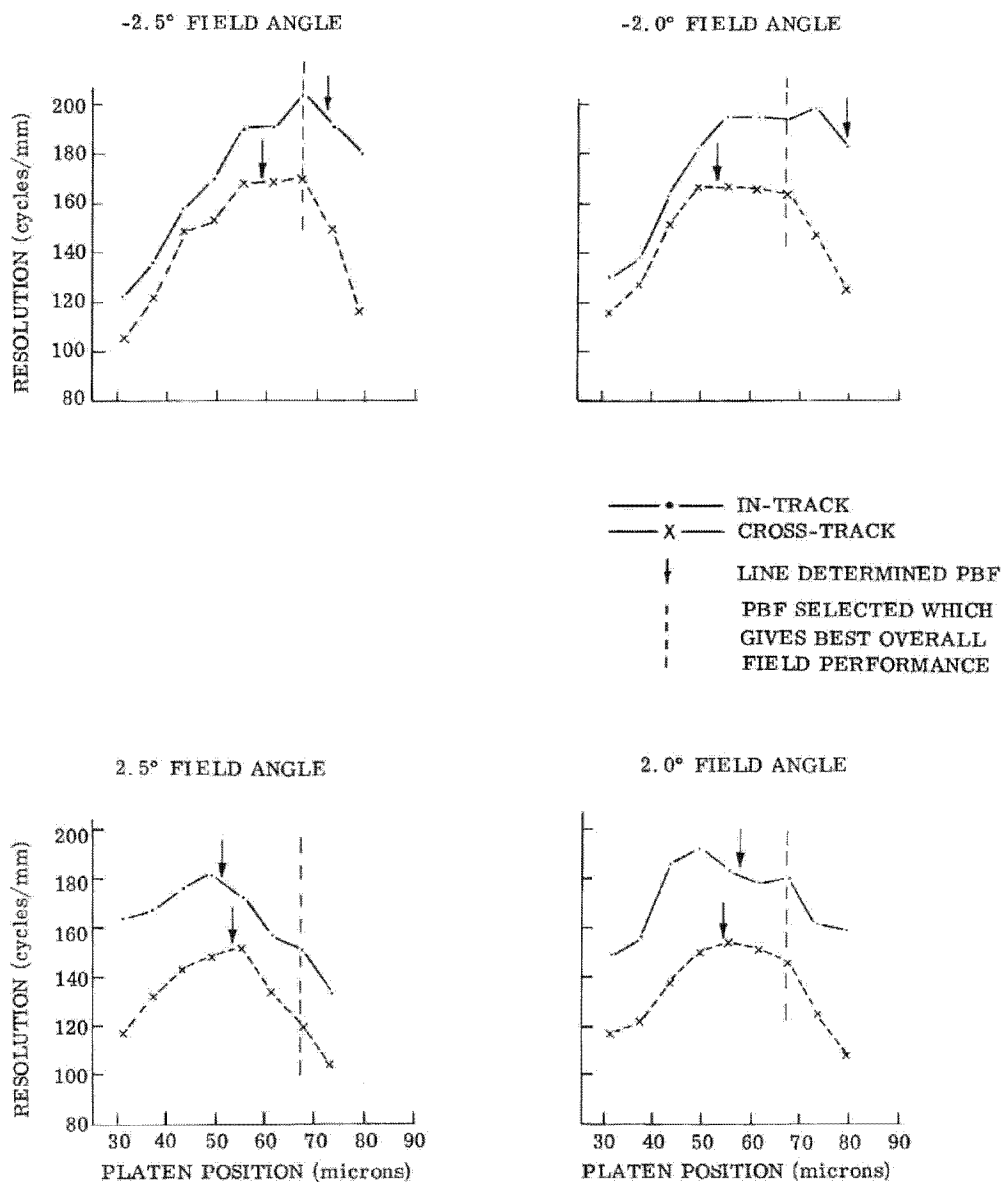
BYE 15250-74

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

FORWARD CAMERA RESOLUTION AS A FUNCTION OF PLATEN POSITION  
FOR VARIOUS FIELD ANGLES (CONT'D)

~~TOP SECRET-HEXAGON~~

3-5

BYE 15250-74

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

AFT CAMERA RESOLUTION AS A FUNCTION OF PLATEN POSITION  
FOR VARIOUS FIELD ANGLES

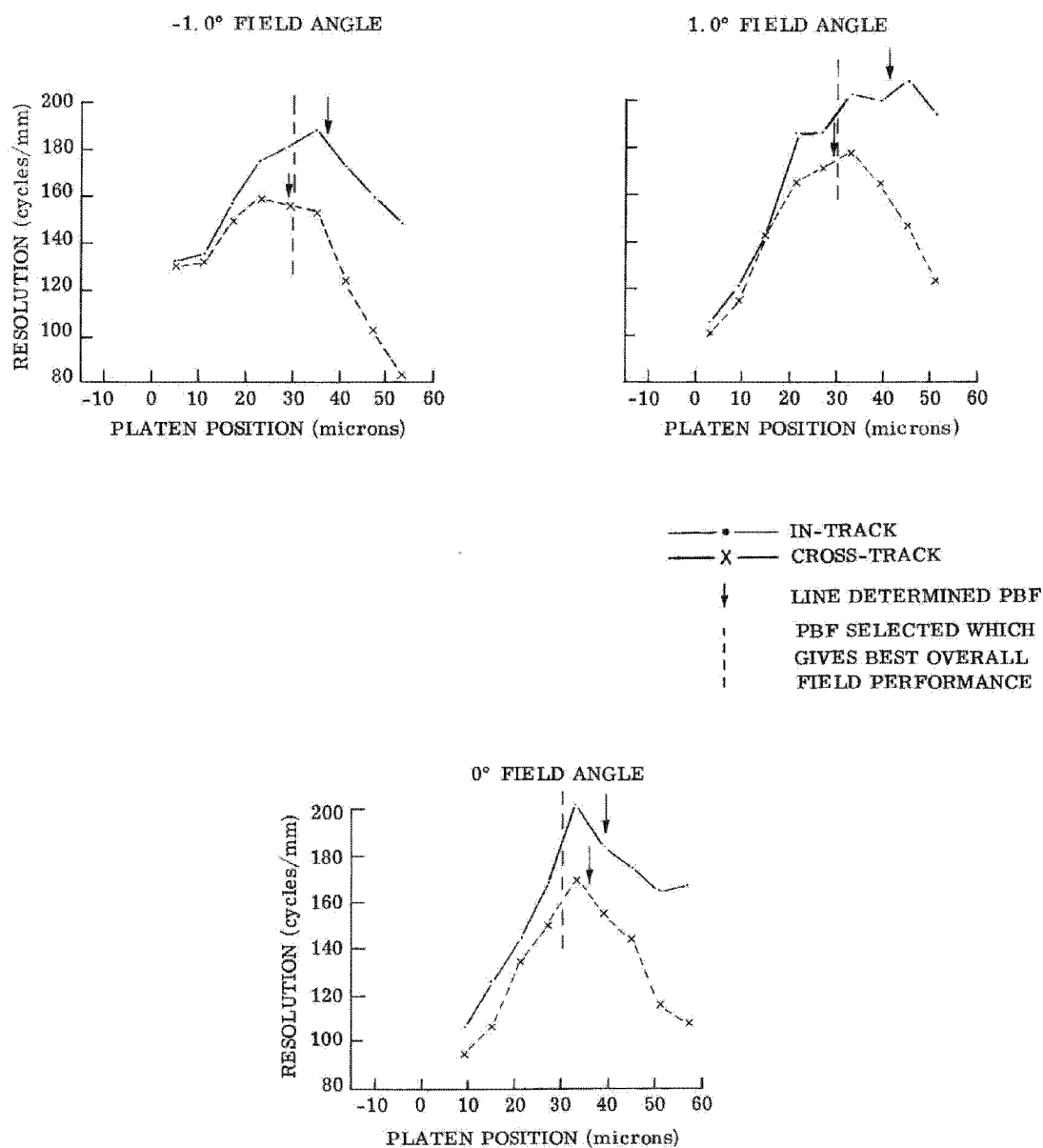
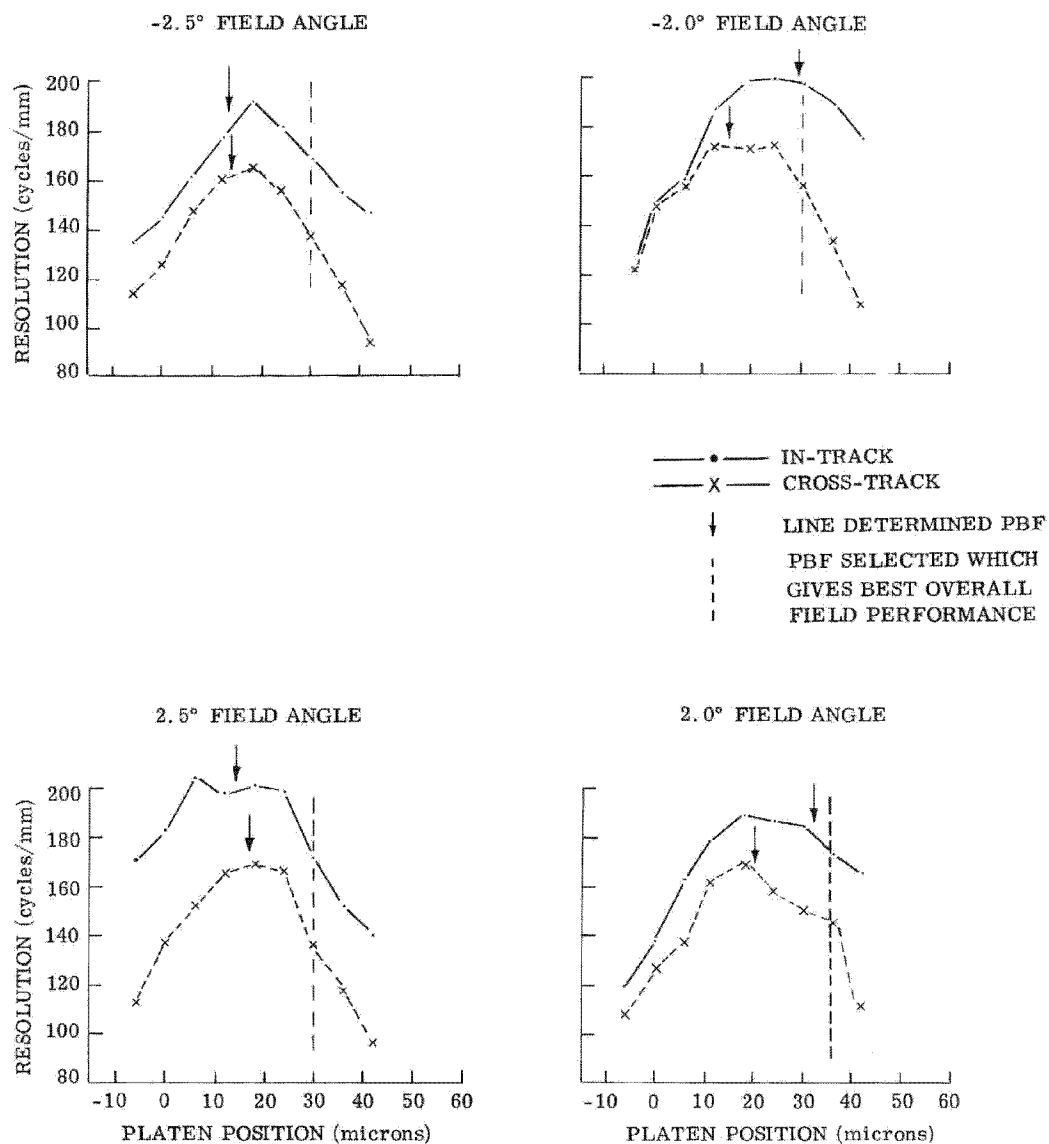


FIGURE 3-2

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BYE 15250-74

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~~TOP SECRET-HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)AFT CAMERA RESOLUTION AS A FUNCTION OF PLATEN POSITION  
FOR VARIOUS FIELD ANGLES (CONT'D)~~TOP SECRET-HEXAGON~~

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BYE 15250-74

Handle via Byeman  
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SV-8 (SN-011)

presented in Figures 3-1 and 3-2. Collimator defocus has been accounted for in these determinations. As in past Chamber A-2 tests, only the 0° collimators were used to generate the above data, since the field collimators do not encompass the entire sweep across the web.

Field profiles at a particular platen position, in terms of the 2:1 contrast tribar data from the Chamber A-2 test, are given in Figures 3-3 and 3-4. The positions were chosen so as to encompass that platen setting which gives the best overall performance. The data given in Figures 3-3 and 3-4 is summarized in Tables 3-3 and 3-4. The resolution performance was derived directly from Figures 3-1 and 3-2, using interpolation between data points where necessary. Based on this analysis, the Forward Camera platen setting for optimum performance falls between 65 and 70 microns; a 67 micron setting was selected. The most favorable position on the Aft Camera is at 30 microns. These two best focus platen positions are shown as vertical dashed lines in Figures 3-1 and 3-2 to show the difference from the peak performance made across the field. There was a significant difference from the peak noted at the 2° and 2.5° field positions of the Forward Camera; while the only significant departure noted from the Aft Camera was at the +2.5° field positions. Average resolution thus balanced across the field (Tables 3-3 and 3-4) is 180 cycles/mm in-track and 155 cycles/mm cross-track for both cameras.

Figures 3-1 and 3-2 reveal several aspects of resolution performance based on the measured maximum resolution at each of the seven field positions tested, see Table 3-5. The in-track performance is consistently superior to cross-track. The superiority ranges from 9% to 20% on the Forward and 11% to 17% on the Aft, but average is approximately 15% for each camera. This 15% difference is attributed to differences in the MTFs introduced by the asymmetrical shape of the central obscuration. The range of maximum in-track and cross-track resolution is greater for the Forward than the Aft, although the average levels are essentially the same: approximately 195 cycles/mm in-track and 165 cycles/mm cross-track. The 2.5° field position resolution is not suppressed, as it has been with previous camera systems tested via the vehicle pitch configuration in Chamber A-2.

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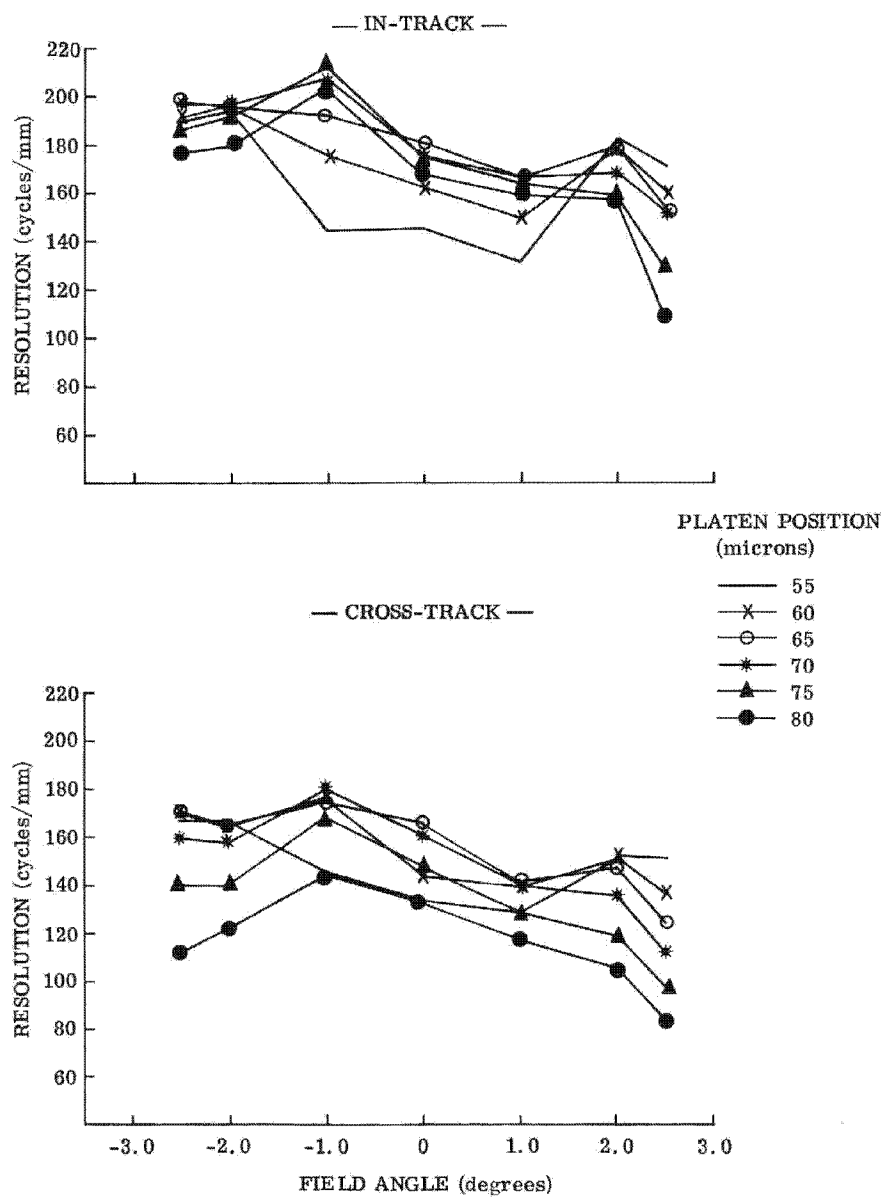
~~TOP SECRET-HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A-2 RESOLUTION ACROSS THE FIELD AS A FUNCTION OF  
PLATEN POSITION FOR FORWARD CAMERA

FIGURE 3-3

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3-9

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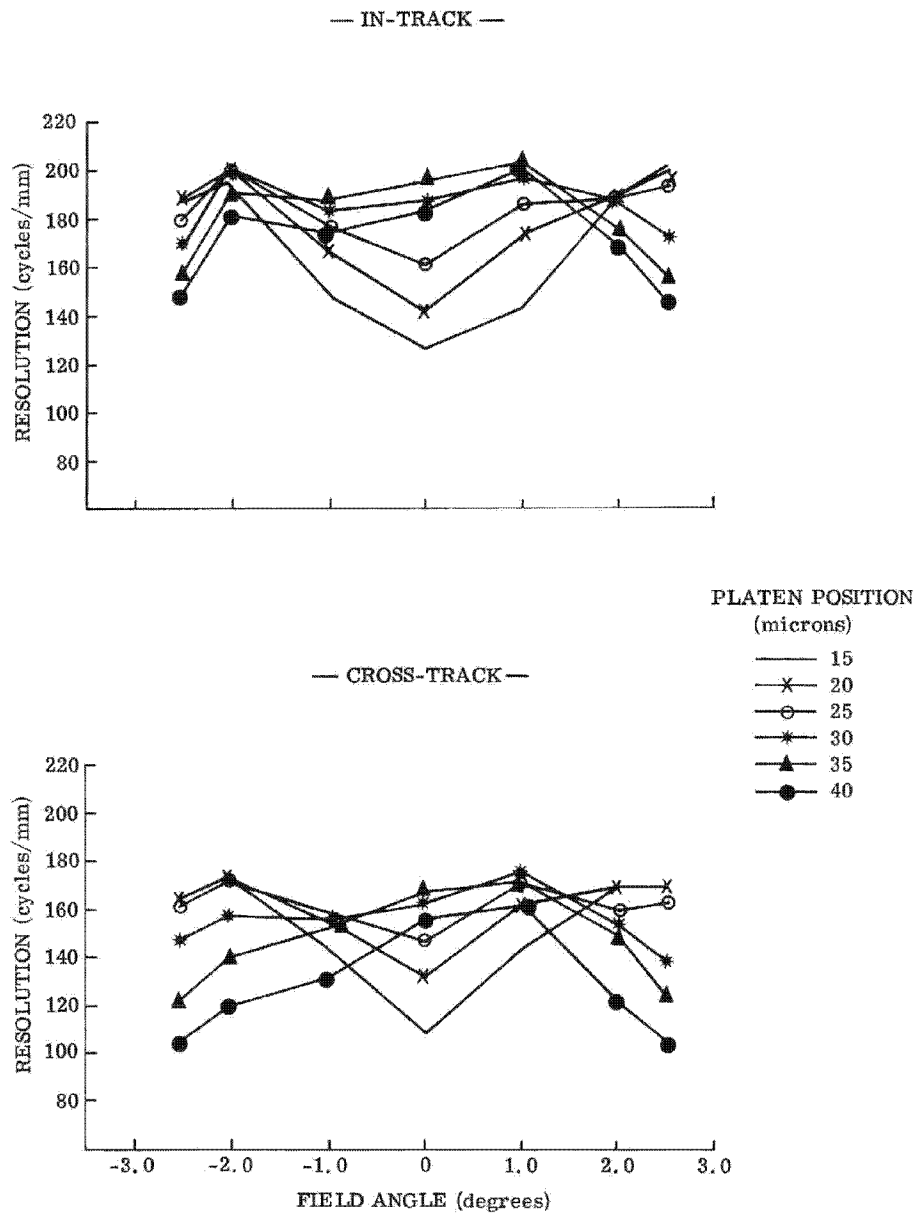
~~TOP SECRET-HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A-2 RESOLUTION ACROSS THE FIELD AS A FUNCTION OF  
PLATEN POSITION FOR AFT CAMERA

FIGURE 3-4

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TABLE 3-3  
CHAMBER A-2 FORWARD CAMERA FIELD RESOLUTION PERFORMANCE  
(cycles/mm)

| Platen<br>Position<br>(microns) | — In-Track —          |      |      |     |     |     |      | Average |
|---------------------------------|-----------------------|------|------|-----|-----|-----|------|---------|
|                                 | Field Angle (degrees) |      |      |     |     |     |      |         |
|                                 | -2.5                  | -2.0 | -1.0 | 0   | 1.0 | 2.0 | 2.5  |         |
| 55                              | 190                   | 195  | 146  | 146 | 132 | 183 | 172  | 166     |
| 60                              | 192                   | 195  | 176  | 163 | 150 | 179 | 161  | 173     |
| 65                              | 198                   | 195  | 192  | 181 | 166 | 180 | 153  | 181     |
| 70                              | 197                   | 197  | 208  | 176 | 167 | 170 | 142  | 180     |
| 75                              | 187                   | 192  | 213  | 176 | 165 | 160 | 130* | 175     |
| 80                              | 177*                  | 180* | 204  | 169 | 160 | 158 | 110* | 165     |
| — Cross-Track —                 |                       |      |      |     |     |     |      |         |
| 55                              | 167                   | 167  | 146  | 134 | 128 | 154 | 152  | 150     |
| 60                              | 170                   | 166  | 176  | 144 | 140 | 152 | 137  | 155     |
| 65                              | 170                   | 165  | 174  | 165 | 142 | 148 | 125  | 156     |
| 70                              | 160                   | 158  | 180  | 161 | 141 | 137 | 113  | 150     |
| 75                              | 140                   | 140  | 168  | 148 | 130 | 120 | 98*  | 135     |
| 80                              | 112*                  | 122* | 144  | 133 | 118 | 106 | 84*  | 117     |

NOTE: The asterisk (\*) denotes extrapolated values.

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TABLE 3-4

CHAMBER A-2 AFT CAMERA FIELD RESOLUTION PERFORMANCE  
(cycles/mm)

## — In-Track —

| Platen<br>Position<br>(microns) | Field Angle (degrees) |      |      |     |     |     |     | Average |
|---------------------------------|-----------------------|------|------|-----|-----|-----|-----|---------|
|                                 | -2.5                  | -2.0 | -1.0 | 0   | 1.0 | 2.0 | 2.5 |         |
| 15                              | 185                   | 192  | 148  | 126 | 142 | 186 | 200 | 168     |
| 20                              | 187                   | 199  | 166  | 141 | 173 | 189 | 199 | 179     |
| 25                              | 178                   | 199  | 176  | 160 | 185 | 187 | 192 | 182     |
| 30                              | 168                   | 197  | 182  | 186 | 195 | 185 | 171 | 183     |
| 35                              | 156                   | 190  | 186  | 195 | 201 | 175 | 154 | 180     |
| 40                              | 148                   | 180  | 174  | 182 | 200 | 168 | 144 | 171     |

## — Cross-Track —

|    |     |     |     |     |     |     |     |     |
|----|-----|-----|-----|-----|-----|-----|-----|-----|
| 15 | 163 | 172 | 143 | 107 | 142 | 167 | 167 | 152 |
| 20 | 162 | 171 | 154 | 130 | 160 | 167 | 167 | 159 |
| 25 | 160 | 170 | 157 | 145 | 169 | 157 | 160 | 160 |
| 30 | 136 | 156 | 155 | 160 | 174 | 151 | 136 | 153 |
| 35 | 121 | 139 | 152 | 165 | 172 | 147 | 121 | 145 |
| 40 | 104 | 119 | 130 | 154 | 160 | 120 | 103 | 127 |

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 3-5  
MEASURED MAXIMUM RESOLUTION DATA  
(cycles/mm)

| Field<br>Position<br>(degrees) | Forward Camera |             | Aft Camera |             |
|--------------------------------|----------------|-------------|------------|-------------|
|                                | In-Track       | Cross-Track | In-Track   | Cross-Track |
| -2.5                           | 203            | 169         | 191        | 164         |
| -2.0                           | 198            | 167         | 199        | 173         |
| -1.0                           | 214            | 181         | 186        | 158         |
| 0                              | 181            | 165         | 202        | 170         |
| 1.0                            | 167            | 142         | 206        | 176         |
| 2.0                            | 192            | 154         | 189        | 169         |
| 2.5                            | 181            | 151         | 204        | 169         |
| Averages                       | 191            | 161         | 197        | 168         |

### 3.3.2 Resolution as a Function of Slit Width

During the A-2 tests, resolution performance was obtained at a  $V_x/h$  of .052 with slit widths of .615" and .303 inch. Exposure differences were accounted for by adjustment of collimator illumination levels. The thru focus data from these tests are shown in Figures 3-5 and 3-6. The Forward Camera performance drops by 15% at best focus, for both the in-track and cross-track cases, at the wide slit position. This is consistent with the losses measured in the acceptance testing of this camera in 5 out of 6 test cases, see Figure 4-4, SN-011 Acceptance Team Report (BYE 15312-72). The Aft Camera performance shows no difference in peak resolution with the two slit widths tested. The Acceptance Team did not report data for this camera. As SV-8 is expected to be launched in March, however, the anticipated slit widths will be narrow (.2" to .3") and will decrease as the mission progresses. Thus, no loss in performance on either camera is expected due to the slit widths on Mission 1208.

### 3.3.3 Comparison of Chambers A and A-2 Resolution Performance

Comparisons of resolution performance were made using those thru focus tests which occurred at similar field positions in the two chambers, see Figures 3-7 and 3-8. Both sets of data represent 2:1 tribar readings read by AFSPPF personnel. Due to the difference in focus settings of the collimators used in these chambers, the two sets of data are offset with respect to their absolute platen positions, but are made comparable to one another. Table 3-6 gives the PBFs expected in Chamber A-2 based on: (1) Chamber A tests, (2) the tribar and line PBFs actually measured in Chamber A-2, and (3) the differences in microns between the two test beds. The differences are seen to be negligible.

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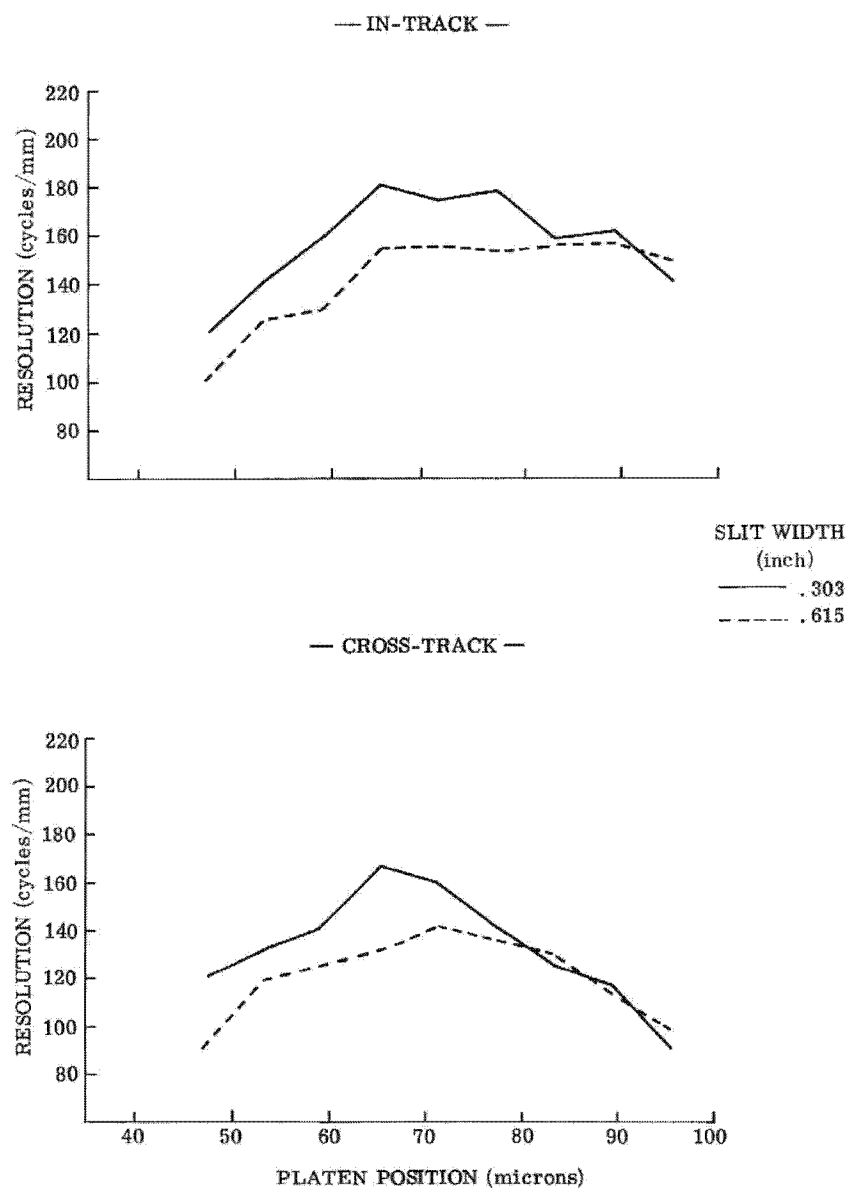
~~TOP SECRET - HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A-2 RESOLUTION AS A FUNCTION OF SLIT WIDTH FOR  
FORWARD CAMERA AT 0° PITCH AND 0° FIELD ANGLES

FIGURE 3-5

~~TOP SECRET - HEXAGON~~

3-14

BYE 15250-74

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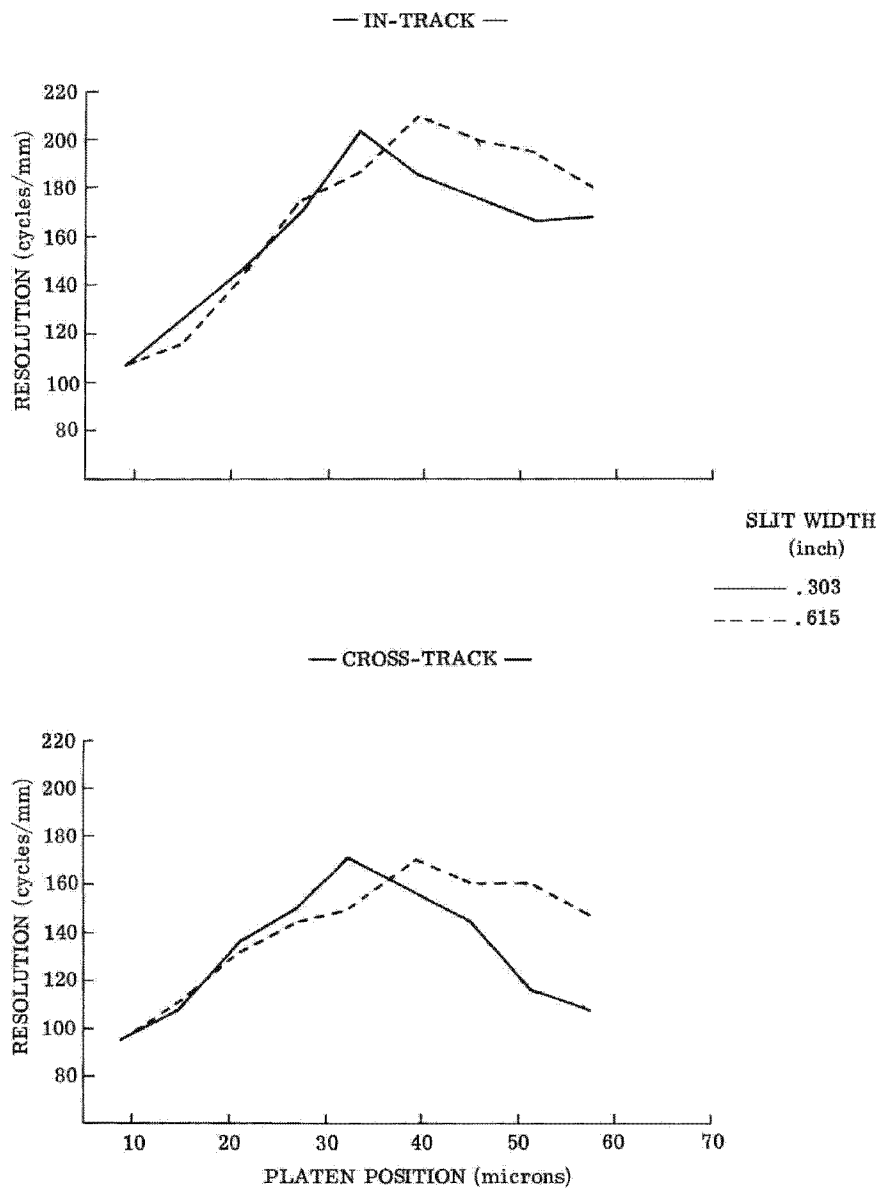
~~TOP SECRET-HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A-2 RESOLUTION AS A FUNCTION OF SLIT WIDTH FOR  
AFT CAMERA AT 0° PITCH AND 0° FIELD ANGLES

FIGURE 3-6

~~TOP SECRET-HEXAGON~~

3-15

BYE 15250-74

Handle via Byeman  
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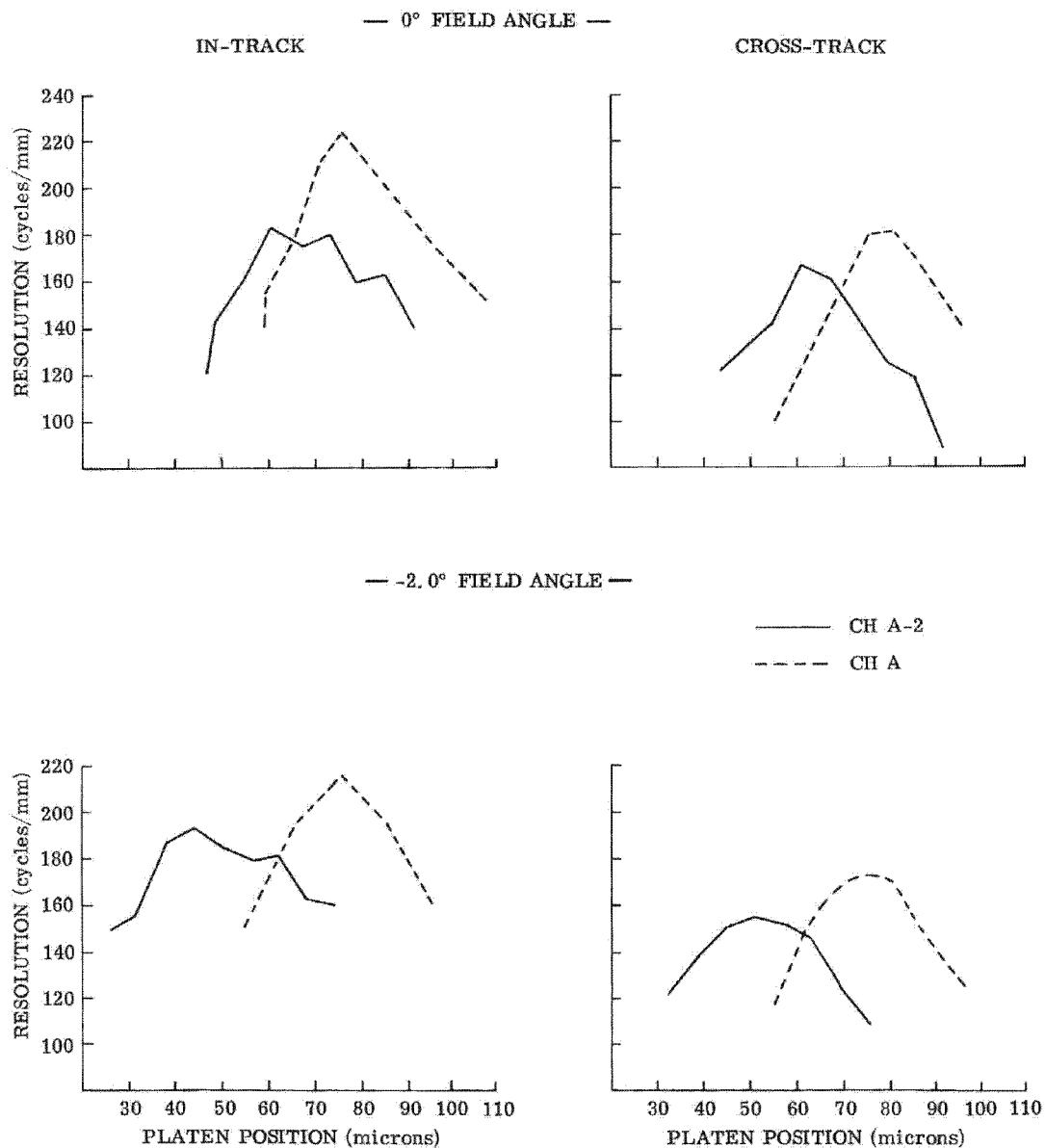
~~TOP SECRET-HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A VERSUS CHAMBER A-2 RESOLUTION COMPARISON  
FOR FORWARD CAMERA

FIGURE 3-7

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BYE 15250-74

Handle via Eyeman  
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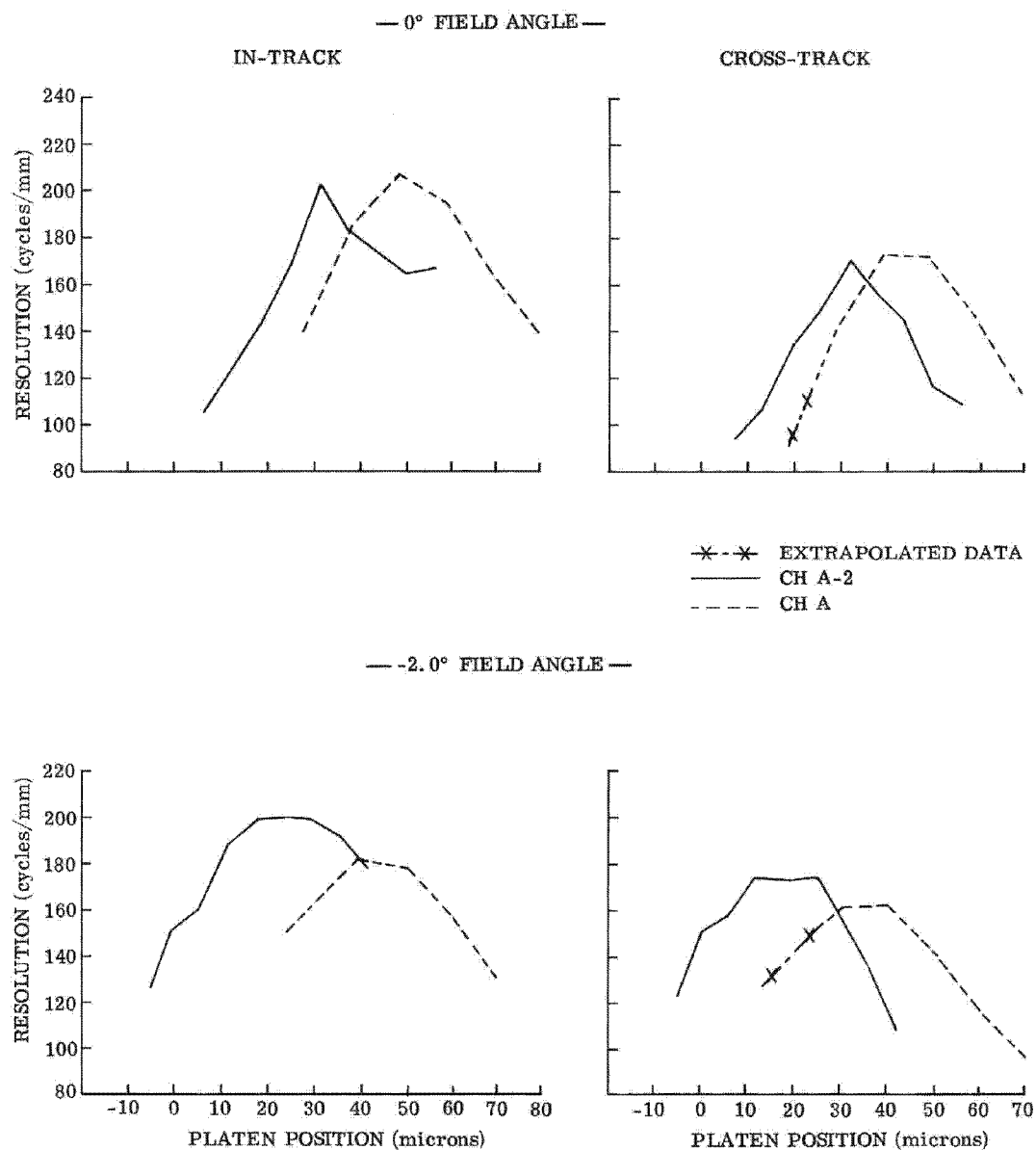
~~TOP SECRET HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)CHAMBER A VERSUS CHAMBER A-2 RESOLUTION COMPARISON  
FOR AFT CAMERA

FIGURE 3-8

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3-17

BYE 15250-74

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SV-8 (SN-011)

TABLE 3-6

## FOCUS SHIFTS BETWEEN CHAMBERS A AND A-2

(microns)

| Factor                        | Forward Camera | Aft Camera |
|-------------------------------|----------------|------------|
| Chamber A                     | 86             | 47         |
| 120 NM to $\infty$ correction | -10            | -10        |
| Expected Chamber A-2 PBF      | 76             | 37         |
| Chamber A-2 Tribars           | 69 (-7)        | 30 (-7)    |
| Chamber A-2 Lines             | 74 (-2)        | 33 (-4)    |

The Forward Camera peak performance as measured in Chamber A was 8% to 18% higher than that measured in Chamber A-2 for both the in-track and cross-track data, the average difference being 12 percent. The Chamber A field performance of the Forward Camera was flat with no requirement for tilt. This does not agree with the Chamber A-2 data, which has about 20 microns of field curvature along with an apparent platen tilt requirement. Detailed examination of the platen tilt question is given in Section V.

A similar comparison between the chambers for the Aft Camera shows equivalent performance at 0° of field for both the in-track and cross-track data. The -2.0° field data was 8% higher in Chamber A-2 than in Chamber A test. This difference is not considered significant. Field curvature as measured during acceptance testing was about 5 to 7 microns with some apparent tilt required. The readiness testing indicates a field curvature of 20 microns with no tilt required. At present, these differences between chambers are not clearly understood. However, the performance measured in both chambers meets requirements and is not a cause for concern.

In summary, there is no significant difference in PBF determination and resolution performance between acceptance and readiness testing. What is consistently different between the two test beds, however, is the field curvature and platen tilt indications. The Chamber A-2 configuration is more susceptible to error in this regard than Chamber A.

#### 3.3.4 Variability of Resolution

A measure of image quality variability in terms of the 2:1 tribar readings is the ratio of the standard deviation-to-mean resolution for a series of replicated tribar images. For a given field position, this ratio was generated for four platen positions about the PBF. These were then averaged and used to characterize a given test case.

This analysis was done at each of the field positions obtained in the pitch and wide slit test sequences for both the in-track and cross-track resolution data, see Table 3-7. Both cameras have about

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the same amount of variability (7% on the average) at each of the tested field positions. For the wide .615" slit case, the Forward Camera data has a greater variability (10%) than that found with the .303" slit. This increase in resolution variability due to wide slit usage with the Forward Camera is commensurate with selective loss of resolution performance level under the same conditions. No change in variability was detected in the Aft Camera data with the wide slit.

TABLE 3-7

## RESOLUTION VARIABILITY

— Vx/h of .052, Slit Width of .303" —

| Field Angle<br>(degrees) | Forward Camera |             | Aft Camera |             |
|--------------------------|----------------|-------------|------------|-------------|
|                          | In-Track       | Cross-Track | In-Track   | Cross-Track |
| 2.5                      | .06            | .07         | .07        | .06         |
| 2.0                      | .05            | .08         | .06        | .07         |
| 1.0                      | .06            | .08         | .06        | .05         |
| 0.0                      | .06            | .08         | .06        | .08         |
| -1.0                     | .07            | .08         | .07        | .08         |
| -2.0                     | .07            | .05         | .06        | .07         |
| -2.5                     | .07            | .06         | .06        | .07         |

— Vx/h of .052, Slit Width of .615" —

|     |     |     |     |     |
|-----|-----|-----|-----|-----|
| 0.0 | .11 | .10 | .07 | .07 |
|-----|-----|-----|-----|-----|

NOTE: These values are a computation of  $\frac{\text{standard deviation (cycles/mm)}}{\text{mean (cycles/mm)}}$ .

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3.4 CONCLUSIONS AND RECOMMENDATIONS

A. Both cameras have adequate average resolution performance across the field of 167 cycles/mm at 2:1 contrast. The average resolution ranged between 155 and 179 cycles/mm.

B. The best resolution performance balance across the field is obtained with a platen position of 67 microns on the Forward and 30 microns on the Aft Camera under readiness test conditions.

C. Wide slits introduce measurable resolution loss and increased resolution variability on the Forward Camera only. However, this is not considered to be significant factor due to the anticipated March launch.

D. The 2.5° field position resolution performance is not suppressed as it has been for previous camera systems.

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## SECTION IV

## FILM SYNCHRONIZATION TESTS

## 4.1 INTRODUCTION

Film synchronization tests are conducted on the HEXAGON Program to directly measure the smear introduced into the imagery. This information is then used to adjust the film velocity and the platen skew angle to minimize smear characteristics. Smear values measured in the tests are also used analytically to predict the camera system performance by combining them with independent measures of the optical system modulation transfer function (MTF) and the measure of camera system dynamic focus as determined from Chamber A thermal vacuum tests. This section contains the results of the 1414 Film synchronization tests, including the photographic and electromechanical evaluation of the On-Orbit Adjust Assembly (OOAA) tests. Color film testing was not accomplished during either of the Chamber A-2 tests.

## 4.2 GRAVITY EFFECTS ON IMAGE MOTION

The gravity induced image motion corrections for this flight model were determined by dynamic image motion tests. Gravity corrections for a  $V_x/h$  of .052 are displayed in Table 4-1; the FIDAP Program scales these values to the appropriate test  $V_x/h$ .

TABLE 4-1

GRAVITY CORRECTION DATA FOR A  $V_x/h$  OF .052

(inches/second)

## — Forward Camera —

| Direction   | Collimator Position (degrees) |       |       |       |
|-------------|-------------------------------|-------|-------|-------|
|             | -45                           | 0     | 37    | 55    |
| In-Track    | .027                          | -.004 | -.025 | -.030 |
| Cross-Track | -.011                         | -.021 | -.025 | -.011 |

## — Aft Camera —

|             |       |       |       |       |
|-------------|-------|-------|-------|-------|
| In-Track    | .030  | -.002 | -.030 | -.035 |
| Cross-Track | -.018 | -.023 | -.016 | -.010 |

## 4.3 "C" TARGET ROTATION

Measurements on SN-001 thru SN-006 have shown that the "C" targets of Chamber A are not perfectly aligned with respect to the scan planes of the cameras. The effect of the "C" target rotation is to change the predicted in-track flash target displacements when IMC is enabled, and hence to alter the sync data. The rotation for each Chamber A-2 collimator has been measured on SV-8 film. All sync-flash data in this

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report has been corrected for these measured rotations.

## 4.4 OOAA CALIBRATION EVALUATION

The results of the OOAA calibration sequences performed during the Chamber A-2 vacuum test are presented in Tables 4-2 and 4-3 and Figures 4-1 thru 4-4. Table 4-2 shows the results of the OOAA tests run at  $V_x/h$  values of .052 and .044 at the  $0^\circ$  and  $37^\circ$  scan positions. Figures 4-1 and 4-4 are plots of the  $0^\circ$  and  $37^\circ$  scan position data. Straight lines have been fitted to the points using the least squares technique. The equations of these best fit straight lines for the  $0^\circ$  collimator are listed in Table 4-3, together with the correlation that indicated the accuracy of fit. A comparison of the OOAA calibration curves shows that uniformity exists between the  $0^\circ$  and  $37^\circ$  results.

The mean smear as calculated from the FIDAP Program shows good correlation between the OOAA calibration test curves and the theoretical curves, with the exception of the Forward Camera in the cross-track direction. The calibration curves at a  $V_x/h$  of .052 and .044 did not intersect as seen in Figure 4-1. This condition did not exist in the acceptance test data prior to the metering capstan servo modification.

The scale factors for both the in-track and cross-track were slightly smaller than those expected from the nominal design. The Forward Camera scale factors are 5.2% to 11.2% lower than nominal, while the Aft are 1.6% to 7.3% lower. These deviations from nominal are not critical over the operating range of the OOAA settings.

## 4.5 SYNC ERROR MEASUREMENT SUMMARY

Tables 4-4 thru 4-7 present the summary of the SV-8 film synchronization performance from the Chamber A and Chamber A-2 tests. The following are significant observations and analysis relating to the film synchronization.

## 4.5.1 Chamber A Versus Chamber A-2 Comparison

The comparison between the mean smear data from Chamber A and Chamber A-2 tests was fair. The differences in the mean errors, which are not significant for the  $0^\circ$  scan position, can be explained by the fact that the OOAA box was changed between the two tests. As with previous systems, the  $37^\circ$  position did not compare well with the  $55^\circ$  position. The Forward Camera has a positive change of .07 inch/second in-track from the Chamber A test indicating an in-track velocity ramp.

## 4.5.2 Flight Configuration Test

Data from post Chamber A-2 vacuum tests with the IMC disable box removed (box-out) indicated no change in the mean image motion errors of either camera.

## 4.6 ON-ORBIT IMAGE MOTION ERROR PREDICTIONS

The predictions of SV-8 on-orbit image motion errors at a  $V_x/h$  of .052 are depicted on an original negative frame format for the Forward and Aft Cameras, see Figures 4-5 and 4-6. These figures were

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TABLE 4-2  
PHOTOGRAPHIC MEAN ERROR VERSUS COMMAND FROM  
OOAA CALIBRATION SEQUENCE

| Nominal<br>Vx/h | Error (inches/second) |          |               |       |                |            |               |       |                |       |
|-----------------|-----------------------|----------|---------------|-------|----------------|------------|---------------|-------|----------------|-------|
|                 | Forward Camera        |          |               |       |                | Aft Camera |               |       |                |       |
|                 | OOAA Command          |          | 0° Collimator |       | 37° Collimator |            | 0° Collimator |       | 37° Collimator |       |
|                 | Skew                  | Velocity | IT            | XT    | IT             | XT         | IT            | XT    | IT             | XT    |
| .052            | 15                    | -5       | .181          | -.083 | .219           | -.089      | -.150         | -.037 | -.182          | -.060 |
|                 | 5                     | -21      | .076          | -.323 | .123           | -.340      | -.063         | -.257 | -.182          | -.289 |
|                 | 0                     | 0        | .033          | -.019 | .088           | -.045      | .009          | .039  | -.041          | -.023 |
|                 | -5                    | 10       | -.010         | .095  | .035           | .110       | .036          | .164  | .005           | .178  |
|                 | -15                   | 5        | -.094         | .047  | -.060          | .057       | .116          | .125  | .090           | .092  |
| .044            | 15                    | -5       | .150          | -.068 | .202           | -.094      | -.137         | -.017 | -.166          | -.049 |
|                 | 5                     | -21      | .064          | -.270 | .117           | -.270      | -.057         | -.214 | -.073          | -.221 |
|                 | 0                     | 0        | .037          | -.004 | .088           | -.022      | -.018         | .031  | -.048          | .044  |
|                 | -5                    | 10       | .002          | .158  | .052           | .100       | .021          | .166  | -.014          | .122  |
|                 | -15                   | 5        | -.072         | .054  | -.027          | .061       | .103          | .083  | .078           | .069  |

NOTE: All mean errors are stated using the FIDAP sign convention.

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TABLE 4-3  
OOAA CALIBRATION SEQUENCE BEST-FIT LINEAR EQUATIONS  
FOR THE 0° COLLIMATOR

| Camera  | Nominal<br>Vx/h | Direction   | Best-Fit<br>Equation | Correlation<br>Coefficient |
|---------|-----------------|-------------|----------------------|----------------------------|
| Forward | .052            | In-Track    | $Y = .037 + .009X$   | .9979                      |
|         |                 | Cross-Track | $Y = -.029 + .0136X$ | .9977                      |
|         | .044            | In-Track    | $Y = .036 + .0073X$  | .9981                      |
|         |                 | Cross-Track | $Y = -.006 + .0125X$ | .9999                      |
| Aft     | .052            | In-Track    | $Y = -.014 - .009X$  | -.9988                     |
|         |                 | Cross-Track | $Y = .037 + .014X$   | .9977                      |
|         | .044            | In-Track    | $Y = -.018 - .008X$  | -.9999                     |
|         |                 | Cross-Track | $Y = .036 + .012X$   | .9979                      |

- NOTES: 1. See Figures 4-1 and 4-2.
2. In the best fit equations X represents the command in counts and Y represents the response in inches/second.
3. The Y responses are stated using the FIDAP sign convention.

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4-4

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## FORWARD CAMERA MEASURED MEAN SMEAR VERSUS OAAA COMMAND

AT 0° SCAN POSITION

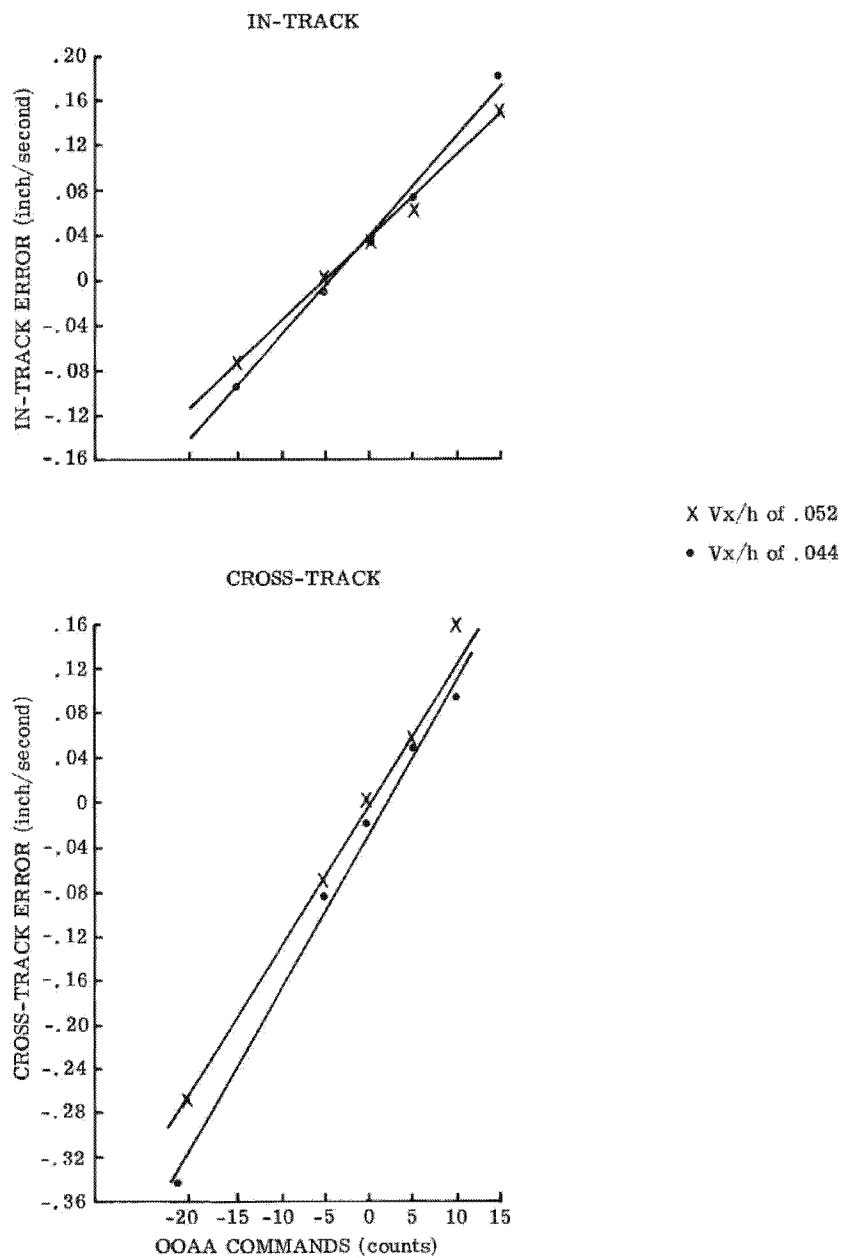


FIGURE 4-1

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4-5

BYE 15250-74

Handle via Byeman  
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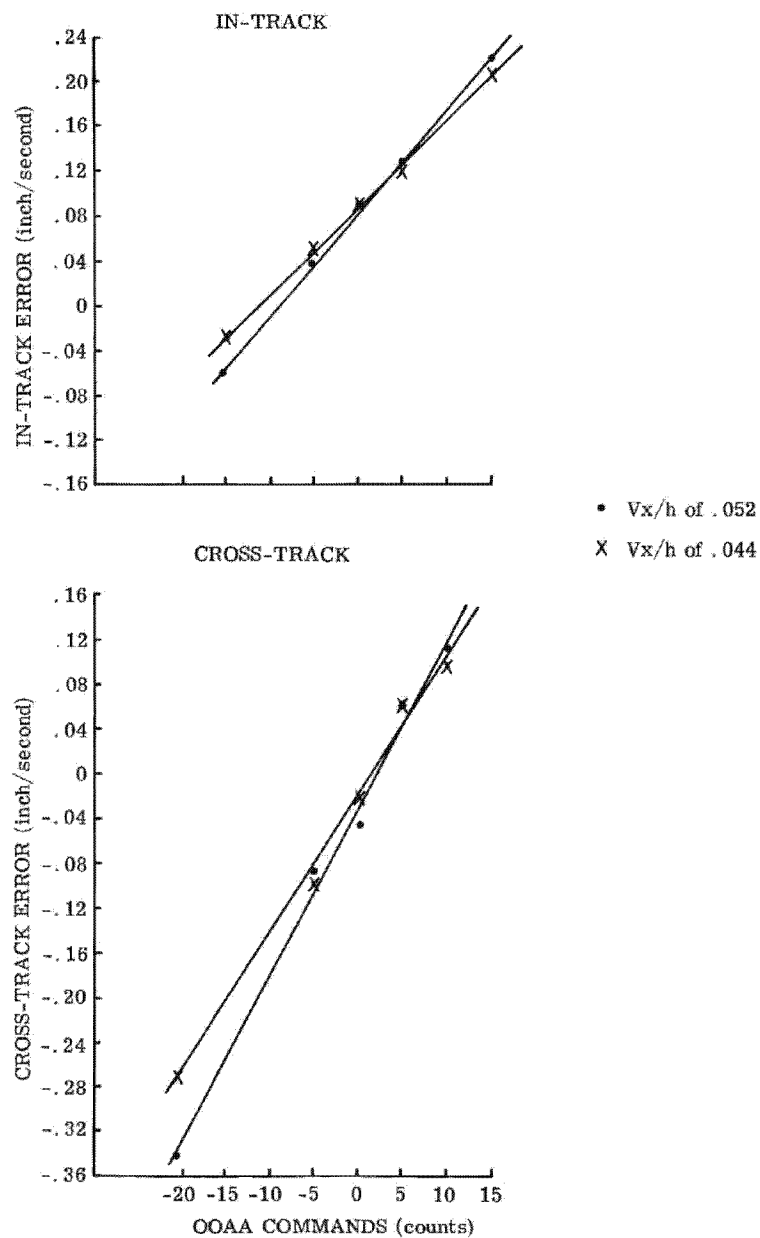
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SV-8 (SN-011)FORWARD CAMERA MEASURED MEAN SMEAR VERSUS OAAA COMMAND  
AT 37° SCAN POSITION

FIGURE 4-2

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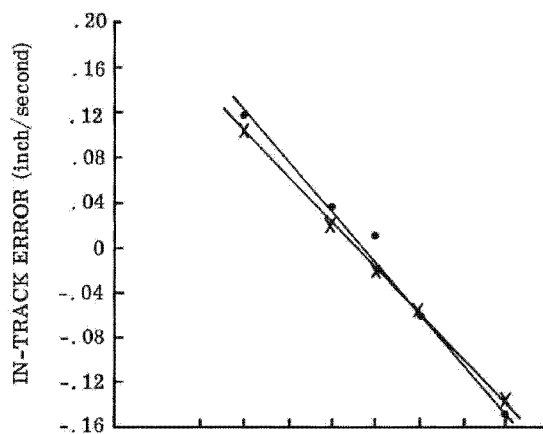
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## AFT CAMERA MEASURED MEAN SMEAR VERSUS OAAA COMMAND

AT 0° SCAN POSITION

IN-TRACK



• Vx/h of .052

X Vx/h of .044

CROSS-TRACK

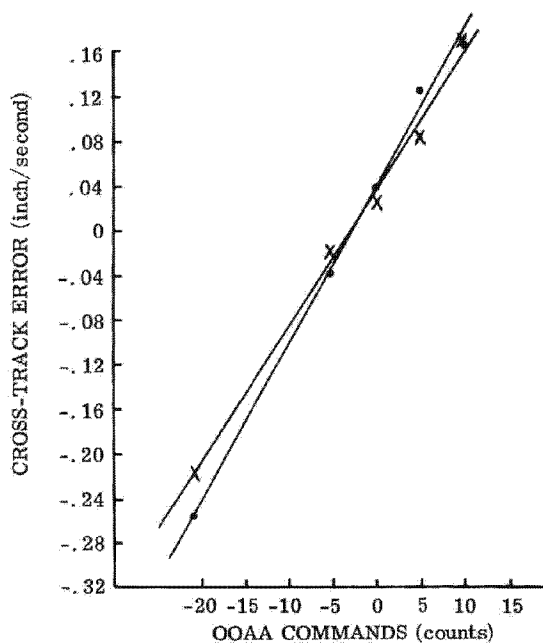


FIGURE 4-3

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4-7

BYE 15250-74

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## AFT CAMERA MEASURED MEAN SMEAR VERSUS OAAA COMMAND

AT 37° SCAN POSITION

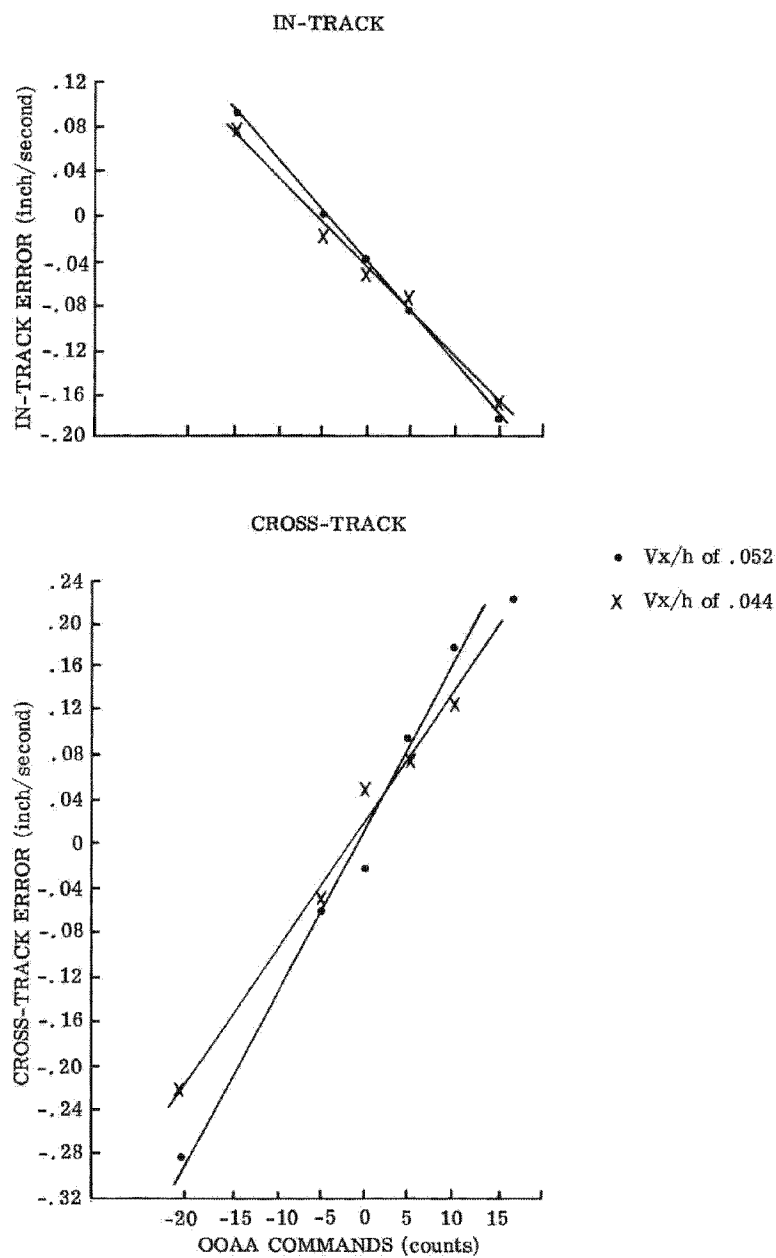


FIGURE 4-4

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4-8

BYE 15250-74

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TABLE 4-4

## FILM SYNCHRONIZATION ERROR SUMMARY

| Forward Camera  |                          | IMC Enabled |               |       | Temperature 70° |          |          |
|-----------------|--------------------------|-------------|---------------|-------|-----------------|----------|----------|
| Nominal<br>Vx/h | Direction                | Spec        | 0° COLLIMATOR |       |                 |          |          |
|                 |                          |             | Chamber A     |       | Chamber A-2     |          |          |
|                 |                          |             | Vac Accept    |       | Vacuum          | Post Vac | Post Vac |
|                 |                          |             | SSC           | SPPF  | Box-In          | Box-In   | Box-Out  |
| .052            | IN-TRACK<br>MEAN         | $\pm .050$  |               | .014  | .033            | .029     | .034     |
|                 | IN-TRACK<br>TWO SIGMA    | .050        |               | .031  | .034            | .021     | .032     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .050$  |               | -.002 | -.019           | -.039    | -.017    |
|                 | CROSS-TRACK<br>TWO SIGMA | .100        |               | .029  | .055            | .044     | .045     |
| .044            | IN-TRACK<br>MEAN         | $\pm .050$  |               | .015  | .037            | .030     | .027     |
|                 | IN-TRACK<br>TWO SIGMA    | .050        |               | .034  | .041            | .016     | .027     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .050$  |               | .002  | -.005           | -.023    | -.029    |
|                 | CROSS-TRACK<br>TWO SIGMA | .098        |               | .039  | .051            | .057     | .057     |
| .036            | IN-TRACK<br>MEAN         | $\pm .035$  |               | .008  | .017            | -        | .027     |
|                 | IN-TRACK<br>TWO SIGMA    | .037        |               | .030  | .027            | -        | .021     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .045$  |               | .003  | -.023           | -        | .009     |
|                 | CROSS-TRACK<br>TWO SIGMA | .098        |               | .038  | .043            | -        | .038     |

NOTE: Table Information

- (a) All data (+) unless noted.
- (b) Plus (+) in-track error indicates the platen leads optical bar.
- (c) Plus (+) cross-track error means film speed is too fast.
- (d) This is the FIDAP sign convention.

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TABLE 4-5

## FILM SYNCHRONIZATION ERROR SUMMARY

Forward Camera IMC Enabled Temperature 70°

| Nominal<br>Vx/h | Direction                | Spec  | 55° COLLIMATOR |       | 37° COLLIMATOR |          |          |
|-----------------|--------------------------|-------|----------------|-------|----------------|----------|----------|
|                 |                          |       | Chamber A      |       | Chamber A-2    |          |          |
|                 |                          |       | Vac Accept     |       | Vacuum         | Post Vac | Post Vac |
|                 |                          |       | SSC            | SPPF  | Box-In         | Box-In   | Box-Out  |
| .052            | IN-TRACK<br>MEAN         | ±.050 |                | .013  | .082*          | .075*    | .074*    |
|                 | IN-TRACK<br>TWO SIGMA    | .050  |                | .030  | .042           | .031     | .030     |
|                 | CROSS-TRACK<br>MEAN      | ±.050 |                | -.036 | -.045          | -.028    | -.027    |
|                 | CROSS-TRACK<br>TWO SIGMA | .100  |                | .038  | .079           | .049     | .042     |
| .044            | IN-TRACK<br>MEAN         | ±.050 |                | .019  | .088*          | .058*    | .087*    |
|                 | IN-TRACK<br>TWO SIGMA    | .050  |                | .023  | .042           | .026     | .025     |
|                 | CROSS-TRACK<br>MEAN      | ±.050 |                | -.028 | -.021          | -.035    | -.066    |
|                 | CROSS-TRACK<br>TWO SIGMA | .098  |                | .032  | .041           | .041     | .037     |
| .036            | IN-TRACK<br>MEAN         | ±.045 |                | .016  | .050*          | -        | .052*    |
|                 | IN-TRACK<br>TWO SIGMA    | .037  |                | .016  | .048           | -        | .016     |
|                 | CROSS-TRACK<br>MEAN      | ±.045 |                | -.027 | -.020          | -        | -.015    |
|                 | CROSS-TRACK<br>TWO SIGMA | .098  |                | .049  | .052           | -        | .033     |

\* Out-of-specification.

NOTE: Table Information

- (a) All data (+) unless noted.
- (b) Plus (+) in-track error indicates the platen leads optical bar.
- (c) Plus (+) cross-track error means film speed is too fast.
- (d) This is the FIDAP sign convention.

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TABLE 4-6  
FILM SYNCHRONIZATION ERROR SUMMARY

Aft Camera

IMC Enabled

Temperature 70°

| Nominal<br>Vx/h | Direction                | Spec       | 0° COLLIMATOR |       |             |          |          |
|-----------------|--------------------------|------------|---------------|-------|-------------|----------|----------|
|                 |                          |            | Chamber A     |       | Chamber A-2 |          |          |
|                 |                          |            | Vac Accept    |       | Vacuum      | Post Vac | Post Vac |
|                 |                          |            | SSC           | SPPF  | Box-In      | Box-In   | Box-Out  |
| .052            | IN-TRACK<br>MEAN         | $\pm .050$ |               | .002  | -.008       | -.015    | -.022    |
|                 | IN-TRACK<br>TWO SIGMA    | .050       |               | .024  | .033        | .025     | .025     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .050$ |               | .015  | .039        | .049     | .044     |
|                 | CROSS-TRACK<br>TWO SIGMA | .100       |               | .048  | .064        | .054     | .051     |
| .044            | IN-TRACK<br>MEAN         | $\pm .050$ |               | -.003 | -.017       | -.018    | -.024    |
|                 | IN-TRACK<br>TWO SIGMA    | .050       |               | .022  | .027        | .034     | .019     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .050$ |               | .018  | .031        | .028     | .022     |
|                 | CROSS-TRACK<br>TWO SIGMA | .098       |               | .040  | .055        | .040     | .074     |
| .036            | IN-TRACK<br>MEAN         | $\pm .035$ |               | 0.0   | -.015       | -        | -.007    |
|                 | IN-TRACK<br>TWO SIGMA    | .037       |               | .019  | .039        | -        | .017     |
|                 | CROSS-TRACK<br>MEAN      | $\pm .045$ |               | .001  | .008        | -        | .024     |
|                 | CROSS-TRACK<br>TWO SIGMA | .098       |               | .028  | .084        | -        | .048     |

## NOTE: Table Information

- (a) All data (+) unless noted.
- (b) Plus (+) in-track error indicates the platen leads optical bar.
- (c) Plus (+) cross-track error means film speed is too fast.
- (d) This is the FIDAP sign convention.

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TABLE 4-7

## FILM SYNCHRONIZATION ERROR SUMMARY

Aft Camera

IMC Enabled

Temperature 70°

| Nominal<br>Vx/h | Direction                | 55° COLLIMATOR |            |       | 37° COLLIMATOR |          |          |
|-----------------|--------------------------|----------------|------------|-------|----------------|----------|----------|
|                 |                          | Spec           | Chamber A  |       | Chamber A-2    |          |          |
|                 |                          |                | Vac Accept |       | Vacuum         | Post Vac | Post Vac |
|                 |                          |                | SSC        | SPPF  | Box-In         | Box-In   | Box-Out  |
| .052            | IN-TRACK<br>MEAN         | ± .050         |            | -.048 | -.045          | -.035    | -.034    |
|                 | IN-TRACK<br>TWO SIGMA    | .050           |            | .025  | .038           | .040     | .038     |
|                 | CROSS-TRACK<br>MEAN      | ± .050         |            | .014  | -.021          | -.028    | -.015*   |
|                 | CROSS-TRACK<br>TWO SIGMA | .100           |            | .031  | .062           | .042     | .046     |
| .044            | IN-TRACK<br>MEAN         | ± .050         |            | -.048 | -.045          | -.033    | -.028    |
|                 | IN-TRACK<br>TWO SIGMA    | .050           |            | .017  | .029           | .024     | .022     |
|                 | CROSS-TRACK<br>MEAN      | ± .050         |            | .026  | .033           | .070     | .027     |
|                 | CROSS-TRACK<br>TWO SIGMA | .098           |            | .032  | .056           | .067     | .066     |
| .036            | IN-TRACK<br>MEAN         | ± .045         |            | -.030 | -.026          | -        | -.025    |
|                 | IN-TRACK<br>TWO SIGMA    | .037           |            | .015  | .036           | -        | .023     |
|                 | CROSS-TRACK<br>MEAN      | ± .045         |            | .022  | .002           | -        | -.005*   |
|                 | CROSS-TRACK<br>TWO SIGMA | .098           |            | .036  | .085           | -        | .041     |

\* Out-of-specification.

NOTE: Table Information

- (a) All data (+) unless noted.
- (b) Plus (+) in-track error indicates the platen leads optical bar.
- (c) Plus (+) cross-track error means film speed is too fast.
- (d) This is the FIDAP sign convention.

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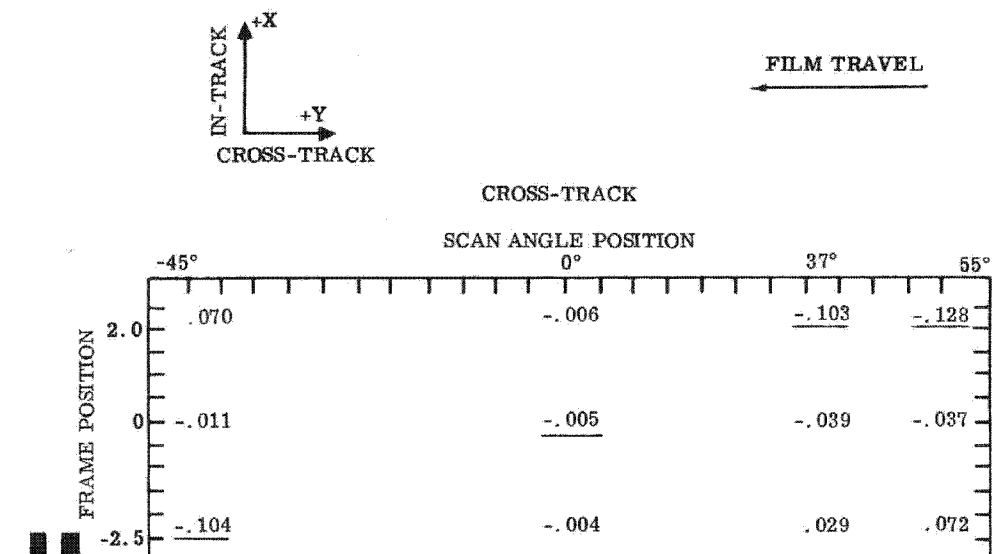
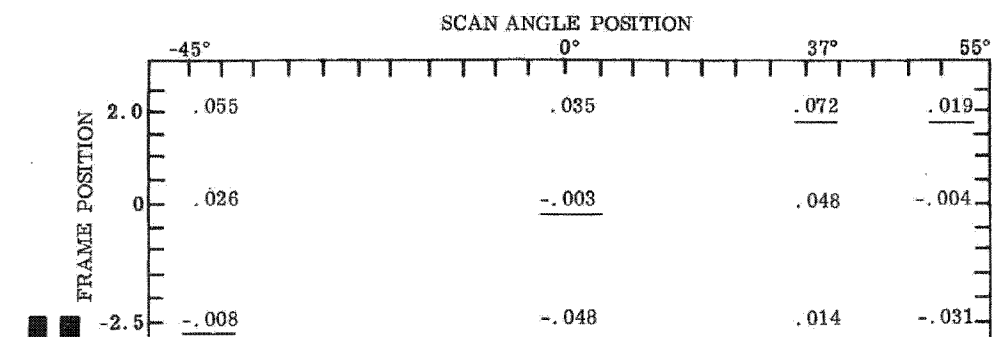
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## FORWARD CAMERA ON-ORBIT IMAGE MOTION ERROR PREDICTION

(Vx/h of .052)

## IN-TRACK



- NOTES: 1. Original negative emulsion side up.  
2. Underlined numbers are at collimator locations.  
3. Signs are expressed in orbital image plane coordinates.  
4. Values are in inches/second.  
5. Values include the effect of the recommended OAAA adjustment.

FIGURE 4-5

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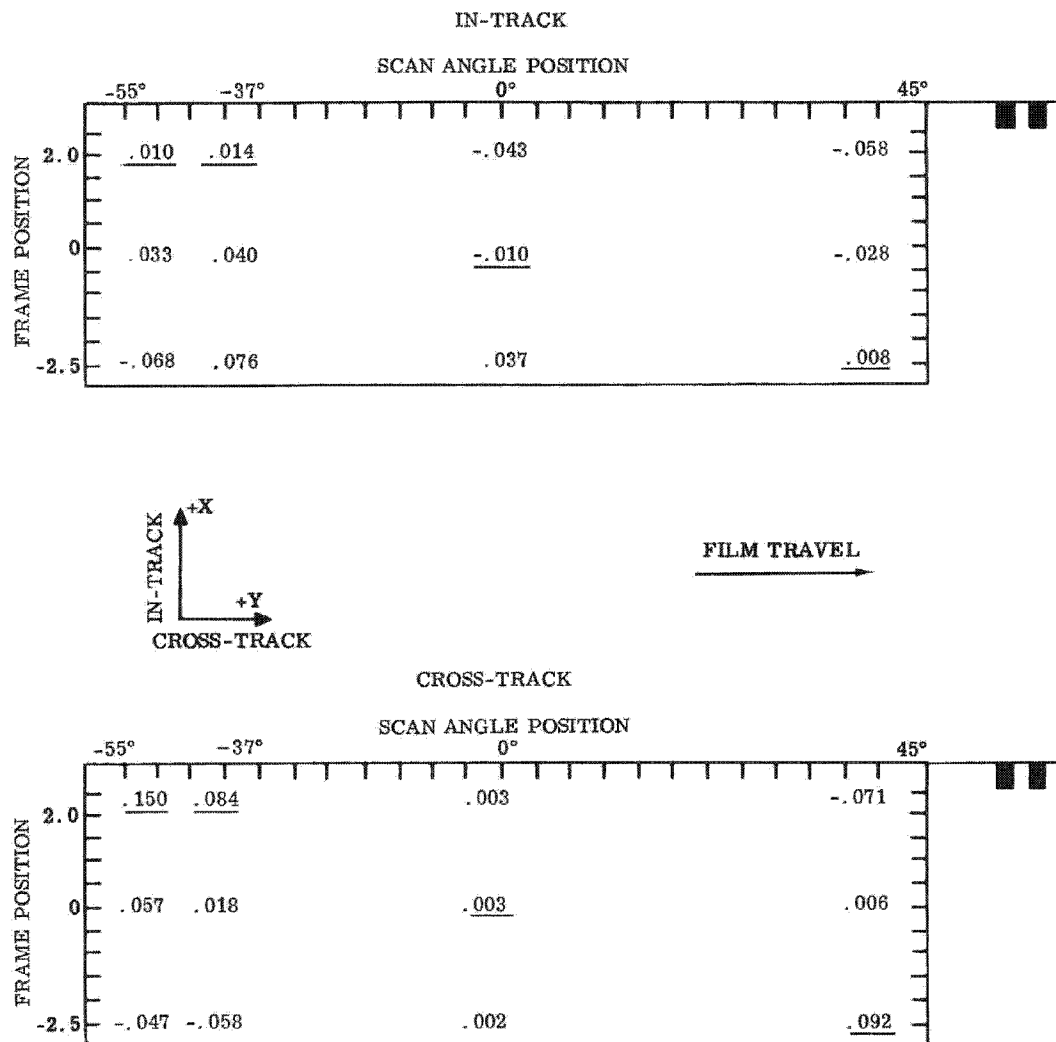
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## AFT CAMERA ON-ORBIT IMAGE MOTION ERROR PREDICTION

(Vx/h of .052)



- NOTES: 1. Original negative emulsion side up.  
2. Underlined numbers are at collimator locations.  
3. Signs are expressed in orbital image plane coordinates.  
4. Values are in inches/second.  
5. Values include the effect of the recommended OAAA adjustment.

FIGURE 4-6

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developed by the algebraic combination of the most recent synchronous flash data with the orbital image motion errors. This data is corrected for both gravity and "C" target rotation. These errors are listed in Table 4-8. Note that the predictions include the effect of the below recommended OOAA adjustments in Figures 4-5 and 4-6 and Table 4-8.

## 4.7 CONCLUSIONS AND RECOMMENDATIONS

A. With a nominal OOAA setting, the Forward Camera meets specification with the exception of the in-track means at the  $37^\circ$  position. However, with the recommended OOAA skew adjustment, the out-of-specification mean smear at  $37^\circ$  is not expected to seriously degrade performance. With a nominal OOAA setting, the Aft Camera mean errors are all within specification.

B. Even though both cameras are within specification, the following OOAA changes to both cameras are recommended to further reduce the mean smear errors. These recommendations are based on the zero smear intercept of the .044 and .052 lines, see Figures 4-1 and 4-3.

(1) An OOAA velocity adjustment of +1 command count from nominal is recommended for cross-track compensation of the Forward Camera.

(2) An OOAA skew adjustment of -4 command counts from nominal is recommended for in-track compensation of the Forward Camera.

(3) An OOAA velocity adjustment of -3 command counts from nominal is recommended for cross-track compensation of the Aft Camera.

(4) An OOAA skew adjustment of -2 command counts from nominal is recommended for in-track compensation of the Aft Camera.

C. A velocity adjustment derived from the acceptance test of -14 command counts from the flight nominal is recommended for Aft Camera cross-track compensation for both SO-255 and FE-3916 materials. This velocity adjustment assumes the mechanical characteristics of the FE-3916 material are similar to SO-255.

~~TOP SECRET-HEXAGON~~

~~TOP SECRET HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)TABLE 4-8  
ORBITAL IMAGE MOTION ERRORS AT Vx/h OF .052, 70°F  
(inches/second)

## Forward Camera

|                                | IN-TRACK |       |       | CROSS-TRACK |       |       | IN-TRACK |       |       | CROSS-TRACK |       |       |
|--------------------------------|----------|-------|-------|-------------|-------|-------|----------|-------|-------|-------------|-------|-------|
| SCAN<br>ANGLE<br>(DEGREES)     | -45      | 0     | 55    | 37          | -45   | 0     | 55       | 37    | -45   | 0           | 55    | 37    |
| FRAME<br>POSITION<br>(DEGREES) | -2.5     | 0     | 2.0   | 2.0         | -2.5  | 0     | 2.0      | 2.0   | 2     | -2.5        | 0     | 2     |
| SHEAR<br>ERROR                 | .058     | .033  | .032  | .082        | -.026 | -.019 | -.045    | -.053 | .058  | .033        | .032  | .082  |
| ORBITAL<br>FIXED<br>KNOWN      | -.030    | 0     | .023  | .026        | -.092 | 0     | -.097    | -.064 | .033  | -.045       | 0     | 0     |
| ORBITAL<br>RESULTANT           | .028     | .033  | .055  | .108        | -.118 | -.019 | -.142    | -.117 | .091  | -.012       | .032  | .082  |
| RECOMMENDED<br>DMAA BIAS       | -.036    | -.036 | -.036 | -.036       | .014  | .014  | .014     | .014  | -.036 | -.036       | -.036 | -.036 |
| RESULTANT                      | -.008    | -.003 | .019  | .072        | -.104 | -.005 | -.128    | -.103 | .055  | -.048       | -.004 | .048  |

## Aft Camera

|                                | IN-TRACK |       |       | CROSS-TRACK |       |       | IN-TRACK |       |       | CROSS-TRACK |       |       |
|--------------------------------|----------|-------|-------|-------------|-------|-------|----------|-------|-------|-------------|-------|-------|
| SCAN<br>ANGLE<br>(DEGREES)     | -45      | 0     | 55    | 37          | -45   | 0     | 55       | 37    | -45   | 0           | 55    | 37    |
| FRAME<br>POSITION<br>(DEGREES) | -2.5     | 0     | 2.0   | 2.0         | -2.5  | 0     | 2.0      | 2.0   | 2     | -2.5        | 0     | 2     |
| SHEAR<br>ERROR                 | -.010    | .008  | .045  | .058        | -.037 | -.039 | .021     | -.024 | -.010 | .003        | .045  | .058  |
| ORBITAL<br>FIXED<br>KNOWN      | .036     | 0     | -.017 | -.028       | .087  | 0     | .027     | .006  | -.030 | .047        | .066  | 0     |
| ORBITAL<br>RESULTANT           | .026     | .008  | .028  | .032        | .050  | -.039 | .108     | .042  | -.040 | .055        | .051  | .058  |
| RECOMMENDED<br>DMAA BIAS       | -.018    | -.018 | -.018 | -.018       | .042  | .042  | .042     | .042  | -.018 | -.018       | -.018 | -.018 |
| RESULTANT                      | .008     | -.010 | .010  | .014        | .042  | .033  | .150     | .086  | -.058 | .037        | .033  | .040  |

NOTES: 1. ALL SIGNS EXPRESSED IN ORBITAL IMAGE PLANE COORDINATES ARE DIRECTLY APPLICABLE FOR INPUT TO THE CRYSPER PROGRAM.  
2. THE RESULTANT ERRORS FOR THE IN-TRACK AND CROSS-TRACK DATA FROM BOTH CAMERAS FOR 45 AND 55 DEG POSITIONS ARE CHAMBER A  
DATA ADJUSTED FOR THE DIFFERENCE BETWEEN CHAMBER A AND B2.

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## SECTION V

## FLIGHT FOCUS

## 5.1 INTRODUCTION

The recommended focus settings for the black and white (1414) portion of SV-8 are 68 microns for the Forward and 25 microns for the Aft Camera. Conventional color film (SO-255) and an experimental infrared film (FE-3916) will be included as part of the Aft payload. For the SO-255 and FE-3916 portions of this mission, the platen position should be set at 55 microns, an adjustment of +30 microns. This section gives the rationale for these decisions and includes an analysis of platen tilt adequacy and the filter change effect on focus.

## 5.2 PLATEN TILT ASPECTS

As described in Section III, thru focus tribars and lines at seven field positions across the full format are provided via a series of vehicle pitch tests using the 0° collimator. This data is presented in Figures 3-1 and 3-2. For assessing the adequacy of platen tilt, the PBFs from both diagnostics are summarized in Table 5-1. Tribar resolution data was hand-smoothed to locate central tendency. For cross-track, the two diagnostics consistently substantiate one another, i.e., the difference in PBF is 3 microns or less; and the "best estimates" are simply the averages of two independent determinations. The in-track situation is not as straightforward in that there is a tendency for the line PBFs to focus approximately 8 microns longer than the tribar PBFs. Since more credence is attributed to the thru focus resolution methodology, the line data was not included in the "best estimates". One exception to this is the Aft Camera +1° field case in which the tribar diagnostic does not go thru focus in the usual way; and the "best estimate" is the line determined PBF -8 microns. The "final assessment" PBFs are then the average of the in-track and cross-track "best estimate" PBFs. Figure 5-1 is a plot of these results in comparison with Chamber D interferometric measurements made on the individual optical bars.

The readiness test data analysis indicates 20 microns of field curvature on both cameras which is significantly different from the original optical bar data of 5 microns or less. The fact that this discrepant relationship between Chambers A-2 and D is characteristic is illustrated in Figure 5-2. Figure 5-2 presents a comparison of the SV-8 readiness data to the three preceding systems similarly tested via the vehicle pitch configuration. There is a marked similarity of the four sets of final data, including the asymmetry between the plus and minus field of the Forward Camera. All of the data, normalized to a common central null point, falls within +6 microns of a central tendency. This can be attributed to measurement noise.

Based on this historical comparison, the apparent mistilt of the Forward Camera platen is judged to be non-existent. Further support of this judgment comes from the fact that VEM analysis of image quality

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TABLE 5-1  
TRIBAR AND LINE DETERMINATIONS OF PBF

| Position<br>(degrees) | Raw Data       |           |           |           |            |           |           |           | Best Estimates |           |            |           | Final Assessment |     |
|-----------------------|----------------|-----------|-----------|-----------|------------|-----------|-----------|-----------|----------------|-----------|------------|-----------|------------------|-----|
|                       | Forward Camera |           |           |           | Aft Camera |           |           |           | Fwd Camera     |           | Aft Camera |           | Forward          | Aft |
|                       | Tribars        |           | Lines     |           | Tribars    |           | Lines     |           | IT             | XT        | IT         | XT        |                  |     |
|                       | <u>IT</u>      | <u>XT</u> | <u>IT</u> | <u>XT</u> | <u>IT</u>  | <u>XT</u> | <u>IT</u> | <u>XT</u> | <u>IT</u>      | <u>XT</u> | <u>IT</u>  | <u>XT</u> |                  |     |
| -2.5                  | 64             | 61        | 72        | 59        | 19         | 16        | 13        | 14        | 64             | 60        | 19         | 15        | 62               | 17  |
| -2.0                  | 64             | 58        | 79        | 53        | 23         | 18        | 29        | 15        | 64             | 56        | 23         | 17        | 60               | 20  |
| -1.0                  | 74             | 67        | 81        | 68        | 31         | 28        | 37        | 29        | 74             | 67        | 31         | 28        | 71               | 30  |
| 0                     | 68             | 67        | 76        | 67        | 35         | 33        | 39        | 36        | 68             | 67        | 35         | 34        | 68               | 35  |
| 1.0                   | 70             | 66        | 83        | 68        | 41         | 29        | 41        | 29        | 70             | 67        | 33         | 29        | 69               | 31  |
| 2.0                   | 51             | 56        | 57        | 54        | 22         | 19        | 32        | 20        | 51             | 55        | 22         | 19        | 53               | 21  |
| 2.5                   | 49             | 53        | 51        | 53        | 15         | 17        | 14        | 17        | 50             | 53        | 15         | 17        | 51               | 16  |

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5-2

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## CHAMBER A-2 VERSUS CHAMBER D FIELD CURVATURE COMPARISON

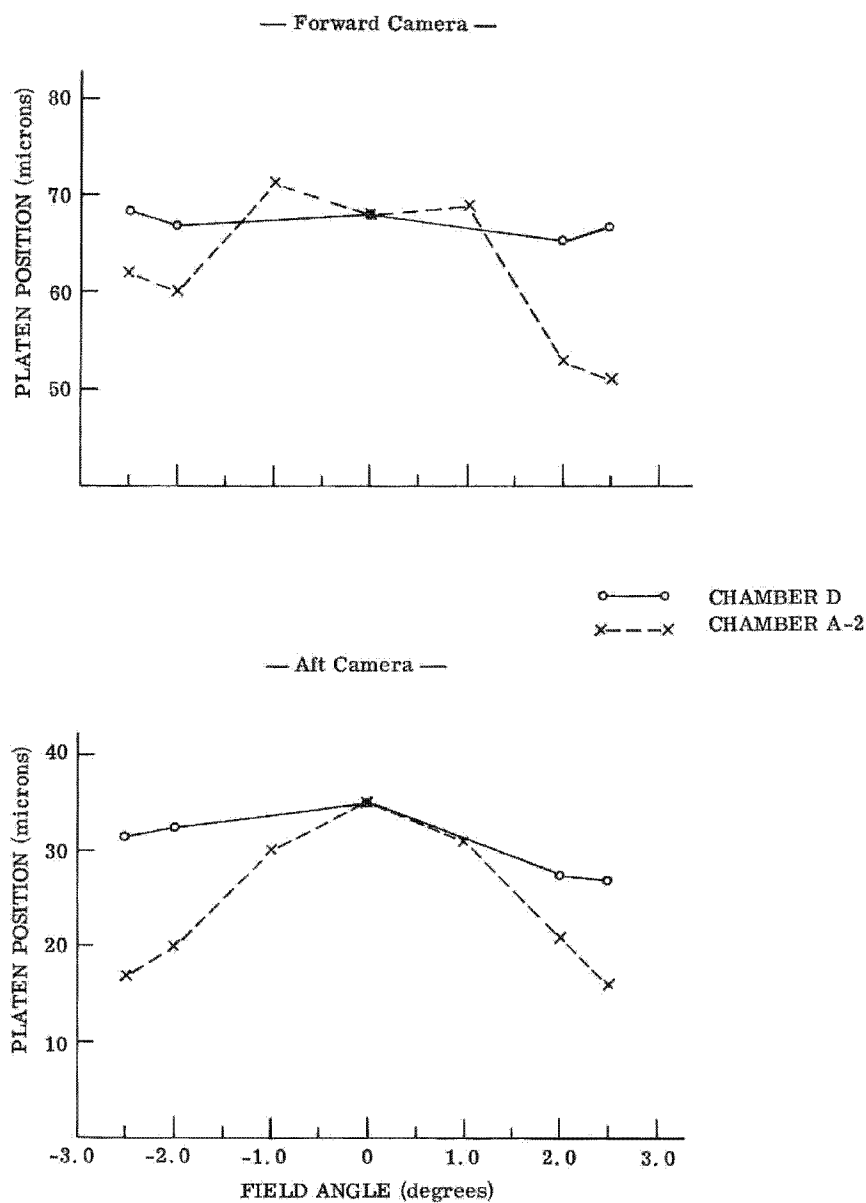


FIGURE 5-1

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5-3

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## HISTORICAL COMPARISON OF CHAMBER A-2 MEASURED FIELD CURVATURES

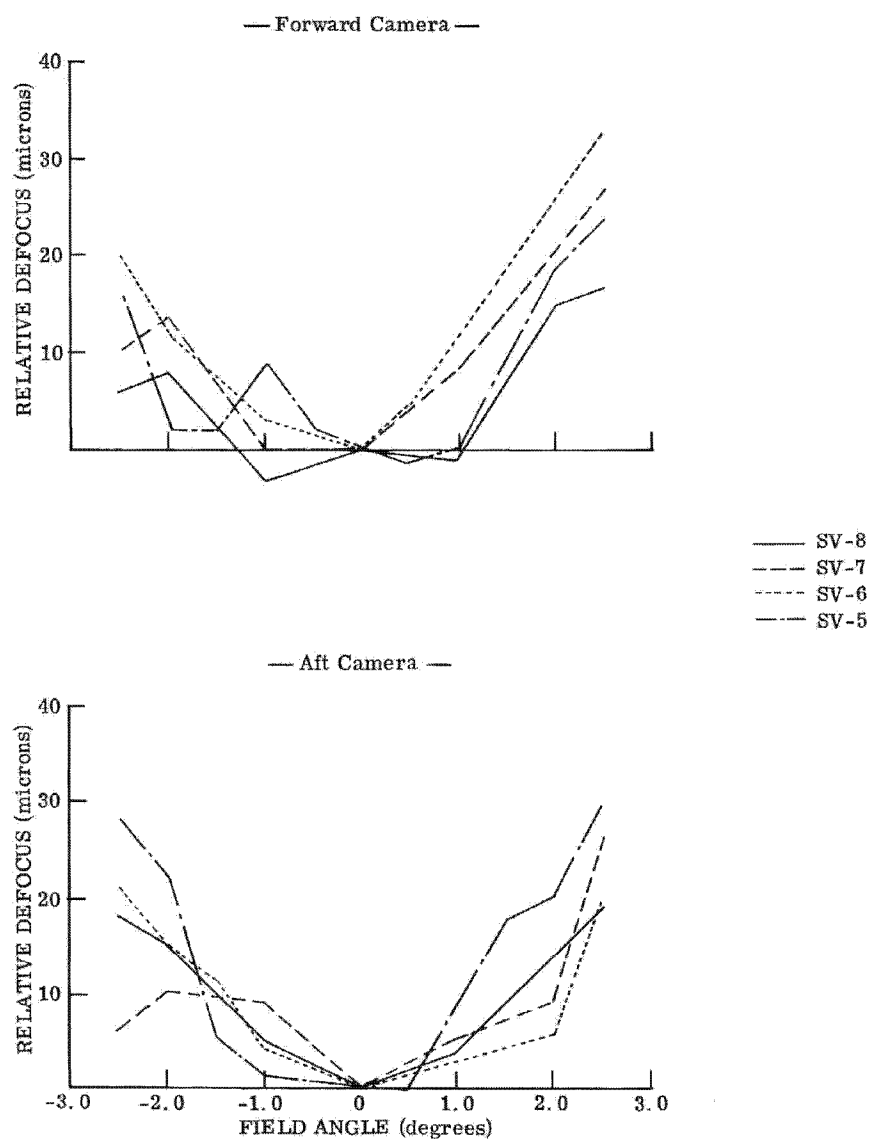


FIGURE 5-2

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5-4

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across the web near nadir from Missions 1205, 1206, and 1207 reveals no evidence of platen mistilt on the Forward or Aft Cameras. This PFA analysis of mission photography also indicates a degree of effective field curvature less severe than the camera/film Chamber A-2 configuration but more severe than the optical bar Chamber D configuration. In summary, the Readiness Team feels that the SV-8 platen tilt is adequate for launch.

### 5.3 IN-FLIGHT CHANGEABLE FILTER (ICF) PERFORMANCE

Both cameras are equipped with ICFs which allow a choice between two filters, a Wratten 12 or a Wratten 2E3. Seq L was run to determine if changes in either performance level or PBF occur when a change is made from one filter to the other. Test parameters were a  $V_x/h$  of .018, a slit width of .259", and the IMC disabled. The results of this analysis are that no detectable difference was noted in resolution or focus on the 1414 Film when switching from one filter to the other.

Replicate frames were acquired with each filter in place at platen positions of 71 and 33 microns for the Forward and Aft Cameras respectively. No change in the 2:1 contrast geometric mean resolution performance was found for either camera with the use of the different filters, see Table 5-2. Microdensitometric analysis of the line targets from the same frames was done using the FOCMO Program to determine PBFs for each filter. Again, no difference was found between the filters for either camera, see Table 5-3.

TABLE 5-2  
COMPARISON OF AVERAGE RESOLUTION WITH TWO FILTERS  
(cycles/mm)

| Filter   | Forward Camera     |             | Aft Camera         |             |
|----------|--------------------|-------------|--------------------|-------------|
|          | Average Resolution | Sample Size | Average Resolution | Sample Size |
| W-12     | 193                | 26          | 185                | 20          |
| W-2E3    | 181                | 18          | 175                | 18          |
| W-12     | 173                | 18          | 182                | 18          |
| W-2E3    | 177                | 18          | 183                | 18          |
| W-12     | 179                | 18          | 184                | 24          |
| Average: |                    |             |                    |             |
| W-12     | 182                | 62          | 184                | 62          |
| W-2E3    | 179                | 36          | 179                | 36          |

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TABLE 5-3  
COMPARISON OF LINE DETERMINED FOCUS WITH TWO FILTERS  
(microns)

| Camera  | Filter | In-Track |             | Cross-Track |             |
|---------|--------|----------|-------------|-------------|-------------|
|         |        | PBF      | Sample Size | PBF         | Sample Size |
| Forward | W-12   | 78       | 31          | 64          | 31          |
|         | W-2E3  | 78       | 18          | 65          | 18          |
| Aft     | W-12   | 45       | 31          | 37          | 31          |
|         | W-2E3  | 45       | 18          | 38          | 18          |

#### 5.4 SELECTION OF LAUNCH PLATEN POSITION

Based upon the resolution performance analysis in Section III, optimally balanced field performance is at platen settings of 67 microns for the Forward and 30 microns for the Aft Camera. Corrections are made for vehicle altitude, gravity effects, and collimator focus as follows:

A. Collimators in Chamber A-2 are set for infinity focus. The reference orbit for Mission 1208 will provide a photographic acquisition average altitude of approximately 85 NM. This difference requires a correction of 14 microns, see Figure 5-3.

B. The on-orbit gravity release effect on focus is measured interferometrically on the individual optical bars by taking measurements with the gravity vector stressing the folding flat via appropriate positioning of the bar. The Chamber C measured residual  $0^\circ$  astigmatism on-axis is  $-.11\lambda$  for OB Set 035 (Forward Camera) and  $-.14\lambda$  for OB Set 037 (Aft Camera). Consistent with previous readiness procedures, the deformation of the folding flat is assumed to be fully spherical. With this assumption, focus shift ( $\Delta F$  in microns) is a linear relationship to residual  $0^\circ$  astigmatism ( $\delta\lambda$ ), i. e.,  $\Delta F = \delta\lambda (137)$ . The resultant corrections in focus are, therefore, -15 microns for the Forward and -19 microns for the Aft Camera.

C. Chamber A-2 collimator focus settings are monitored interferometrically and can depart from specification. During readiness test operations, the Forward  $0^\circ$  collimator was monitored at 2.4 microns deviation and the Aft  $0^\circ$  collimator was monitored to be .5 micron.

These three correction factors are applied to the optimum platen positions to balance the field as derived in Section III to determine the recommended launch settings. Table 5-4 presents these factors for SV-8:

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## FOCUS AS A FUNCTION OF ALTITUDE AND SCAN ANGLE

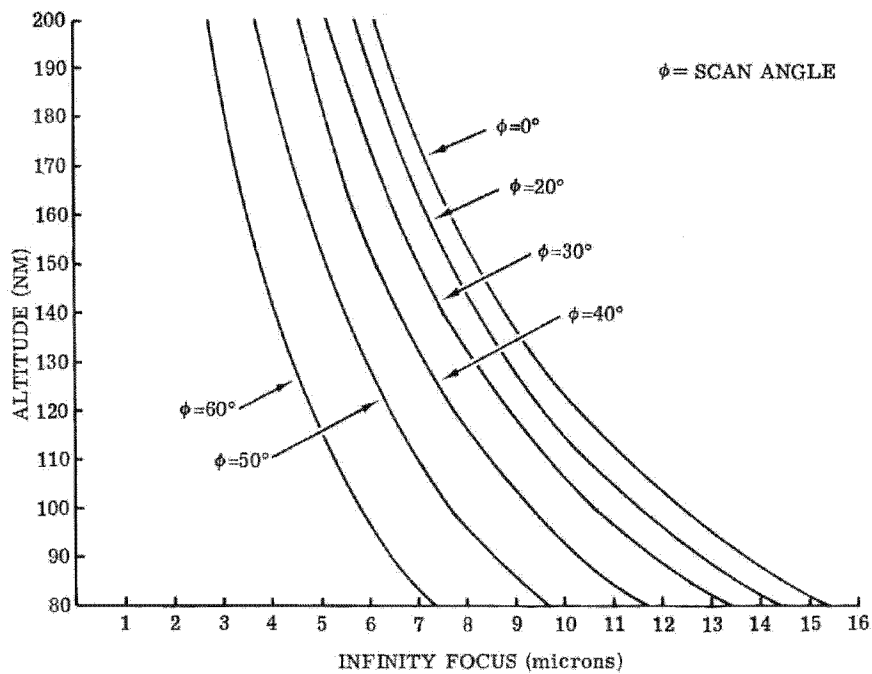


FIGURE 5-3

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TABLE 5-4

## LAUNCH FOCUS SETTING FACTORS

(microns)

| <u>Factor</u>                                                                       | <u>Forward Camera</u> | <u>Aft Camera</u> |
|-------------------------------------------------------------------------------------|-----------------------|-------------------|
| Platen Position for Best Resolution<br>Across Field From Readiness Test<br>Data     | 67                    | 30                |
| Adjustment for 85 NM Mission Altitude                                               | 14                    | 14                |
| Collimator Defocus Adjustment                                                       | 2                     | 0                 |
| Adjustment for Gravity Release on<br>Folding Flat Assuming Spherical<br>Deformation | -15                   | -19               |
| Launch Platen Position                                                              | 68                    | 25                |

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## SECTION VI

## ON-ORBIT PERFORMANCE ESTIMATES

## 6.1 INTRODUCTION

Preflight performance predictions are made for each HEXAGON mission using the CRYSPER Program. CRYSPER predicts the on-orbit performance of the camera system in its expected operating environment. The predictions are two sigma low estimates of resolution in both cycles/mm at the camera as well as ground resolved distance (GRD) of the image. The program has three basic sections that are linked together, each describing a major aspect of the final system resolution. The three sections are:

A. An orbital model which uses as input data the orbital elements for the mission and specific characteristics of the targets. The output of this section of the program is ordered by target access and consists of the solar ephemeris as well as the geometry of each access.

B. An atmospheric model which uses the data generated in the previous section and computes the apparent contrast of each target accessed. It uses an extensive data bank of atmospheric measurements which has been collected during the past five years. This data bank enables this section of the program to estimate the haze levels on a geographic and seasonal probability basis.

C. A camera performance model which is a mathematical description of the performance characteristics of the camera system and flight vehicle. This section uses the output from both of the previous sections as well as the film characteristics and the camera smear/optical performance data under the various operating conditions. The calculation of resolution is obtained by intersecting the system modulation transfer function (MTF) with a threshold modulation (TM) curve that describes the film characteristics under the exposure/contrast conditions prevalent during exposure. CRYSPER has been configured to compute a table of resolution values in either cycles/mm at the film plane or ground resolved distance (GRD) in feet for a range of solar altitudes and latitudes over the entire 120° format. The solar altitude is computed for given latitudes based on the orbital and solar ephemeris data. The computation for the solar altitude is based on the latitude at 0° scan angle. Because of the geometry of the orbital elements and camera configuration, a small difference of approximately 2° maximum is expected in the solar altitude at high scan angles relative to the published angle for 0° scan. This will not affect the prediction significantly. The benefit derived from this change enables one to determine the appropriate predictions based on the expected solar elevation for a given target or area knowing only the geographic latitude of the target. These tables have been used in all previous readiness reports. The table, however, has three limitations:

- (1) It is for an average of the in-track and cross-track resolution.

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(2) The MTF at the  $0^\circ$  and  $\pm 2.0^\circ$  field positions is averaged and used throughout the length of a frame.

(3) It is for only one focus position.

## 6.2 CRYSPER CONCEPTS

During the design and test stages of building a camera system, a set of standard conditions is used that is generally based on best exposure and 2:1 apparent target contrast. This provides a stable base from which design predictions can be compared against actual test chamber results. During flight, though, these stable conditions do not exist.

Each operational target is acquired under its own unique set of conditions. Even the same targets acquired on a later revolution will exhibit new characteristics that will influence the ultimate performance. Two factors that are not within engineering control are the target reflectances and the prevailing haze conditions at the time of exposure. These two factors have a direct and significant influence on performance.

An effort has been undertaken to quantify these two characteristics so that the CRYSPER Program could be used to predict the ground resolved distance for accessed intelligence targets with some relation to reality. The haze has been estimated as a probability distribution on a geographic and seasonal basis. It is a useful estimate on a statistical basis, which is the best one could hope for in making preflight predictions. The target reflectance aspect has been handled by assigning a high and low reflectance to each COMIREX target category. These values were based on density measurements made from past reconnaissance photography. The contrast of these targets is low, the maximum being slightly above 2:1 on the ground. Intelligence target contrasts are further reduced (to perhaps 1.5:1) by the atmospheric haze.

Mobile Controlled Range Network (CORN) tribar targets will be photographed during domestic passes for engineering purposes. These targets have a ground contrast of approximately 5:1. They are useful in assessing on-orbit performance in relation to system design and testing because these targets have, on clear days, an apparent contrast somewhat higher than 2:1 at the camera aperture.

In order to accommodate both the engineering and intelligence needs for resolution predictions, two separate CRYSPER runs are made. The engineering run uses an average haze condition and the nominal CORN tribar target reflectances of 7-33%. This equates to placing a CORN tribar target at all format locations and photographing it on "average" days, see Table 6-1. CRYSPER approximates the engineering ground based tests by controlling the major non-camera related variables and produces GRD values between 2' and 9' as the design indicates. The run for intelligence application equates to replacing the intelligence target with a CORN tribar target that nearly matches it in contrast, and photographing it under

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atmospheric conditions typical of those at that time of the year. Hence, it is not uncommon to have photography of 10 to 15 feet GRD under these conditions even when the camera is operating according to its design, see Table 6-2.

A third type of performance prediction entitled CRYSPER VEM resolution has been included in this section of the readiness report, see Table 6-3. These predictions are designed to relate to the VEM resolution data acquired during the PFA time period and the subsequent in-depth analyses of the mission. VEM provides an estimate of the 2:1 contrast resolution in cycles/mm, the basic performance measure of the camera system. The VEM matrix is calibrated to 2:1 contrast resolution irrespective of the contrast of the edge itself, so the atmospheric subroutines of CRYSPER, which ultimately adjust the AIM curve for exposure and contrast, are bypassed.

## 6.3 PREDICTIONS FOR MISSION 1208

A series of CRYSPER runs have been made to estimate the performance from Mission 1208. The CRYSPER output discussed in this section consists of the format/solar altitude table and one page of the target access data for the conditions used. The orbital elements for a March 1974 launch were used along with the performance estimates from the Chamber A acceptance test and the latest Chamber A-2 test. Chamber A-2 provides data at only two collimator locations, whereas Chamber A has three. In order to have as much data as possible for determining the synchronization errors as a function of scan angle, both sets of data are used. There are, however, some inconsistencies in the data between these two tests. This causes slight inconsistencies in the resolution predictions as a function of scan angle. All runs are for descending passes.

The output used for the first five tables has been expanded to include GRD in feet. The computation used to convert from film plane resolution in cycles/mm to GRD takes into account the slant range and perspective factors of the acquisition. It is therefore a number that relates to flat objects on the ground, i. e., CORN tribar targets.

## 6.4 UNCERTAINTIES IN PERFORMANCE ESTIMATES

The predictions made in this test have been based primarily on laboratory data. Since there are uncertainties in some of the data, a CRYSPER run was made using a worse case estimate for some of these parameters.

Tables 6-4 and 6-5 are estimates of the performance to be expected with worse case errors of defocus and smear. These tables are comparable to Tables 6-1 and 6-3 respectively. Based on past experience, the magnitude of the focus error can be as much as eight microns, while discrepancies in the synchronization data could produce errors in the mean smear rates of .05 inch/second. The predicted resolution for CORN targets with these errors (Tables 6-4 and 6-5) shows a significant loss in resolution.

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TABLE 6-1

MISSION 1208 CRYSPER PREDICTIONS OF TWO SIGMA LOW RESOLUTION  
FOR 7-33% REFLECTANCE TARGETS (CORN TRIBAR SIMULATIONS)  
(lines/mm and feet)

| TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN LINES/MM) FOR VARIOUS SUN AND SCAN ANGLES |      |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------------------------------------------------------------------------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| (0 CENTER 120 SCAN)                                                                                 |      |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                                                                                                     | SCAN | -60 | -50 | -40 | -30 | -20 | -10 | 0   | 10  | 20  | 30  | 40  | 50  | 60  |
| AFT CAMERA                                                                                          |      |     |     |     |     |     |     |     |     |     |     |     |     |     |
| LAT SUN                                                                                             | 80   | 8   | 65  | 76  | 85  | 88  | 95  | 101 | 103 | 99  | 94  | 88  | 83  | 76  |
| 75                                                                                                  | 13   | 92  | 104 | 118 | 123 | 132 | 138 | 140 | 137 | 132 | 126 | 119 | 109 | 99  |
| 70                                                                                                  | 18   | 105 | 120 | 134 | 141 | 150 | 156 | 160 | 156 | 151 | 145 | 137 | 127 | 114 |
| 65                                                                                                  | 23   | 116 | 132 | 147 | 154 | 163 | 169 | 174 | 171 | 166 | 159 | 150 | 139 | 125 |
| 60                                                                                                  | 27   | 124 | 142 | 156 | 164 | 173 | 179 | 184 | 181 | 176 | 169 | 160 | 148 | 132 |
| SSN 011 OSN 378                                                                                     | 50   | 35  | 135 | 154 | 165 | 173 | 181 | 187 | 192 | 190 | 185 | 179 | 174 | 161 |
| 40                                                                                                  | 43   | 144 | 165 | 175 | 184 | 192 | 197 | 200 | 199 | 195 | 189 | 179 | 171 | 152 |
| 30                                                                                                  | 50   | 150 | 172 | 183 | 192 | 200 | 204 | 206 | 205 | 201 | 195 | 185 | 178 | 157 |
| 20                                                                                                  | 56   | 153 | 177 | 187 | 197 | 204 | 208 | 210 | 209 | 205 | 199 | 189 | 182 | 160 |
| FORWARD CAMERA                                                                                      |      |     |     |     |     |     |     |     |     |     |     |     |     |     |
| LAT SUN                                                                                             | 80   | 8   | 56  | 69  | 75  | 80  | 87  | 93  | 101 | 94  | 89  | 82  | 76  | 69  |
| 75                                                                                                  | 13   | 89  | 99  | 106 | 114 | 121 | 128 | 136 | 130 | 124 | 117 | 109 | 108 | 99  |
| 70                                                                                                  | 18   | 104 | 116 | 125 | 132 | 140 | 147 | 154 | 148 | 143 | 135 | 127 | 125 | 115 |
| 65                                                                                                  | 23   | 117 | 129 | 139 | 147 | 154 | 161 | 166 | 162 | 156 | 149 | 141 | 137 | 126 |
| 60                                                                                                  | 27   | 125 | 140 | 149 | 157 | 164 | 170 | 175 | 171 | 166 | 159 | 150 | 146 | 134 |
| SSN 011 OSN 354                                                                                     | 50   | 35  | 137 | 152 | 160 | 168 | 174 | 179 | 183 | 179 | 175 | 168 | 163 | 158 |
| 40                                                                                                  | 43   | 145 | 162 | 169 | 178 | 184 | 190 | 193 | 190 | 185 | 178 | 169 | 166 | 152 |
| 30                                                                                                  | 50   | 152 | 169 | 177 | 186 | 192 | 197 | 200 | 196 | 191 | 184 | 175 | 172 | 157 |
| 20                                                                                                  | 56   | 155 | 173 | 181 | 190 | 196 | 201 | 203 | 200 | 195 | 188 | 179 | 175 | 160 |

| TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN FEET) FOR VARIOUS SUN AND SCAN ANGLES |      |       |       |       |      |      |      |      |      |      |      |      |      |       |
|-------------------------------------------------------------------------------------------------|------|-------|-------|-------|------|------|------|------|------|------|------|------|------|-------|
| (0 CENTER 120 SCAN)                                                                             |      |       |       |       |      |      |      |      |      |      |      |      |      |       |
|                                                                                                 | SCAN | -60   | -50   | -40   | -30  | -20  | -10  | 0    | 10   | 20   | 30   | 40   | 50   | 60    |
| AFT CAMERA                                                                                      |      |       |       |       |      |      |      |      |      |      |      |      |      |       |
| LAT SUN                                                                                         | 80   | 8     | 20.97 | 11.47 | 7.58 | 5.99 | 4.68 | 4.28 | 4.10 | 4.34 | 4.92 | 6.01 | 7.83 | 11.44 |
| 75                                                                                              | 13   | 14.36 | 8.12  | 5.37  | 4.20 | 3.45 | 3.07 | 2.93 | 3.09 | 3.45 | 4.13 | 5.35 | 7.78 | 13.41 |
| 70                                                                                              | 18   | 12.31 | 6.90  | 4.63  | 3.61 | 2.97 | 2.65 | 2.52 | 2.65 | 2.94 | 3.51 | 4.54 | 6.57 | 11.43 |
| 65                                                                                              | 23   | 10.91 | 6.14  | 4.14  | 3.23 | 2.68 | 2.40 | 2.28 | 2.38 | 2.64 | 3.13 | 4.05 | 5.86 | 10.22 |
| 60                                                                                              | 27   | 10.01 | 5.62  | 3.83  | 2.99 | 2.48 | 2.23 | 2.12 | 2.21 | 2.44 | 2.89 | 3.72 | 5.39 | 9.47  |
| SSN 011 OSN 378                                                                                 | 50   | 35    | 8.91  | 4.99  | 3.50 | 2.74 | 2.29 | 2.06 | 1.97 | 2.04 | 2.24 | 2.65 | 3.32 | 4.79  |
| 40                                                                                              | 43   | 8.13  | 4.56  | 3.22  | 2.51 | 2.11 | 1.92 | 1.84 | 1.90 | 2.08 | 2.45 | 3.14 | 4.41 | 7.72  |
| 30                                                                                              | 50   | 7.68  | 4.30  | 3.03  | 2.37 | 2.00 | 1.83 | 1.76 | 1.89 | 2.09 | 2.34 | 2.89 | 4.17 | 7.34  |
| 20                                                                                              | 56   | 7.49  | 4.17  | 2.95  | 2.31 | 1.96 | 1.79 | 1.73 | 1.78 | 1.95 | 2.29 | 2.93 | 4.07 | 7.17  |
| FORWARD CAMERA                                                                                  |      |       |       |       |      |      |      |      |      |      |      |      |      |       |
| LAT SUN                                                                                         | 80   | 8     | 24.33 | 12.51 | 8.58 | 6.43 | 5.32 | 4.62 | 4.18 | 4.56 | 5.23 | 6.44 | 8.53 | 11.68 |
| 75                                                                                              | 13   | 14.99 | 8.59  | 5.95  | 4.55 | 3.75 | 3.28 | 3.03 | 3.24 | 3.66 | 4.43 | 5.79 | 7.88 | 13.41 |
| 70                                                                                              | 18   | 12.48 | 7.15  | 4.97  | 3.83 | 3.18 | 2.82 | 2.63 | 2.79 | 3.12 | 3.75 | 4.88 | 6.65 | 11.29 |
| 65                                                                                              | 23   | 10.89 | 6.29  | 4.36  | 3.40 | 2.84 | 2.52 | 2.38 | 2.51 | 2.80 | 3.35 | 4.33 | 5.96 | 10.12 |
| 60                                                                                              | 27   | 9.95  | 5.72  | 4.00  | 3.10 | 2.61 | 2.34 | 2.22 | 2.33 | 2.58 | 3.08 | 3.98 | 5.47 | 9.29  |
| SSN 011 OSN 354                                                                                 | 50   | 35    | 8.73  | 5.06  | 3.60 | 2.82 | 2.38 | 2.15 | 2.06 | 2.15 | 2.38 | 2.82 | 3.54 | 4.90  |
| 40                                                                                              | 43   | 8.04  | 4.84  | 3.32  | 2.59 | 2.20 | 1.98 | 1.90 | 1.99 | 2.19 | 2.60 | 3.33 | 4.52 | 7.69  |
| 30                                                                                              | 50   | 7.58  | 4.38  | 3.13  | 2.45 | 2.08 | 1.88 | 1.82 | 1.89 | 2.09 | 2.47 | 3.18 | 4.32 | 7.34  |
| 20                                                                                              | 56   | 7.39  | 4.27  | 3.06  | 2.40 | 2.04 | 1.85 | 1.79 | 1.86 | 2.05 | 2.42 | 3.11 | 4.23 | 7.19  |

PARAMETERS ASSOCIATED WITH THE LAST ENTRY IN THE RIGHT HAND COLUMN OF THE TABLE

| TARGET   | REFLECTANCE | SUN | HAZE | SOLAR | DATE   | RDSH | INERTIAL | SATELLITE | SAT      | OBLATE  | SATELLITE | VXQH            | VYQH                  |
|----------|-------------|-----|------|-------|--------|------|----------|-----------|----------|---------|-----------|-----------------|-----------------------|
| LATITUDE | HIGH        | LOW | TYPE | CONC  | MO     | Y    | VELOCITY | LAT       | ALT      | EARTH   | TO EARTH  |                 |                       |
| D M S    |             |     |      |       |        |      | (FT/SEC) | (DEGREES) | (NM)     | RADIUS  | CENTERING |                 |                       |
| 19 39 33 | 33          | 7   | 1    | 4     | 129.77 | 17   | 3.7%     | 0.00015   | 25700.78 | 20.1422 | 29.0560   | 89.1 + 3442.6 = | 3531.6 0.0460 0.00263 |

~~TOP SECRET - HEXAGON~~

BYE 15250-74

Handle via Byeman  
Controls Only

~~TOP SECRET - HEXAGON~~

FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 6-2

MISSION 1208 CRYSPER PREDICTIONS OF TWO SIGMA LOW RESOLUTION  
FOR 10-20% REFLECTANCE TARGETS (NOMINAL INTELLIGENCE TARGETS)  
(lines/mm and feet)

|                |                 | TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN LINES/MM) FOR VARIOUS SUN AND SCAN ANGLES |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|----------------|-----------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                |                 | (O CENTER 120 SCAN)                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                |                 | SCAN                                                                                                | -60 | -50 | -40 | -30 | -20 | -10 | 0   | 10  | 20  | 30  | 40  | 50  | 60  |     |
|                |                 | LAT SUN                                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AFT CAMERA     | SSN 011 OSN 378 | 80                                                                                                  | 8   | 45  | 59  | 68  | 72  | 78  | 82  | 84  | 81  | 77  | 72  | 66  | 59  | 69  |
|                |                 | 75                                                                                                  | 13  | 68  | 81  | 93  | 99  | 106 | 110 | 112 | 110 | 106 | 101 | 94  | 85  | 73  |
|                |                 | 70                                                                                                  | 18  | 78  | 93  | 105 | 111 | 119 | 123 | 126 | 123 | 120 | 114 | 107 | 98  | 85  |
|                |                 | 65                                                                                                  | 23  | 87  | 102 | 114 | 121 | 128 | 132 | 135 | 133 | 129 | 124 | 117 | 107 | 93  |
|                |                 | 60                                                                                                  | 27  | 93  | 109 | 120 | 127 | 134 | 139 | 142 | 140 | 136 | 130 | 123 | 113 | 99  |
|                |                 | 50                                                                                                  | 35  | 102 | 118 | 129 | 136 | 143 | 148 | 151 | 149 | 145 | 140 | 132 | 121 | 107 |
|                |                 | 40                                                                                                  | 43  | 109 | 124 | 136 | 144 | 150 | 154 | 157 | 155 | 152 | 146 | 138 | 128 | 113 |
|                |                 | 30                                                                                                  | 50  | 112 | 129 | 140 | 148 | 155 | 158 | 161 | 160 | 156 | 151 | 142 | 132 | 117 |
|                |                 | 20                                                                                                  | 56  | 115 | 131 | 143 | 151 | 157 | 161 | 163 | 162 | 158 | 153 | 145 | 134 | 119 |
| FORWARD CAMERA | SSN 011 OSN 35A | 80                                                                                                  | 8   | 38  | 54  | 61  | 66  | 72  | 77  | 83  | 78  | 74  | 68  | 62  | 58  | 48  |
|                |                 | 75                                                                                                  | 13  | 66  | 78  | 86  | 93  | 99  | 105 | 110 | 106 | 102 | 96  | 89  | 85  | 74  |
|                |                 | 70                                                                                                  | 18  | 78  | 91  | 99  | 107 | 113 | 118 | 123 | 119 | 115 | 109 | 102 | 98  | 86  |
|                |                 | 65                                                                                                  | 23  | 88  | 101 | 110 | 117 | 123 | 128 | 131 | 128 | 124 | 119 | 111 | 107 | 94  |
|                |                 | 60                                                                                                  | 27  | 94  | 109 | 118 | 125 | 130 | 135 | 138 | 135 | 131 | 125 | 118 | 113 | 101 |
|                |                 | 50                                                                                                  | 35  | 104 | 118 | 128 | 135 | 140 | 144 | 147 | 144 | 140 | 134 | 127 | 122 | 110 |
|                |                 | 40                                                                                                  | 43  | 111 | 125 | 135 | 142 | 148 | 152 | 154 | 151 | 147 | 142 | 134 | 128 | 115 |
|                |                 | 30                                                                                                  | 50  | 115 | 130 | 140 | 147 | 153 | 157 | 158 | 156 | 152 | 146 | 138 | 132 | 119 |
|                |                 | 20                                                                                                  | 56  | 117 | 132 | 142 | 150 | 155 | 159 | 160 | 158 | 154 | 149 | 141 | 134 | 121 |

|                |                 | TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN FEET) FOR VARIOUS SUN AND SCAN ANGLES |     |       |       |       |      |      |      |      |      |      |      |       |       |       |
|----------------|-----------------|-------------------------------------------------------------------------------------------------|-----|-------|-------|-------|------|------|------|------|------|------|------|-------|-------|-------|
|                |                 | (O CENTER 120 SCAN)                                                                             |     |       |       |       |      |      |      |      |      |      |      |       |       |       |
|                |                 | SCAN                                                                                            | -60 | -50   | -40   | -30   | -20  | -10  | 0    | 10   | 20   | 30   | 40   | 50    | 60    |       |
|                |                 | LAT SUN                                                                                         |     |       |       |       |      |      |      |      |      |      |      |       |       |       |
| AFT CAMERA     | SSN 011 OSN 378 | 80                                                                                              | 8   | 30.16 | 14.73 | 9.49  | 7.34 | 5.94 | 5.22 | 5.01 | 5.28 | 5.99 | 7.33 | 9.75  | 14.65 | 27.65 |
|                |                 | 75                                                                                              | 13  | 19.46 | 10.40 | 6.77  | 5.22 | 4.29 | 3.82 | 3.66 | 3.83 | 4.28 | 5.12 | 6.70  | 9.93  | 18.13 |
|                |                 | 70                                                                                              | 18  | 16.55 | 8.90  | 5.89  | 4.55 | 3.75 | 3.36 | 3.20 | 3.35 | 3.72 | 4.44 | 5.78  | 8.46  | 15.36 |
|                |                 | 65                                                                                              | 23  | 14.65 | 7.93  | 5.33  | 4.12 | 3.41 | 3.06 | 2.93 | 3.05 | 3.38 | 4.02 | 5.21  | 7.63  | 13.67 |
|                |                 | 60                                                                                              | 27  | 13.36 | 7.32  | 4.94  | 3.83 | 3.19 | 2.87 | 2.74 | 2.85 | 3.16 | 3.75 | 4.84  | 7.07  | 12.57 |
|                |                 | 50                                                                                              | 35  | 11.80 | 6.54  | 4.48  | 3.47 | 2.90 | 2.61 | 2.49 | 2.59 | 2.86 | 3.39 | 4.38  | 6.35  | 11.23 |
|                |                 | 40                                                                                              | 43  | 10.81 | 6.04  | 4.15  | 3.21 | 2.70 | 2.44 | 2.34 | 2.42 | 2.67 | 3.15 | 4.07  | 5.90  | 10.34 |
|                |                 | 30                                                                                              | 50  | 10.26 | 5.76  | 3.94  | 3.07 | 2.58 | 2.34 | 2.26 | 2.33 | 2.56 | 3.02 | 3.89  | 5.63  | 9.84  |
|                |                 | 20                                                                                              | 56  | 10.00 | 5.64  | 3.87  | 3.01 | 2.54 | 2.31 | 2.22 | 2.29 | 2.52 | 2.98 | 3.82  | 5.53  | 9.63  |
| FORWARD CAMERA | SSN 011 OSN 35A | 80                                                                                              | 8   | 35.81 | 16.00 | 10.59 | 7.96 | 6.43 | 5.56 | 5.05 | 5.48 | 6.23 | 7.77 | 10.48 | 14.92 | 28.47 |
|                |                 | 75                                                                                              | 13  | 20.14 | 10.87 | 7.33  | 5.58 | 4.60 | 4.02 | 3.73 | 3.97 | 4.46 | 5.41 | 7.13  | 10.01 | 18.07 |
|                |                 | 70                                                                                              | 18  | 16.62 | 9.12  | 6.22  | 4.75 | 3.94 | 3.50 | 3.29 | 3.47 | 3.87 | 4.66 | 6.08  | 8.50  | 15.17 |
|                |                 | 65                                                                                              | 23  | 14.49 | 8.05  | 5.50  | 4.25 | 3.53 | 3.17 | 3.01 | 3.16 | 3.51 | 4.20 | 5.45  | 7.62  | 13.49 |
|                |                 | 60                                                                                              | 27  | 13.17 | 7.34  | 5.05  | 3.91 | 3.29 | 2.95 | 2.82 | 2.99 | 3.27 | 3.90 | 5.04  | 7.05  | 12.35 |
|                |                 | 50                                                                                              | 35  | 11.53 | 6.52  | 4.50  | 3.51 | 2.97 | 2.68 | 2.57 | 2.68 | 2.97 | 3.52 | 4.54  | 6.33  | 10.97 |
|                |                 | 40                                                                                              | 43  | 10.54 | 6.01  | 4.17  | 3.25 | 2.75 | 2.48 | 2.39 | 2.49 | 2.75 | 3.26 | 4.21  | 5.88  | 10.13 |
|                |                 | 30                                                                                              | 50  | 9.99  | 5.71  | 3.97  | 3.09 | 2.62 | 2.37 | 2.29 | 2.38 | 2.63 | 3.11 | 4.01  | 5.62  | 9.68  |
|                |                 | 20                                                                                              | 56  | 9.77  | 5.59  | 3.89  | 3.03 | 2.57 | 2.34 | 2.26 | 2.34 | 2.59 | 3.06 | 3.93  | 5.53  | 9.48  |

PARAMETERS ASSOCIATED WITH THE LAST ENTRY IN THE RIGHT HAND COLUMN OF THE TABLE

| TARGET REFLECTANCE | TARGET | HAZE | SOLAR          | DATE    | MOON | INERTIAL | SATELLITE      | SAT  | OBLATE | SATELLITE  | VXOH   | VYOH    |
|--------------------|--------|------|----------------|---------|------|----------|----------------|------|--------|------------|--------|---------|
| LATITUDE HIGH LOW  | SUN    | COND | AZIM           | D M Y   |      | VELOCITY | LAT LONG       | ALT  | EARTH  | TO EARTH   |        |         |
| D M S              | TYPE   |      | MUTH A D R     |         |      | (FT/SEC) | (DEGREES)      | (NM) | RADIUS | CENTER(NM) |        |         |
| 19 39 33 20 10     | 1      | 4    | 129.77 17 3 74 | 0.00015 |      | 25700.78 | 20.1422 29.060 | 89.1 | 3442.6 | 3531.6     | 0.0460 | 0.00263 |

~~TOP SECRET - HEXAGON~~

~~TOP SECRET - HEXAGON~~FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 6-3

MISSION 1208 CRYSPER VEM PREDICTIONS OF TWO SIGMA LOW RESOLUTION  
FOR 2:1 APPARENT CONTRAST OBJECTS  
(lines/mm and feet)

| TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN LINES/MM) FOR VARIOUS SUN AND SCAN ANGLES |                 |                     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------------------------------------------------------------------------------------------------|-----------------|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                                                                                                     |                 | (0 CENTER 120 SCAN) |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                                                                                                     |                 | SCAN                | -60 | -50 | -40 | -30 | -20 | -10 | 0   | 10  | 20  | 30  | 40  | 50  | 60  |
|                                                                                                     |                 | LAT SUN             |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AFT CAMERA                                                                                          | 80              | 8                   | 75  | 81  | 88  | 91  | 97  | 102 | 104 | 100 | 96  | 90  | 85  | 81  | 79  |
|                                                                                                     | 75              | 13                  | 101 | 108 | 119 | 122 | 129 | 134 | 136 | 133 | 129 | 124 | 119 | 112 | 108 |
|                                                                                                     | 70              | 18                  | 115 | 122 | 133 | 137 | 144 | 148 | 152 | 149 | 145 | 140 | 135 | 129 | 122 |
|                                                                                                     | 65              | 23                  | 124 | 134 | 143 | 147 | 154 | 158 | 161 | 159 | 155 | 151 | 145 | 139 | 130 |
|                                                                                                     | 60              | 27                  | 129 | 141 | 150 | 154 | 160 | 167 | 171 | 169 | 165 | 158 | 152 | 145 | 139 |
|                                                                                                     | 50              | 35                  | 137 | 150 | 157 | 162 | 171 | 175 | 179 | 177 | 174 | 166 | 161 | 153 | 145 |
|                                                                                                     | 40              | 43                  | 145 | 156 | 164 | 172 | 178 | 181 | 183 | 182 | 179 | 175 | 169 | 159 | 150 |
|                                                                                                     | 30              | 50                  | 149 | 160 | 168 | 177 | 182 | 185 | 187 | 185 | 183 | 178 | 172 | 162 | 153 |
|                                                                                                     | 20              | 56                  | 150 | 162 | 174 | 180 | 184 | 187 | 188 | 187 | 184 | 180 | 174 | 166 | 154 |
|                                                                                                     | SSN 011 OSN 378 |                     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FORWARD CAMERA                                                                                      | 80              | 8                   | 65  | 74  | 77  | 82  | 88  | 94  | 101 | 95  | 90  | 84  | 79  | 60  | 77  |
|                                                                                                     | 75              | 13                  | 97  | 102 | 107 | 113 | 119 | 125 | 132 | 126 | 121 | 115 | 110 | 111 | 109 |
|                                                                                                     | 70              | 18                  | 113 | 118 | 124 | 129 | 135 | 140 | 146 | 141 | 136 | 131 | 125 | 127 | 123 |
|                                                                                                     | 65              | 23                  | 123 | 131 | 136 | 141 | 145 | 151 | 157 | 153 | 147 | 141 | 136 | 137 | 132 |
|                                                                                                     | 60              | 27                  | 131 | 139 | 144 | 148 | 153 | 160 | 164 | 160 | 156 | 148 | 143 | 143 | 140 |
|                                                                                                     | 50              | 35                  | 141 | 147 | 153 | 158 | 165 | 169 | 172 | 168 | 164 | 159 | 151 | 151 | 146 |
|                                                                                                     | 40              | 43                  | 146 | 154 | 160 | 168 | 172 | 176 | 178 | 175 | 171 | 166 | 160 | 156 | 150 |
|                                                                                                     | 30              | 50                  | 150 | 158 | 167 | 173 | 177 | 180 | 182 | 179 | 175 | 170 | 164 | 159 | 153 |
|                                                                                                     | 20              | 56                  | 152 | 160 | 170 | 175 | 179 | 182 | 183 | 181 | 177 | 172 | 166 | 163 | 154 |
|                                                                                                     | SSN 011 OSN 354 |                     |     |     |     |     |     |     |     |     |     |     |     |     |     |

| TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN FEET) FOR VARIOUS SUN AND SCAN ANGLES |                 |                      |       |       |      |      |      |      |      |      |      |      |      |       |       |
|-------------------------------------------------------------------------------------------------|-----------------|----------------------|-------|-------|------|------|------|------|------|------|------|------|------|-------|-------|
|                                                                                                 |                 | ( 0 CENTER 120 SCAN) |       |       |      |      |      |      |      |      |      |      |      |       |       |
|                                                                                                 |                 | SCAN                 | -60   | -50   | -40  | -30  | -20  | -10  | 0    | 10   | 20   | 30   | 40   | 50    | 60    |
|                                                                                                 |                 | LAT SUN              |       |       |      |      |      |      |      |      |      |      |      |       |       |
| AFT CAMERA                                                                                      | 80              | 8                    | 18.25 | 10.66 | 7.31 | 5.83 | 4.79 | 4.22 | 4.06 | 4.29 | 4.84 | 5.85 | 7.57 | 10.66 | 17.36 |
|                                                                                                 | 75              | 13                   | 13.16 | 7.87  | 5.30 | 4.23 | 3.52 | 3.15 | 3.02 | 3.17 | 3.53 | 4.17 | 5.32 | 7.57  | 12.30 |
|                                                                                                 | 70              | 18                   | 11.29 | 6.80  | 4.65 | 3.71 | 3.09 | 2.78 | 2.66 | 2.78 | 3.08 | 3.63 | 4.61 | 6.46  | 10.65 |
|                                                                                                 | 65              | 23                   | 10.25 | 6.08  | 4.25 | 3.38 | 2.84 | 2.57 | 2.45 | 2.55 | 2.81 | 3.31 | 4.19 | 5.87  | 9.80  |
|                                                                                                 | 60              | 27                   | 9.61  | 5.65  | 3.98 | 3.18 | 2.68 | 2.38 | 2.27 | 2.36 | 2.60 | 3.10 | 3.92 | 5.49  | 9.01  |
|                                                                                                 | 50              | 35                   | 8.79  | 5.15  | 3.66 | 2.92 | 2.43 | 2.20 | 2.11 | 2.18 | 2.39 | 2.85 | 3.60 | 5.05  | 8.29  |
|                                                                                                 | 40              | 43                   | 8.04  | 4.33  | 3.43 | 2.68 | 2.28 | 2.08 | 2.07 | 2.26 | 2.64 | 3.33 | 4.74 | 7.80  |       |
|                                                                                                 | 30              | 50                   | 7.73  | 4.63  | 3.29 | 2.57 | 2.20 | 2.01 | 1.94 | 2.00 | 2.19 | 2.56 | 3.22 | 4.58  | 7.55  |
|                                                                                                 | 20              | 56                   | 7.62  | 4.57  | 3.19 | 2.53 | 2.17 | 1.99 | 1.93 | 1.98 | 2.17 | 2.53 | 3.19 | 4.45  | 7.47  |
|                                                                                                 | SSN 011 OSN 378 |                      |       |       |      |      |      |      |      |      |      |      |      |       |       |
| FORWARD CAMERA                                                                                  | 80              | 8                    | 20.89 | 11.66 | 8.38 | 6.45 | 5.25 | 4.56 | 4.16 | 4.53 | 5.16 | 6.29 | 8.21 | 10.86 | 17.61 |
|                                                                                                 | 75              | 13                   | 13.61 | 8.34  | 5.88 | 4.58 | 3.82 | 3.38 | 3.13 | 3.36 | 3.75 | 4.40 | 5.75 | 7.68  | 12.18 |
|                                                                                                 | 70              | 18                   | 11.50 | 7.05  | 5.00 | 3.93 | 3.30 | 2.95 | 2.77 | 2.93 | 3.26 | 3.88 | 4.96 | 6.53  | 10.56 |
|                                                                                                 | 65              | 23                   | 10.30 | 6.23  | 4.46 | 3.54 | 3.00 | 2.69 | 2.52 | 2.65 | 2.97 | 3.52 | 4.47 | 5.96  | 9.84  |
|                                                                                                 | 60              | 27                   | 9.53  | 5.75  | 4.15 | 3.29 | 2.80 | 2.49 | 2.38 | 2.49 | 2.76 | 3.29 | 4.17 | 5.58  | 8.90  |
|                                                                                                 | 50              | 35                   | 8.48  | 5.23  | 3.76 | 2.99 | 2.52 | 2.29 | 2.19 | 2.29 | 2.53 | 2.97 | 3.82 | 5.12  | 8.24  |
|                                                                                                 | 40              | 43                   | 7.98  | 4.88  | 3.52 | 2.75 | 2.36 | 2.14 | 2.06 | 2.15 | 2.37 | 2.78 | 3.52 | 4.83  | 7.79  |
|                                                                                                 | 30              | 50                   | 7.65  | 4.68  | 3.31 | 2.63 | 2.26 | 2.06 | 2.00 | 2.08 | 2.28 | 2.67 | 3.38 | 4.68  | 7.55  |
|                                                                                                 | 20              | 56                   | 7.54  | 4.62  | 3.26 | 2.60 | 2.23 | 2.04 | 1.98 | 2.05 | 2.26 | 2.64 | 3.33 | 4.55  | 7.46  |
|                                                                                                 | SSN 011 OSN 354 |                      |       |       |      |      |      |      |      |      |      |      |      |       |       |

## PARAMETERS ASSOCIATED WITH THE LAST ENTRY IN THE RIGHT HAND COLUMN OF THE TABLE

| TARGET   | REFLECTANCE | HIGH | LOW | TARGET | HAZE | SOLAR   | DATE    | ADDITIONAL | INERTIAL | SATELLITE | SAT    | OBLATE | SATELLITE | VXON   | VYON           |
|----------|-------------|------|-----|--------|------|---------|---------|------------|----------|-----------|--------|--------|-----------|--------|----------------|
| LATITUDE |             |      |     | SUN    | COND | AZIMUTH | D M Y   |            | VELOCITY | LAT       | LONG   | ALT    | TO EARTH  |        |                |
| D M S    |             |      |     | TYPE   |      |         |         |            | IFT/SEC  | (DEGREES) |        | (NM)   | RADIUS    |        |                |
| 19 39 33 | 33          |      | 7   | 1      | 4    | 129.77  | 17 3 74 | 0.00015    | 25700.78 | 20.1422   | 29.060 | 89.1   | 3642.6    | 3531.6 | 0.0460 0.00283 |

~~TOP SECRET - HEXAGON~~

BYE 15250-74

Handle via Byeman  
Controls Only

~~TOP SECRET - HEXAGON~~

FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 6-4

MISSION 1208 CRYSPER PREDICTIONS OF TWO SIGMA LOW RESOLUTION  
FOR WORSE CASE PHOTOGRAPHY OF 7-33% REFLECTANCE TARGETS  
— 8 MICRONS DEFOCUS, .05 IPS FILM SYNCHRONIZATION ERROR —  
(lines/mm and feet)

|                |                 | TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN LINES/MM) FOR VARIOUS SUN AND SCAN ANGLES |     |     |     |     |     |     |     |     |     |     |     |     |     |
|----------------|-----------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                |                 | (0 CENTER 120 SCAN)                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                |                 | SCAN                                                                                                | -60 | -50 | -40 | -30 | -20 | -10 | 0   | 10  | 20  | 30  | 40  | 50  | 60  |
|                |                 | LAT SUN                                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AFT CAMERA     | SSN 011 OSN 378 | 80                                                                                                  | 8   | 59  | 72  | 81  | 85  | 91  | 95  | 96  | 94  | 89  | 84  | 79  | 65  |
|                |                 | 75                                                                                                  | 13  | 83  | 95  | 106 | 111 | 118 | 124 | 125 | 123 | 118 | 113 | 106 | 88  |
|                |                 | 70                                                                                                  | 18  | 93  | 106 | 114 | 123 | 131 | 136 | 139 | 136 | 132 | 126 | 118 | 99  |
|                |                 | 65                                                                                                  | 23  | 101 | 113 | 125 | 132 | 140 | 145 | 148 | 145 | 140 | 134 | 127 | 106 |
|                |                 | 60                                                                                                  | 27  | 105 | 119 | 131 | 138 | 146 | 152 | 155 | 153 | 148 | 140 | 132 | 110 |
|                |                 | 50                                                                                                  | 35  | 112 | 127 | 135 | 143 | 152 | 158 | 161 | 159 | 154 | 147 | 139 | 116 |
|                |                 | 40                                                                                                  | 43  | 117 | 132 | 141 | 151 | 159 | 164 | 168 | 166 | 161 | 153 | 142 | 121 |
|                |                 | 30                                                                                                  | 50  | 120 | 135 | 145 | 155 | 164 | 170 | 173 | 171 | 166 | 157 | 146 | 124 |
|                |                 | 20                                                                                                  | 56  | 122 | 137 | 147 | 158 | 167 | 173 | 175 | 174 | 168 | 159 | 148 | 126 |
|                |                 | 10                                                                                                  | 61  | 124 | 139 | 149 | 160 | 169 | 175 | 177 | 176 | 170 | 161 | 150 | 128 |
| FORWARD CAMERA | SSN 011 OSN 35A | 80                                                                                                  | 8   | 53  | 67  | 73  | 77  | 84  | 90  | 96  | 91  | 85  | 79  | 73  | 66  |
|                |                 | 75                                                                                                  | 13  | 83  | 93  | 100 | 107 | 114 | 119 | 125 | 120 | 114 | 107 | 101 | 91  |
|                |                 | 70                                                                                                  | 18  | 95  | 106 | 114 | 121 | 127 | 133 | 138 | 133 | 128 | 121 | 113 | 102 |
|                |                 | 65                                                                                                  | 23  | 103 | 116 | 124 | 131 | 138 | 143 | 146 | 142 | 137 | 131 | 123 | 110 |
|                |                 | 60                                                                                                  | 27  | 110 | 122 | 131 | 139 | 145 | 150 | 154 | 150 | 145 | 137 | 129 | 115 |
|                |                 | 50                                                                                                  | 35  | 117 | 130 | 138 | 145 | 151 | 157 | 160 | 156 | 151 | 144 | 137 | 121 |
|                |                 | 40                                                                                                  | 43  | 122 | 136 | 143 | 152 | 159 | 164 | 167 | 164 | 159 | 151 | 141 | 125 |
|                |                 | 30                                                                                                  | 50  | 125 | 139 | 147 | 157 | 164 | 170 | 173 | 169 | 163 | 156 | 145 | 128 |
|                |                 | 20                                                                                                  | 56  | 127 | 141 | 149 | 160 | 167 | 173 | 175 | 172 | 166 | 158 | 148 | 130 |
|                |                 | 10                                                                                                  | 61  | 129 | 143 | 151 | 162 | 169 | 175 | 177 | 174 | 168 | 160 | 150 | 132 |

|                |                 | TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN FEET) FOR VARIOUS SUN AND SCAN ANGLES |     |       |       |      |      |      |      |      |      |      |      |      |       |
|----------------|-----------------|-------------------------------------------------------------------------------------------------|-----|-------|-------|------|------|------|------|------|------|------|------|------|-------|
|                |                 | (0 CENTER 120 SCAN)                                                                             |     |       |       |      |      |      |      |      |      |      |      |      |       |
|                |                 | SCAN                                                                                            | -60 | -50   | -40   | -30  | -20  | -10  | 0    | 10   | 20   | 30   | 40   | 50   | 60    |
|                |                 | LAT SUN                                                                                         |     |       |       |      |      |      |      |      |      |      |      |      |       |
| AFT CAMERA     | SSN 011 OSN 378 | 80                                                                                              | 8   | 22.92 | 12.07 | 7.95 | 6.26 | 5.12 | 4.53 | 4.36 | 4.59 | 5.20 | 6.27 | 8.19 | 21.05 |
|                |                 | 75                                                                                              | 13  | 15.93 | 8.93  | 5.96 | 4.65 | 3.84 | 3.41 | 3.27 | 3.42 | 3.84 | 4.59 | 5.96 | 8.61  |
|                |                 | 70                                                                                              | 18  | 13.95 | 7.85  | 5.32 | 4.11 | 3.39 | 3.03 | 2.90 | 3.03 | 3.38 | 4.03 | 5.25 | 7.60  |
|                |                 | 65                                                                                              | 23  | 12.63 | 7.17  | 4.86 | 3.77 | 3.13 | 2.80 | 2.67 | 2.79 | 3.11 | 3.71 | 4.80 | 6.99  |
|                |                 | 60                                                                                              | 27  | 11.79 | 6.72  | 4.56 | 3.56 | 2.93 | 2.62 | 2.50 | 2.60 | 2.90 | 3.49 | 4.51 | 6.53  |
|                |                 | 50                                                                                              | 35  | 10.69 | 6.08  | 4.26 | 3.30 | 2.73 | 2.45 | 2.34 | 2.43 | 2.70 | 3.23 | 4.14 | 5.96  |
|                |                 | 40                                                                                              | 43  | 9.99  | 5.68  | 4.00 | 3.06 | 2.55 | 2.29 | 2.19 | 2.27 | 2.53 | 3.01 | 3.96 | 5.60  |
|                |                 | 30                                                                                              | 50  | 9.56  | 5.47  | 3.83 | 2.93 | 2.44 | 2.19 | 2.10 | 2.17 | 2.42 | 2.90 | 3.79 | 5.38  |
|                |                 | 20                                                                                              | 56  | 9.37  | 5.38  | 3.77 | 2.89 | 2.39 | 2.15 | 2.07 | 2.14 | 2.38 | 2.86 | 3.74 | 5.31  |
|                |                 | 10                                                                                              | 61  | 9.21  | 5.31  | 3.72 | 2.84 | 2.34 | 2.10 | 2.02 | 2.09 | 2.33 | 2.81 | 3.69 | 5.21  |
| FORWARD CAMERA | SSN 011 OSN 35A | 80                                                                                              | 8   | 25.72 | 12.84 | 8.87 | 6.83 | 5.51 | 4.76 | 4.38 | 4.76 | 5.44 | 6.70 | 8.81 | 20.70 |
|                |                 | 75                                                                                              | 13  | 16.05 | 9.14  | 6.33 | 4.85 | 4.00 | 3.53 | 3.30 | 3.52 | 3.97 | 4.82 | 6.29 | 8.57  |
|                |                 | 70                                                                                              | 18  | 13.71 | 7.86  | 5.41 | 4.19 | 3.51 | 3.10 | 2.93 | 3.10 | 3.47 | 4.18 | 5.46 | 7.46  |
|                |                 | 65                                                                                              | 23  | 12.29 | 7.03  | 4.90 | 3.79 | 3.17 | 2.84 | 2.71 | 2.85 | 3.18 | 3.81 | 4.95 | 6.85  |
|                |                 | 60                                                                                              | 27  | 11.33 | 6.55  | 4.55 | 3.52 | 2.96 | 2.66 | 2.53 | 2.66 | 2.97 | 3.57 | 4.61 | 6.40  |
|                |                 | 50                                                                                              | 35  | 10.22 | 5.93  | 4.18 | 3.26 | 2.74 | 2.46 | 2.36 | 2.47 | 2.75 | 3.29 | 4.21 | 5.84  |
|                |                 | 40                                                                                              | 43  | 9.57  | 5.53  | 3.92 | 3.03 | 2.54 | 2.29 | 2.20 | 2.30 | 2.55 | 3.06 | 4.00 | 5.48  |
|                |                 | 30                                                                                              | 50  | 9.21  | 5.31  | 3.77 | 2.89 | 2.43 | 2.19 | 2.10 | 2.19 | 2.45 | 2.92 | 3.82 | 5.27  |
|                |                 | 20                                                                                              | 56  | 9.06  | 5.23  | 3.70 | 2.85 | 2.40 | 2.15 | 2.07 | 2.16 | 2.41 | 2.88 | 3.75 | 5.21  |
|                |                 | 10                                                                                              | 61  | 8.91  | 5.16  | 3.65 | 2.80 | 2.35 | 2.10 | 2.02 | 2.09 | 2.33 | 2.81 | 3.69 | 5.16  |

PARAMETERS ASSOCIATED WITH THE LAST ENTRY IN THE RIGHT HAND COLUMN OF THE TABLE

| TARGET   | REFLECTANCE | TARGET | HAZE | SOLAR | DATE           | RDOH    | INERTIAL | SATELLITE | SAT    | OBLATE | SATELLITE | VXDH   | VYDH           |
|----------|-------------|--------|------|-------|----------------|---------|----------|-----------|--------|--------|-----------|--------|----------------|
| LATITUDE | HIGH        | SUN    | COND | AZI-  | D M Y          |         | VELOCITY | LAT       | LONG   | ALT    | TO EARTH  |        |                |
| D M S    |             | TYPE   |      | NUTH  | A O R          |         | (FT/SEC) | (DEGREES) |        | (NM)   | RADIUS    |        |                |
| 19 39 33 | 33          | 7      | 1    | 4     | 129.77 17 3 74 | 0.00015 | 25700.78 | 20.1422   | 29.060 | 89.1   | + 3442.6  | 3531.6 | 0.0460 0.00263 |

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BYE 15250-74

Handle via Byeman  
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FLIGHT READINESS REPORT  
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TABLE 6-5

MISSION 1208 CRYSPER VEM PREDICTIONS OF TWO SIGMA LOW RESOLUTION  
FOR WORSE CASE PHOTOGRAPHY FOR 2:1 APPARENT CONTRAST OBJECTS

— 8 MICRONS DEFOCUS, .05 IPS FILM SYNCHRONIZATION ERROR —

(lines/mm and feet)

| TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN LINES/MM) FOR VARIOUS SUN AND SCAN ANGLES |                 |                   |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------------------------------------------------------------------------------------------------|-----------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                                                                                                     |                 | Q CENTER 120 SCAN |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                                                                                                     |                 | SCAN              | -60 | -50 | -40 | -30 | -20 | -10 | 0   | 10  | 20  | 30  | 40  | 50  | 60  |
|                                                                                                     |                 | LAT SUN           |     |     |     |     |     |     |     |     |     |     |     |     |     |
| AFT CAMERA                                                                                          | SSN 011 OSN 378 | 80 8              | 70  | 78  | 85  | 87  | 92  | 96  | 97  | 95  | 91  | 86  | 82  | 79  | 75  |
|                                                                                                     |                 | 75 13             | 91  | 99  | 107 | 111 | 116 | 120 | 122 | 119 | 116 | 111 | 106 | 101 | 98  |
|                                                                                                     |                 | 70 18             | 101 | 107 | 116 | 120 | 126 | 130 | 132 | 130 | 127 | 122 | 116 | 111 | 106 |
|                                                                                                     |                 | 65 23             | 106 | 115 | 122 | 127 | 132 | 136 | 138 | 136 | 133 | 128 | 123 | 116 | 110 |
|                                                                                                     |                 | 60 27             | 110 | 118 | 126 | 131 | 136 | 141 | 144 | 142 | 138 | 132 | 127 | 120 | 114 |
|                                                                                                     |                 | 50 35             | 113 | 123 | 130 | 135 | 143 | 147 | 149 | 148 | 144 | 137 | 131 | 124 | 117 |
|                                                                                                     |                 | 40 43             | 117 | 126 | 134 | 141 | 147 | 151 | 153 | 151 | 148 | 142 | 136 | 127 | 120 |
|                                                                                                     |                 | 30 50             | 119 | 128 | 135 | 144 | 150 | 153 | 155 | 154 | 150 | 144 | 138 | 129 | 121 |
|                                                                                                     |                 | 20 56             | 120 | 129 | 138 | 145 | 151 | 154 | 156 | 155 | 151 | 145 | 138 | 131 | 122 |
|                                                                                                     |                 | 80 8              | 62  | 72  | 75  | 79  | 86  | 91  | 96  | 91  | 86  | 81  | 76  | 78  | 75  |
| FORWARD CAMERA                                                                                      | SSN 011 OSN 35A | 75 13             | 92  | 96  | 101 | 106 | 111 | 116 | 120 | 116 | 111 | 106 | 101 | 102 | 100 |
|                                                                                                     |                 | 70 18             | 102 | 107 | 114 | 119 | 122 | 127 | 131 | 127 | 123 | 118 | 112 | 113 | 110 |
|                                                                                                     |                 | 65 23             | 110 | 117 | 121 | 125 | 130 | 134 | 139 | 135 | 130 | 125 | 119 | 119 | 115 |
|                                                                                                     |                 | 60 27             | 114 | 121 | 126 | 131 | 135 | 141 | 143 | 140 | 136 | 129 | 124 | 127 | 119 |
|                                                                                                     |                 | 50 35             | 120 | 126 | 132 | 137 | 143 | 146 | 148 | 146 | 141 | 136 | 129 | 127 | 122 |
|                                                                                                     |                 | 40 43             | 123 | 129 | 136 | 143 | 147 | 151 | 153 | 151 | 147 | 141 | 135 | 130 | 124 |
|                                                                                                     |                 | 30 50             | 124 | 132 | 140 | 146 | 151 | 155 | 156 | 154 | 150 | 143 | 137 | 132 | 125 |
|                                                                                                     |                 | 20 56             | 125 | 133 | 141 | 147 | 152 | 156 | 157 | 155 | 151 | 145 | 138 | 134 | 125 |
|                                                                                                     |                 | 80 8              | 62  | 72  | 75  | 79  | 86  | 91  | 96  | 91  | 86  | 81  | 76  | 78  | 75  |
|                                                                                                     |                 | 75 13             | 92  | 96  | 101 | 106 | 111 | 116 | 120 | 116 | 111 | 106 | 101 | 102 | 100 |

|                |                 | TYPICAL RESOLUTION OBTAINABLE FROM EACH CAMERA SYSTEM (IN FEET) FOR VARIOUS SUN AND SCAN ANGLES |       |       |      |      |      |      |      |      |      |      |      |       |       |
|----------------|-----------------|-------------------------------------------------------------------------------------------------|-------|-------|------|------|------|------|------|------|------|------|------|-------|-------|
|                |                 | SCAN                                                                                            | -60   | -50   | -40  | -30  | -20  | -10  | 0    | 10   | 20   | 30   | 40   | 50    | 60    |
|                |                 | LAT SUN                                                                                         |       |       |      |      |      |      |      |      |      |      |      |       |       |
| AFT CAMERA     | SSN 011 OSN 378 | 80 8                                                                                            | 19.45 | 11.11 | 7.63 | 6.10 | 5.03 | 4.48 | 4.32 | 4.54 | 5.11 | 6.12 | 7.88 | 11.12 | 18.74 |
|                |                 | 75 13                                                                                           | 14.53 | 8.59  | 5.88 | 4.68 | 3.91 | 3.51 | 3.38 | 3.53 | 3.93 | 4.65 | 5.93 | 8.39  | 13.65 |
|                |                 | 70 18                                                                                           | 12.01 | 7.72  | 5.34 | 4.22 | 3.53 | 3.10 | 3.05 | 3.18 | 3.52 | 4.17 | 5.32 | 7.47  | 12.34 |
|                |                 | 65 23                                                                                           | 11.93 | 7.10  | 4.98 | 3.93 | 3.30 | 2.98 | 2.86 | 2.98 | 3.29 | 3.88 | 4.95 | 7.00  | 11.57 |
|                |                 | 60 27                                                                                           | 11.32 | 6.74  | 4.73 | 3.74 | 3.15 | 2.82 | 2.70 | 2.81 | 3.10 | 3.70 | 4.71 | 6.65  | 10.92 |
|                |                 | 50 35                                                                                           | 10.56 | 6.25  | 4.42 | 3.49 | 2.91 | 2.63 | 2.52 | 2.61 | 2.89 | 3.46 | 4.41 | 6.20  | 10.27 |
|                |                 | 40 43                                                                                           | 9.92  | 5.94  | 4.21 | 3.28 | 2.76 | 2.50 | 2.40 | 2.49 | 2.74 | 3.25 | 4.15 | 5.91  | 9.77  |
|                |                 | 30 50                                                                                           | 9.62  | 5.77  | 4.09 | 3.17 | 2.67 | 2.42 | 2.34 | 2.42 | 2.66 | 3.15 | 4.03 | 5.74  | 9.44  |
|                |                 | 20 56                                                                                           | 9.53  | 5.73  | 4.01 | 3.14 | 2.65 | 2.41 | 2.33 | 2.40 | 2.65 | 3.13 | 4.00 | 5.63  | 9.42  |
|                |                 | 80 8                                                                                            | 21.78 | 12.02 | 8.59 | 6.65 | 5.42 | 4.73 | 4.36 | 4.73 | 5.38 | 6.55 | 8.51 | 11.19 | 18.23 |
| FORWARD CAMERA | SSN 011 OSN 35A | 75 13                                                                                           | 14.48 | 8.84  | 6.26 | 4.89 | 4.08 | 3.63 | 3.42 | 3.63 | 4.08 | 4.88 | 6.26 | 8.33  | 13.33 |
|                |                 | 70 18                                                                                           | 12.71 | 7.73  | 5.44 | 4.29 | 3.63 | 3.26 | 3.08 | 3.25 | 3.62 | 4.31 | 5.55 | 7.34  | 11.87 |
|                |                 | 65 23                                                                                           | 11.56 | 6.97  | 5.00 | 3.97 | 3.35 | 3.02 | 2.85 | 2.99 | 3.36 | 3.99 | 5.10 | 6.85  | 11.09 |
|                |                 | 60 27                                                                                           | 10.89 | 6.58  | 4.74 | 3.73 | 3.17 | 2.83 | 2.72 | 2.83 | 3.16 | 3.78 | 4.82 | 6.52  | 10.45 |
|                |                 | 50 35                                                                                           | 9.97  | 6.12  | 4.36 | 3.44 | 2.90 | 2.64 | 2.54 | 2.65 | 2.94 | 3.47 | 4.47 | 6.08  | 9.83  |
|                |                 | 40 43                                                                                           | 9.52  | 5.80  | 4.13 | 3.22 | 2.75 | 2.49 | 2.39 | 2.50 | 2.76 | 3.28 | 4.18 | 5.79  | 9.42  |
|                |                 | 30 50                                                                                           | 9.27  | 5.62  | 3.95 | 3.13 | 2.65 | 2.40 | 2.32 | 2.41 | 2.67 | 3.17 | 4.04 | 5.63  | 9.20  |
|                |                 | 20 56                                                                                           | 9.20  | 5.57  | 3.91 | 3.10 | 2.62 | 2.38 | 2.31 | 2.40 | 2.65 | 3.14 | 4.00 | 5.51  | 9.15  |
|                |                 | 80 8                                                                                            | 21.78 | 12.02 | 8.59 | 6.65 | 5.42 | 4.73 | 4.36 | 4.73 | 5.38 | 6.55 | 8.51 | 11.19 | 18.23 |
|                |                 | 75 13                                                                                           | 14.48 | 8.84  | 6.26 | 4.89 | 4.08 | 3.63 | 3.42 | 3.63 | 4.08 | 4.88 | 6.26 | 8.33  | 13.33 |

PARAMETERS ASSOCIATED WITH THE LAST ENTRY IN THE RIGHT HAND COLUMN OF THE TABLE

| TARGET   | REFLECTANCE | TARGET | HAZE | SOLAR | DATE      | RDOH  | INERTIAL | SATELLITE | SAT     | OBLATE | SATELLITE | VXOH       | VYOH                  |
|----------|-------------|--------|------|-------|-----------|-------|----------|-----------|---------|--------|-----------|------------|-----------------------|
| LATITUDE | HIGH        | LOW    | SUN  | COND  | AZE       | D M Y | VELOCITY | LAT       | LONG    | ALT    | EARTH     | IN EARTH   |                       |
| O M S    |             |        | TYPE |       | MUTH      | A O R | (FT/SEC) | (DEGREES) |         | (NM)   | RADIUS    | CENTER(NM) |                       |
| 19 39 33 | 33          | 7      | 1    | 4     | 129.77 17 | 3 74  | 0.00015  | 25700.78  | 20.1422 | 29.060 | 89.1      | 3442.8     | 3591.6 0.0460 0.00263 |

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~~TOP SECRET-HEXAGON~~

FLIGHT READINESS REPORT  
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## SECTION VII

## ELECTROMECHANICAL ANALYSIS

## 7.1 INTRODUCTION

The electromechanical (EM) evaluation reported in this section was derived from telemetry data from the tests run at the West Coast Facility using MACFACT, GOTCHA, Strip Charts, CALCOMP Plots, and other evaluation techniques.

## 7.2 SCAN MODE, SCAN SECTOR PLACEMENT, AND SHUTTER OPERATION

The capability to operate at various scan angles and scan centers is demonstrated by the testing at WCFO. The contractor's evaluation indicates that the system meets the specified requirements, with the following exceptions:

A. The platen position modulation command is incorrect for the first frame for certain scan angle/scan center combinations. This is due to a late PSW-Not signal from the SCC box. The PSW-Not signal will normally occur at 69.5° (Forward OB) once the Forward/Aft enable signal has been generated by the SCC. However, for the first frame the signal occurs in conjunction with the first Forward transition point. Depending on the selected scan angle and scan center, the transition points may occur after 69.5°, delaying generation of the PSW-Not signal. Table 7-1 lists the scan modes affected.

TABLE 7-1

## SCAN MODES AFFECTED BY LATE PSW-NOT SIGNAL

| Scan Center<br>(degrees) | Scan Angle (degrees) |         |    |     |
|--------------------------|----------------------|---------|----|-----|
|                          | 30                   | 60      | 90 | 120 |
| -45                      | Aft                  |         |    |     |
| -30                      | Aft                  | Aft     |    |     |
| -15                      | Aft                  | Aft     | -  |     |
| 0                        | -                    | -       | -  | -   |
| 15                       | Forward              | Forward | -  |     |
| 30                       | Forward              | Forward |    |     |
| 45                       | Forward              |         |    |     |

NOTE: Dashes denote scan modes not affected.

B. The first frame of operation on both cameras has an early opening and closing (6° to 10°) of the shutter. This operation is a characteristic of the design.

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### 7.3 START/STOP TIMES

The start/stop times for SV-8 were evaluated from the data in Sequences V and W of the Chamber A-2 vacuum test. Table 7-2 summarizes the results of the start/stop time evaluation.

TABLE 7-2

## START/STOP TIMES

(seconds)

| Parameter               | Seq V (Vx/h of .0519) |          | Seq W (Vx/h of .0442) |          | Seq 12-2<br>(Vx/h of .0278) |
|-------------------------|-----------------------|----------|-----------------------|----------|-----------------------------|
|                         | Nominal               | Measured | Nominal               | Measured | Measured                    |
| TOBACC                  | 11.53                 | 11.51    | 9.82                  | 9.88     | -                           |
| TFSU                    | 10.95                 | 10.74    | 9.33                  | 9.31     | -                           |
| TBC                     | 0.26                  | 0.28     | 0.31                  | 0.31     | -                           |
| T 1 + T 2 (VI Enabled)  | -                     | 1.42     | -                     | 1.28     | -                           |
| T 1 + T 2 (VI Disabled) | -                     | -        | -                     | -        | .85                         |
| T3                      | -                     | 0.62     | -                     | 0.58     | -                           |
| 2RWV/A                  | 2.18                  | 2.09     | 2.18                  | 2.07     | -                           |
| T 1-0                   | -                     | 6.18     | -                     | 7.23     | -                           |
| T 2-1                   | -                     | 8.58     | -                     | 10.19    | -                           |
| T 3-2                   | 10.42                 | 10.39    | 8.71                  | 8.62     | -                           |
| T 4-3                   | 10.42                 | 9.88     | 6.86                  | 6.32     | -                           |
| T 5-4                   | 0.56                  | 0.34     | 0.56                  | 0.34     | -                           |

- NOTES: 1. TOBACC is the time for the OB velocity command to go from 0 to final run value.
2. TFSU is the time for the SU velocity command to go from 0 to final run value.
3. TBC is the time from metering capstan (MC) tachometer transition start to first shutter open on the Forward Camera. The values shown have been increased by .03 seconds to account for the early shutter open on the first frame.
4. T 1 is the delay between OBs on-command and OB velocity tach start.
5. Note: Before determining T 2, verify that the OBs have reached constant velocity prior to FTs on. T 2 is the delay between film transports (FTs) on-command and SU velocity is commanded to start.
6. T 3 is the time from constant SU velocity command to MC transition. There is no clear cut nominal value for T 1, T 2, or T 3. The sum of T 1 and T 2 should be used as a guide for setting TDELTA OB and TDELTA FT in the TUNITY data base. Note: These times for T 1 and T 2 are calculated with Verification Interlock Enable. Another set of values for T 1 and T 2 are required with the Verification Interlock Disabled.

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## FLIGHT READINESS REPORT

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7. 2RWV/A is the duration of the rewind as indicated by the SU velocity command.
8. T 1-0 is the time from FTs off-command until the SU velocity command begins its ramp down.  
Nominal values are not obtainable.
9. T 2-1 is the time from OB off-command until OB velocity tach begins its ramp-down.  
Nominal values are not obtainable.
10. T 3-2 is the duration of the OB velocity tach ramp-down to 18 degrees per second.
11. T 4-3 is the time the OBs remain at 18 degrees per second.
12. T 5-4 is the time from end of 18 degrees per second until the OBs have stopped.

## 7.4 SLIT WIDTH

Table 7-3 summarizes the values extracted from slit width calibration. All measured values are within specification limits.

TABLE 7-3

## SLIT WIDTH DATA

(inches)

| Forward Camera |                      |                     | Aft Camera           |                     |
|----------------|----------------------|---------------------|----------------------|---------------------|
| Command        | Telemetry<br>Reading | Film<br>Measurement | Telemetry<br>Reading | Film<br>Measurement |
| .080           | .080                 | .080                | .080                 | .080                |
| .150           | .150                 | .150                | .150                 | .150                |
| .281           | .280                 | .280                | .277                 | .276                |
| .525           | .522                 | .528                | .522                 | .525                |
| .910           | .901                 | .905                | .901                 | .900                |
| .525           | .527                 | .535                | .527                 | .530                |
| .281           | .280                 | .280                | .280                 | .280                |
| .150           | .147                 | .150                | .149                 | .150                |
| .080           | .080                 | .080                | .080                 | .080                |

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BYE 15250-74

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FLIGHT READINESS REPORT  
SV-8 (SN-011)

7.5 LATERAL SEPARATION FOCUS SENSOR (LSFS)

The LSFS calibration curves for Mission 1208 are shown in Figures 7-1 and 7-2. The ground test curves, which are the basis for the flight calibration, are also shown. This data was obtained from Seq 5 of the Chamber A-1 test at a  $V_x/h$  of .044, 62° F with IMC enabled. The companion curves showing LSFS bias as a function of temperature based on the Chamber A tests are shown in Figure 7-3. The bias curves are referenced to zero at 62° F, which corresponds to the calibration temperature.

The orbital calibration curves reflect a predicted gravity release of 10 microns for the Forward and 14 microns for the Aft Camera.

The slopes of the calibration curves at the plane of best focus (PBF) are approximately 2.52 microns/count for the Forward Camera and 2.06 microns/count for the Aft.

7.6 OPTICAL BAR ANGULAR VELOCITY SCALING TO  $V_x/h$

The optical bar velocity has been consistently within the required  $\pm 1\%$  of the commanded velocity in tests run at the WCFO Facility.

Table 7-4 is a tabulation of optical bar velocity scaling data obtained from tests conducted in Chamber A-2. The data shows max/min percentage velocity errors (measured versus commanded) calculated from 0-180° pulses.

TABLE 7-4  
CHAMBER A-2 OPTICAL BAR VELOCITY SCALING  
DATA CALCULATED FROM 0° - 180° PULSES  
(percent)

| Sequence | $V_x/h$<br>(radians/second) | Forward Optical Bar |         | Aft Optical Bar |         |
|----------|-----------------------------|---------------------|---------|-----------------|---------|
|          |                             | Maximum             | Minimum | Maximum         | Minimum |
| F        | .036                        | .334                | .286    | .334            | .286    |
| Q        | .036                        | .334                | .286    | .334            | .286    |
| L        | .044                        | .369                | .297    | .369            | .297    |
| W        | .044                        | .369                | .297    | .369            | .297    |
| H        | .052                        | .344                | .243    | .344            | .243    |
| V        | .052                        | .344                | .243    | .344            | .243    |

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## FORWARD CAMERA LSFS CALIBRATION CURVES

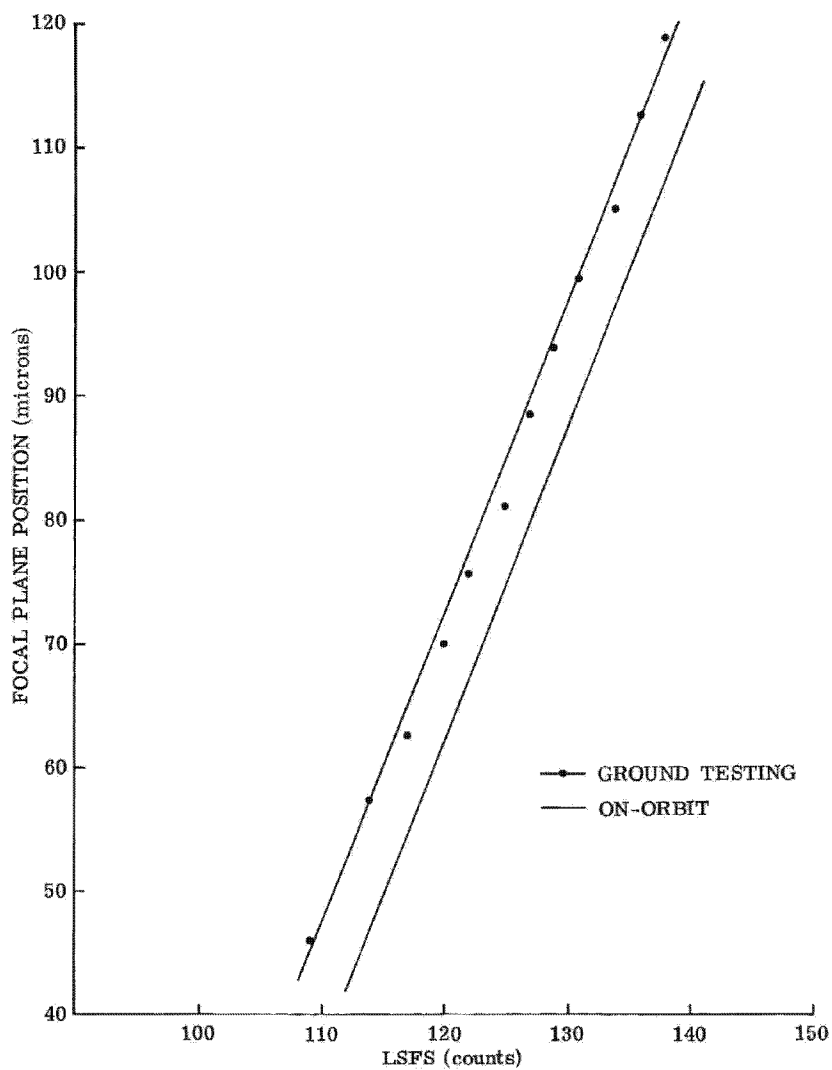


FIGURE 7-1

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## AFT CAMERA LSFS CALIBRATION CURVE

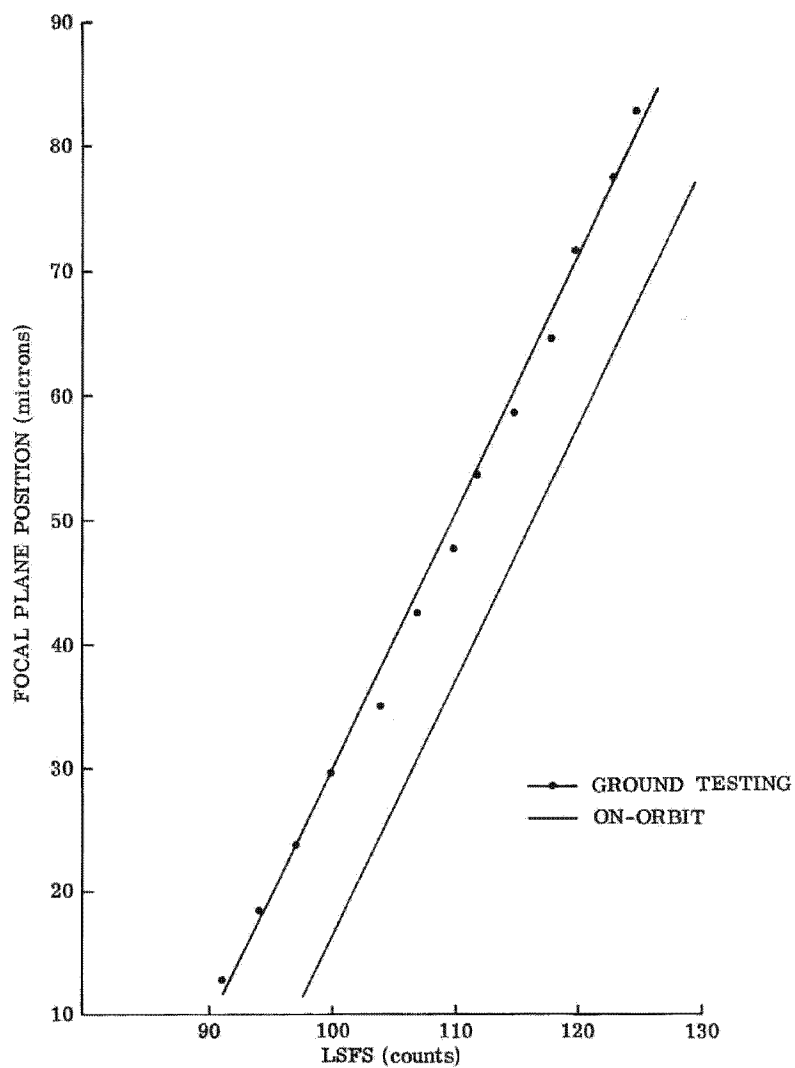


FIGURE 7-2

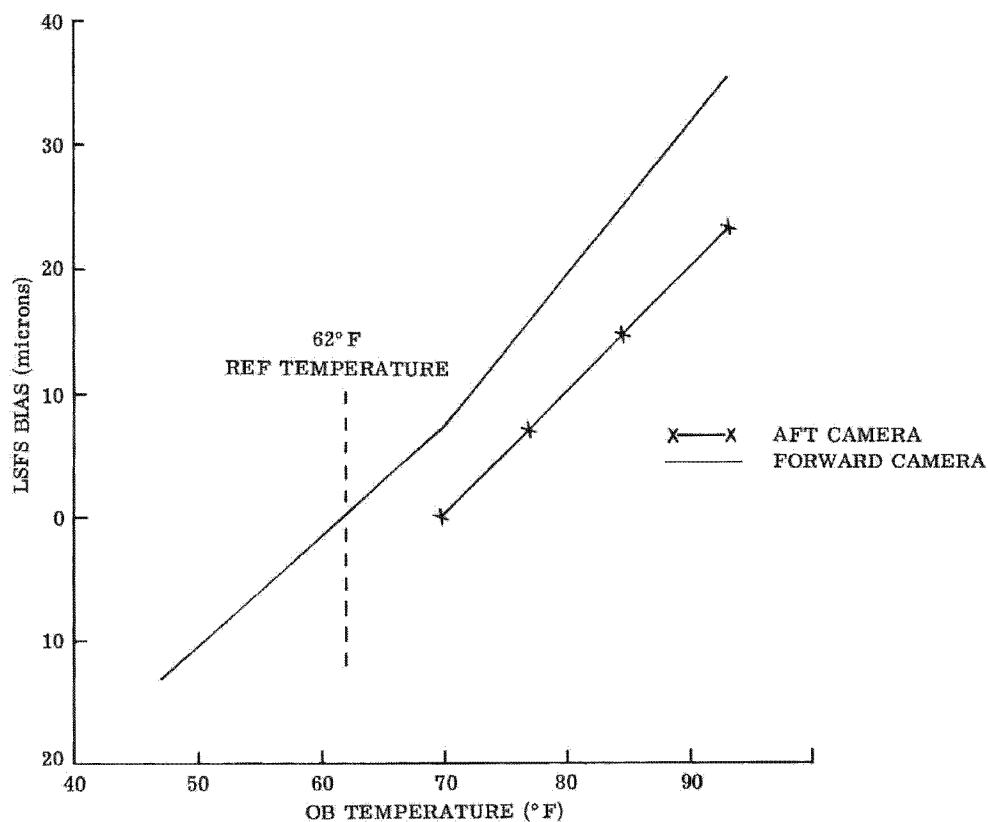
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## LSFS TEMPERATURE BIAS PROFILE



NOTE: FPP is corrected as a function of temperature by algebraically adding the LSFS bias value, at the measured OB temperature, to the 62° F calibration curve.

FIGURE 7-3

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## 7.7 METERING CAPSTAN (MC) TO OPTICAL BAR (OB) SYNCHRONIZATION

The metering capstan summed error (MCSE) signals and film-to-bar synchronization (FBS) signals were used during WCFO testing to assess the expected photographic performance. Table 7-5 on page 7-9 is a tabulation of the mean value and standard deviation of both signals obtained from three in-air Chamber A-2 tests. The FBS signals (P451 and P452) follow the nominal expected profiles reasonably well, except during the settling time.

## 7.8 PLATEN PERFORMANCE

Table 7-6 presents the max, min, mean, and standard deviation for the platen photo mode summed error signal. All values are in arc-seconds using a scale factor of 98.7 arc-seconds per volt.

The data is based on three in-air sequences from Chamber A-2 tests and are representative of the platen servo performance during WCFO testing. All of the recorded values are within the limits of  $\pm 26.9$  arc-seconds.

TABLE 7-6

PLATEN PHOTO SUMMED ERRORS  
(arc-seconds)

| Camera  | Factor  | Seq M | Seq Q | Seq R |
|---------|---------|-------|-------|-------|
| Forward | Maximum | 7.8   | 9.8   | 7.8   |
|         | Minimum | -9.9  | -9.9  | -11.8 |
|         | Mean    | -3.8  | -3.7  | -3.8  |
|         | STDV    | 3.8   | 4.1   | 4.2   |
| Aft     | Maximum | 11.7  | 13.7  | 11.7  |
|         | Minimum | -7.9  | -5.9  | -9.9  |
|         | Mean    | 3.2   | 3.8   | 2.5   |
|         | STDV    | 5.0   | 4.9   | 5.2   |

## 7.9 FINE TENSION SENSOR PERFORMANCE

The differential fine tension sensors have been limit checked by MACFACT at  $\pm .1$  pound for all WCFO testing done on SV-8. The Forward and Aft Camera differential tension always reports 100% within tolerance.

Table 7-7 shows the average, for nine frames, of the differential tension sensor readings across the format on a run with a Vx/h of .044. The readings are derived from the GOTCHA output which displays the maximum tension value for each 15° of format.

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TABLE 7-5

FILM-TO-BAR SYNCHRONIZATION FROM CHAMBER A-2 TEST  
(inch/second)

| Seq | Scan Angle/<br>Scan Center<br>(degrees) | Vx/h<br>(radians/second) | Parameter | Forward Camera |      | Aft Camera |       |
|-----|-----------------------------------------|--------------------------|-----------|----------------|------|------------|-------|
|     |                                         |                          |           | MCSE           | FBS  | MCSE       | FBS   |
| Q   | 90/0                                    | .036                     | Mean      | -.002          | .007 | .001       | .003  |
|     |                                         |                          | STDV      | .014           | .023 | .011       | .018  |
| M   | 90/0                                    | .044                     | Mean      | -.013          | .015 | -.010      | -.002 |
|     |                                         |                          | STDV      | .014           | .038 | .013       | .023  |
| R   | 90/0                                    | .052                     | Mean      | -.028          | .018 | -.025      | .002  |
|     |                                         |                          | STDV      | .016           | .046 | .014       | .030  |

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TABLE 7-7

DIFFERENTIAL TENSION FOR CHAMBER A-2, SEQ M AT  $V_x/h$  OF .044

| Scan Sector<br>(degrees) | Forward Camera (Frames 003-011) | Aft Camera (Frames 003-011) |
|--------------------------|---------------------------------|-----------------------------|
|                          | Maximum<br>(pounds)             | Maximum<br>(pounds)         |
| -60 . . . -45            | -                               | -                           |
| -45 . . . -30            | .064                            | .027                        |
| -30 . . . -15            | .000                            | .007                        |
| -15 . . . 0              | .000                            | .007                        |
| 0 . . . +15              | .000                            | .007                        |
| +15 . . . +30            | .000                            | .007                        |
| +30 . . . +45            | .000                            | .007                        |
| +45 . . . +60            | -                               | -                           |

## 7.10 FRAME LENGTH AND INTERFRAME SPACING

The EM data indicates that the frame lengths and interframe spaces meet the specified requirements. Measurements made on the retrieved film indicated that the frame length and interframe spaces are within specifications.

## 7.11 STEERER PERFORMANCE

SV-8 steerer performance has been satisfactory as indicated by proper tracking during the WCFO test cycle. Rewinds of up to 76 inches/second were demonstrated during Chamber A testing and proper steering was observed throughout all testing phases. Table 7-8 lists the average steerer position values in PCM counts during various runs in vacuum. This data can be compared with flight data to assist in film tracking evaluations.

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TABLE 7-8  
AVERAGE STEERER POSITIONS  
(PCM counts)

| Scan Angle/<br>Scan Center<br>(degrees) | Vx/h<br>(radians/second) | Forward Camera |           | Aft Camera |           |
|-----------------------------------------|--------------------------|----------------|-----------|------------|-----------|
|                                         |                          | Take-up        | Film Path | Take-up    | Film Path |
| 120/0                                   | .052                     | 128            | 130       | 131        | 129       |
| 120/0                                   | .048                     | 128            | 130       | 126        | 122       |
| 120/0                                   | .044                     | 127            | 123       | 129        | 124       |
| 90/-15                                  | .018                     | 125            | 116       | 120        | 120       |
| 90/15                                   | .027                     | 127            | 119       | 125        | 121       |
| 60/-30                                  | .036                     | 130            | 119       | 131        | 121       |
| 60/30                                   | .036                     | 129            | 118       | 130        | 138       |
| 30/-45                                  | .052                     | 125            | 119       | 130        | 121       |
| 30/45                                   | .052                     | 119            | 118       | 131        | 121       |
| 30/-15                                  | .052                     | 120            | 116       | 122        | 131       |
| 30/15                                   | .052                     | 128            | 133       | 121        | 133       |

#### 7.12 METERING CAPSTAN SETTling TIME

The settling time for SV-8 was determined by examining the FBS signal from 10 frames of both cameras from Chamber A-2 Sequences V and W. The results are summarized as follows:

##### A. Seq W (Vx/h of .044)

###### (1) Forward Camera

The film-to-bar error was less than .05 inch/second by shutter open on all frames.

###### (2) Aft Camera

The film-to-bar error was less than .05 inch/second by shutter open on all but one frame.

On that frame, the error was .136 inch/second for one data sample 1.16° after shutter open.

##### B. Seq V (Vx/h of .052)

###### (1) Forward Camera

The film-to-bar error was less than .05 inch/second by shutter open on all but one frame.

On that frame, the error was .053 inch/second for one data sample 1.69° after shutter open.

###### (2) Aft Camera

The film-to-bar error was less than .05 inch/second by shutter open on all frames.

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### 7.13 METERING CAPSTAN FOURIER ANALYSIS

MACFACT results and SSTC strip charts show that the MCSE signal for both cameras contains relatively insignificant resonances throughout the  $V_x/h$  range from .036 to .054 radians/second. Standard deviations and harmonic amplitudes are small in comparison to previous systems. Therefore, Fourier analyses were performed on only one frame for each camera at a typical flight  $V_x/h$  value (.04699). Figure 7-4 shows the MCSE signal and corresponding line spectra. Table 7-9 is a tabulation of spikes versus frequency.

The maximum amplitude spike occurred at approximately 94 Hz for both cameras and was approximately .0039 inch/second. SV-7 had maximum amplitude spikes of approximately .011 inch/second at 120 Hz. Other relatively small spikes occur at approximate multiples of 25 Hz.

TABLE 7-9

#### SPECTRUM CHARACTERISTICS

| Forward Camera<br>(Frame 069) |                         | Aft Camera<br>(Frame 066) |                         |
|-------------------------------|-------------------------|---------------------------|-------------------------|
| Frequency<br>(Hz)             | Amplitude<br>(inch/sec) | Frequency<br>(Hz)         | Amplitude<br>(inch/sec) |
| 24                            | .0014                   | 30                        | .0015                   |
| 58                            | .0013                   | 57                        | .0016                   |
| 80                            | .0019                   | 75                        | .0014                   |
| 94                            | .0039                   | 94                        | .0038                   |
| 146                           | .0010                   | 169                       | .0011                   |

MCRECON was run for five frames on each camera from the same test sequence used for Fourier analysis. Figure 7-5 shows the predicted smear for Frames 069 (Forward) and 066 (Aft). Table 7-10 is a tabulation of mean values and standard deviations for smear ( $\Delta S$ ) and FBS error.

TABLE 7-10

#### MCRECON OUTPUT FOR SMEAR AND FBS ERROR

|                    | $\Delta S$ (microns) |                    | FBS Error (inch/second) |                    |
|--------------------|----------------------|--------------------|-------------------------|--------------------|
|                    | Mean                 | Standard Deviation | Mean                    | Standard Deviation |
| Fr 069 (Fwd)       | -.0020               | 1.455              | .0193                   | .0400              |
| Fr 066 (Aft)       | -.2768               | 1.341              | .0092                   | .0194              |
| Fwd (5 Frames Avg) | .0181                | 1.380              | .0180                   | .0385              |
| Aft (5 Frames Avg) | -.230                | 1.401              | .0083                   | .0191              |

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## HARMONIC CONTENT FROM FOURIER ANALYSIS

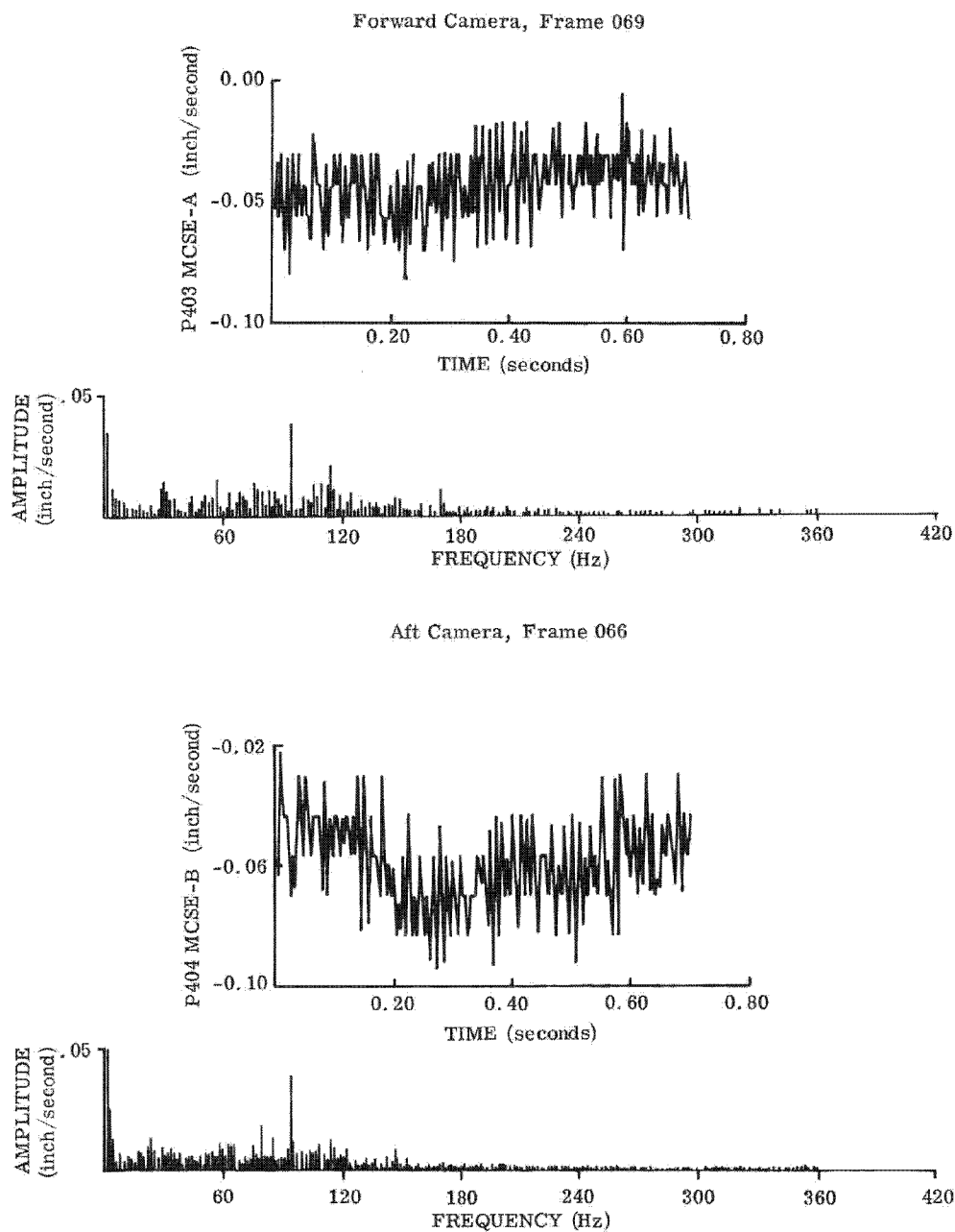


FIGURE 7-4

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BYE 15250-74

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## PREDICTED SMEAR FROM MCRECON PROGRAM

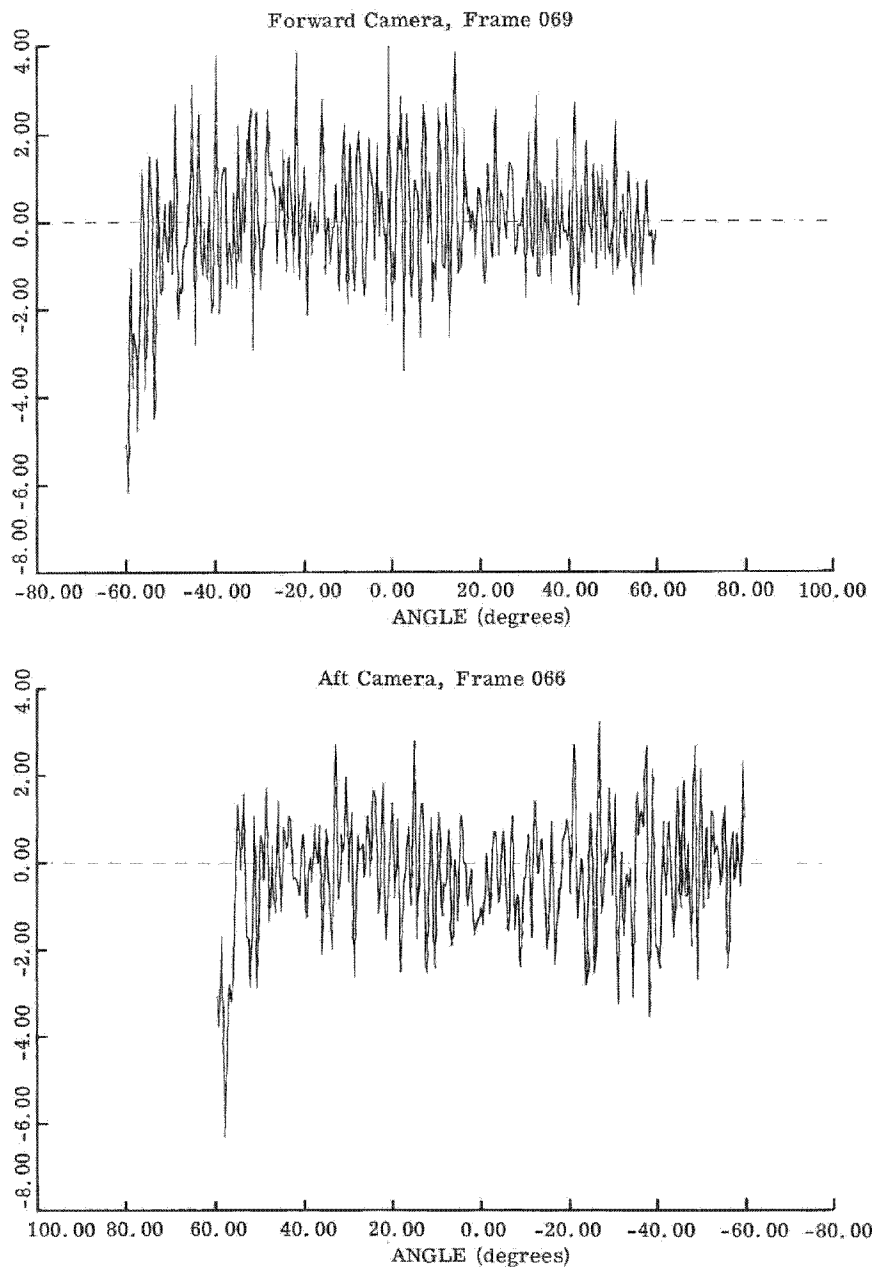


FIGURE 7-5

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## 7.14 AUGIE PERFORMANCE EVALUATION CRITERIA

The metering capstan summed errors, input and output fine tensions, and platen photo summed errors are measurements that are limit checked in AUGIE. The limit check occurs only during the period when the shutter signal indicates open. The algorithm provides the limit check and outputs all telemetry values that have a PCM count magnitude that falls outside the defined limits. The limits are established for each measurement and input to the AUGIE software during the preflight mode generation cycle. The following criteria was used to establish the limits for those performance evaluation parameters listed:

A. Forward Camera Metering Capstan Summed Error (P403)

The mean for P403 was derived from several Chamber A-2 test sequences. One hundred and twelve PCM counts (2.22 volts) was selected as the most representative mean value. The mean shift as the result of changing variables in the test sequence (i.e., scan length,  $V_x/h$ ,  $V_y/h$ , OQAA bias, etc.) was determined to be 2 PCM counts. The mean standard deviation for the representative test sequences was .016 inch/second. This results in a three sigma equivalent to .048 inch/second which converts into 4 PCM counts. Therefore, to set the limits for P403 in the AUGIE the mean shift was added to the three sigma to obtain a 6 PCM count tolerance (.120 volt), see Table 7-11.

B. Aft Camera Metering Capstan Summed Error (P404)

The mean for P404 was determined from the same test sequences used to compute the mean for P403. One hundred and thirteen PCM counts (2.24 volts) was selected as the most representative mean value. The mean shift for P404 as a result of test variables was determined to be 2 PCM counts. The mean standard deviation for the test sequences was .014 inch/second. This results in a three sigma equivalent to .042 inch/second which converts into 4 PCM counts. Therefore, to set the limits for P404 in the AUGIE the mean shift was added to the three sigma to obtain a 6 PCM count tolerance (.120 volt), see Table 7-11.

C. Input and Output Fine Tension (P703, P704, P707, P708)

The reporting limits for the fine tensions were set so that any deviation of more than .104 pound from the 2.5 pound nominal would be reported, see Table 7-11.

D. Platen Photo Summed Error (P411, P412)

The mean was determined to be 126 PCM counts (2.50 volts) for both cameras. The limits in AUGIE were set to the budgeted platen photo summed error tolerance. Test sequences from Chamber A-2 showed that the performance is consistently within 100% using the budgeted tolerance, see Table 7-11.

E. Forward Camera Optical Bar Summed Error (P501)

The Forward Camera OB summed error mean was established from strip chart evaluation of several test sequences. The mean for the Forward Camera was 108 PCM counts (2.14 volts). The

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TABLE 7-11

## AUGIE ON-ORBIT SYSTEM CALIBRATION LOG

| Parameter                        | Camera | Data Nominal |             | Tolerance |                | Nomenclature |
|----------------------------------|--------|--------------|-------------|-----------|----------------|--------------|
|                                  |        | Volts        | Eng Units   | Volts     | Eng Units      |              |
| Metering Capstan<br>Summed Error | Fwd    | 2.22         | 0.0 ips     | .120      | .0800 ips      | P403         |
|                                  | Aft    | 2.24         | 0.0         | .120      | .0800          | P404         |
| Input Fine<br>Tension            | Fwd    | 2.50         | 0.0 lbs     | .280      | .104 lbs       | P703         |
|                                  | Aft    | 2.50         | 0.0         | .280      | .104           | P708         |
| Platen Photo<br>Summed Error     | Fwd    | 2.50         | 0.0 arc-sec | .260      | 25.7 arc-sec   | P411         |
|                                  | Aft    | 2.50         | 0.0         | .260      | 25.7           | P412         |
| Optical Bar<br>Summed Error      | Fwd    | 2.14         | 0.0 rad/sec | 1.00      | .00383 rad/sec | P501         |
|                                  | Aft    | 2.16         | 0.0         | 1.00      | .00383         | P502         |

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tolerance allowed is 50 PCM counts which is large enough to prevent excessive reporting resulting from the effect of chute pressure on the OB summed error. However, 50 PCM counts is significantly tighter than the budgeted tolerance, see Table 7-11.

F. Aft Camera Optical Bar Summed Error

The Aft Camera OB summed error mean was established from strip chart evaluation of several test sequences. The mean for the Aft Camera was 109 PCM counts (2.16 volts). The same tolerance was used as for P501, see Table 7-11.

## 7.15 ON-ORBIT ADJUSTMENT ASSEMBLY (OOAA)

The OOAA calibration tests consisted of Chamber A-2 Sequences V and W. Skew commands of 0, +5, and +15 steps and  $V_f$  commands of 0, +5, 10, and -21 steps were executed in these sequences. The results of these modulation commands are summarized in Figures 7-6 thru 7-9 showing both nominal smear calculated from photographic measurements (FIDAP) and the FBS telemetry indications. This data has been used to adjust the FBS nominals in the computer programs, which are used to evaluate flight FBS performance, to bring them into agreement with FIDAP.

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CHAMBER A-2, FORWARD CAMERA OAAA - FBS CALIBRATION

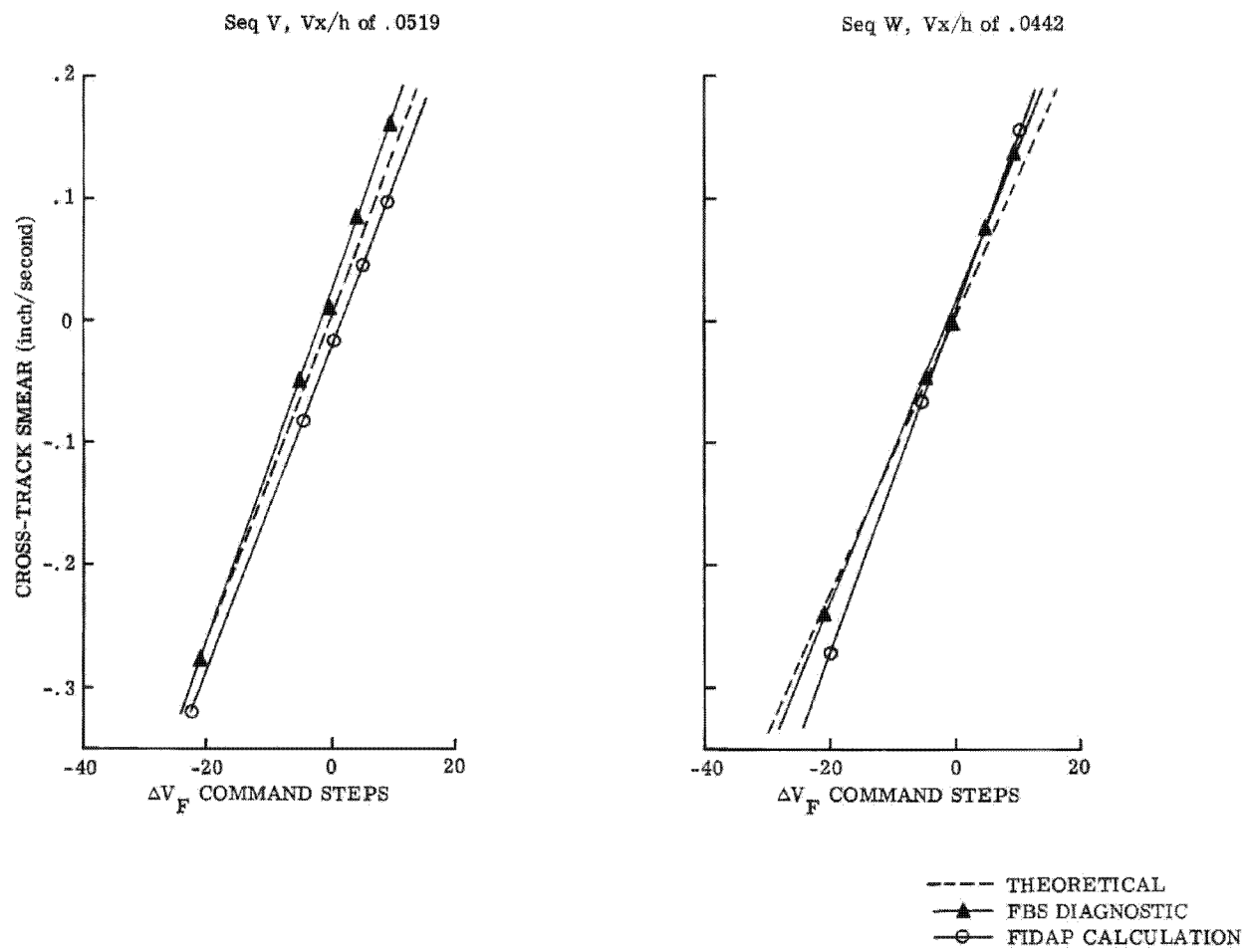


FIGURE 7-6

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CHAMBER A-2, AFT CAMERA OAAA - FBS CALIBRATION

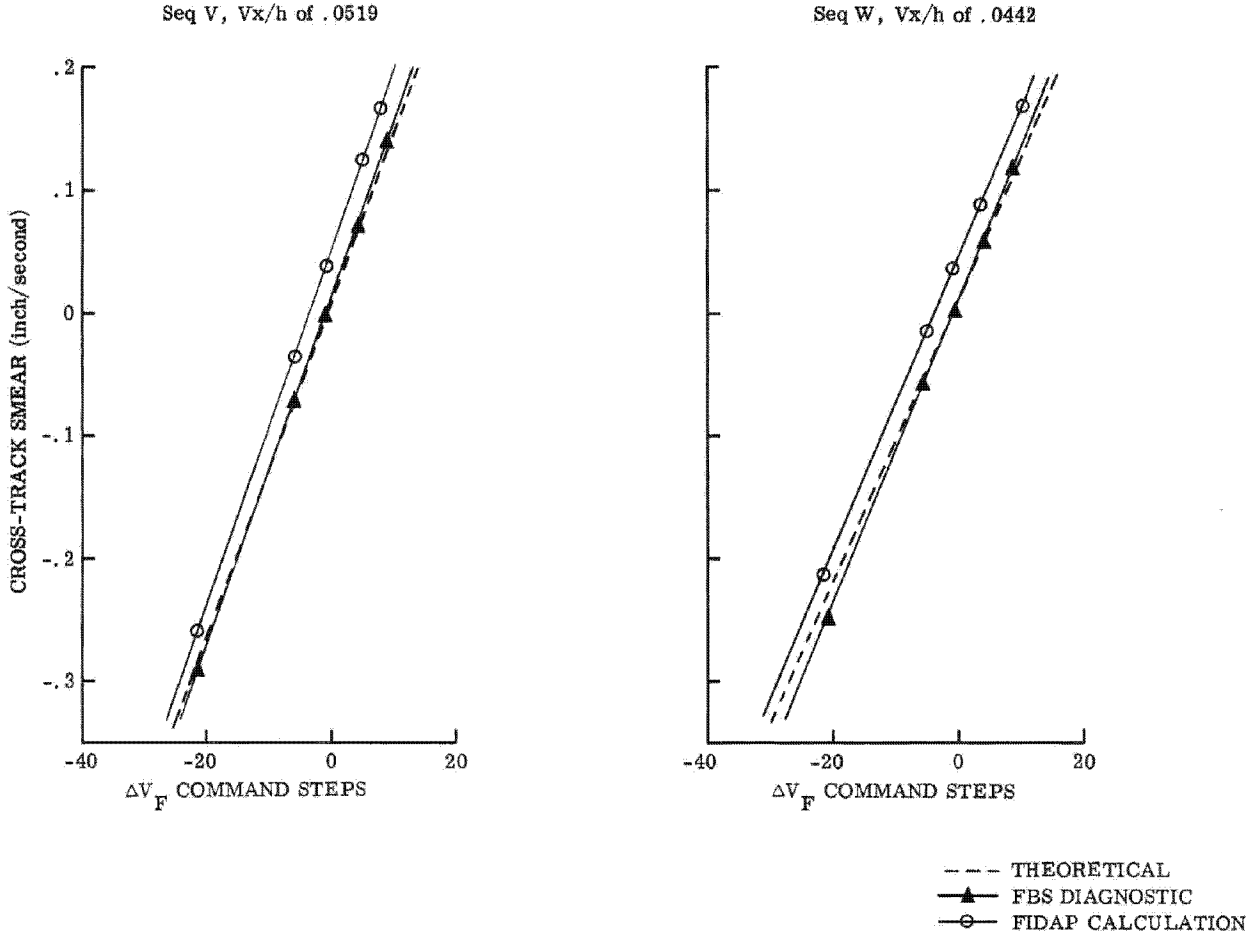


FIGURE 7-7

~~TOP SECRET HEXAGON~~

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FLIGHT READINESS REPORT  
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CHAMBER A-2, AFT CAMERA OAAA - FBS CALIBRATION

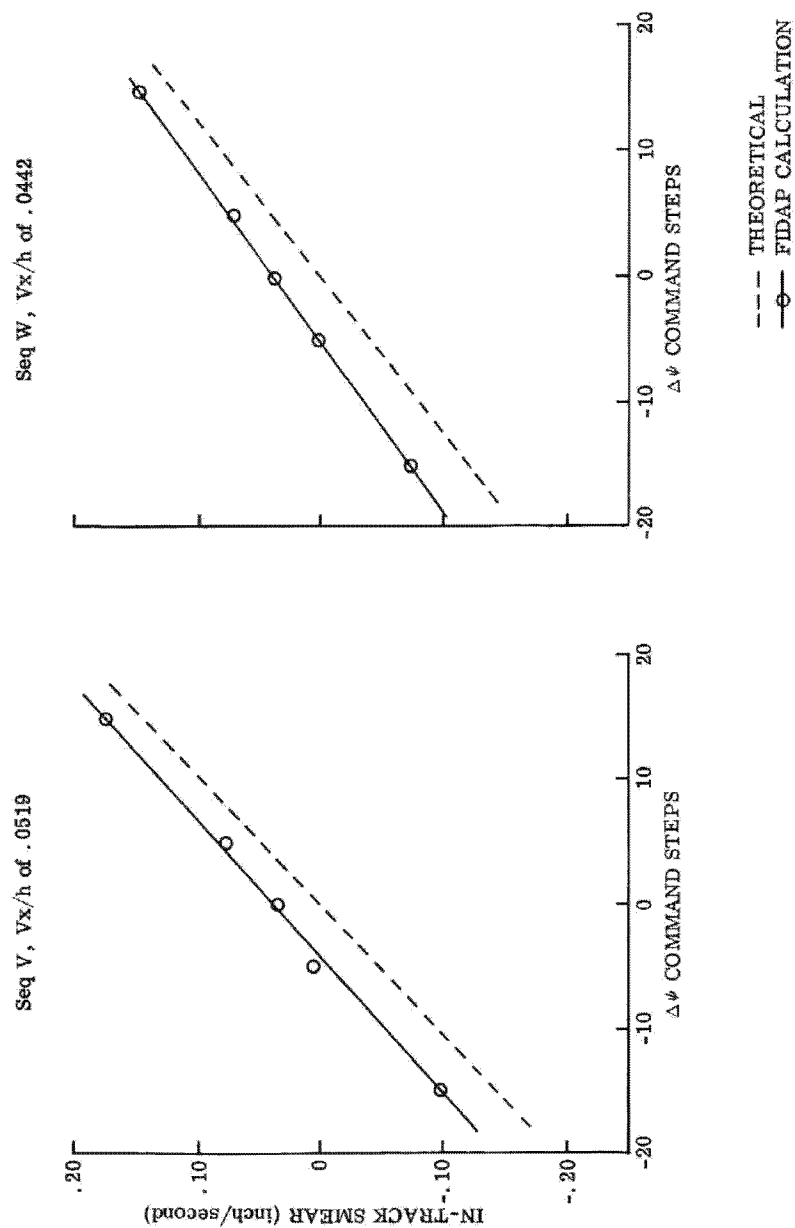


FIGURE 7-8

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FLIGHT READINESS REPORT  
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CHAMBER A-2, FORWARD CAMERA OAAA - FBS CALIBRATION

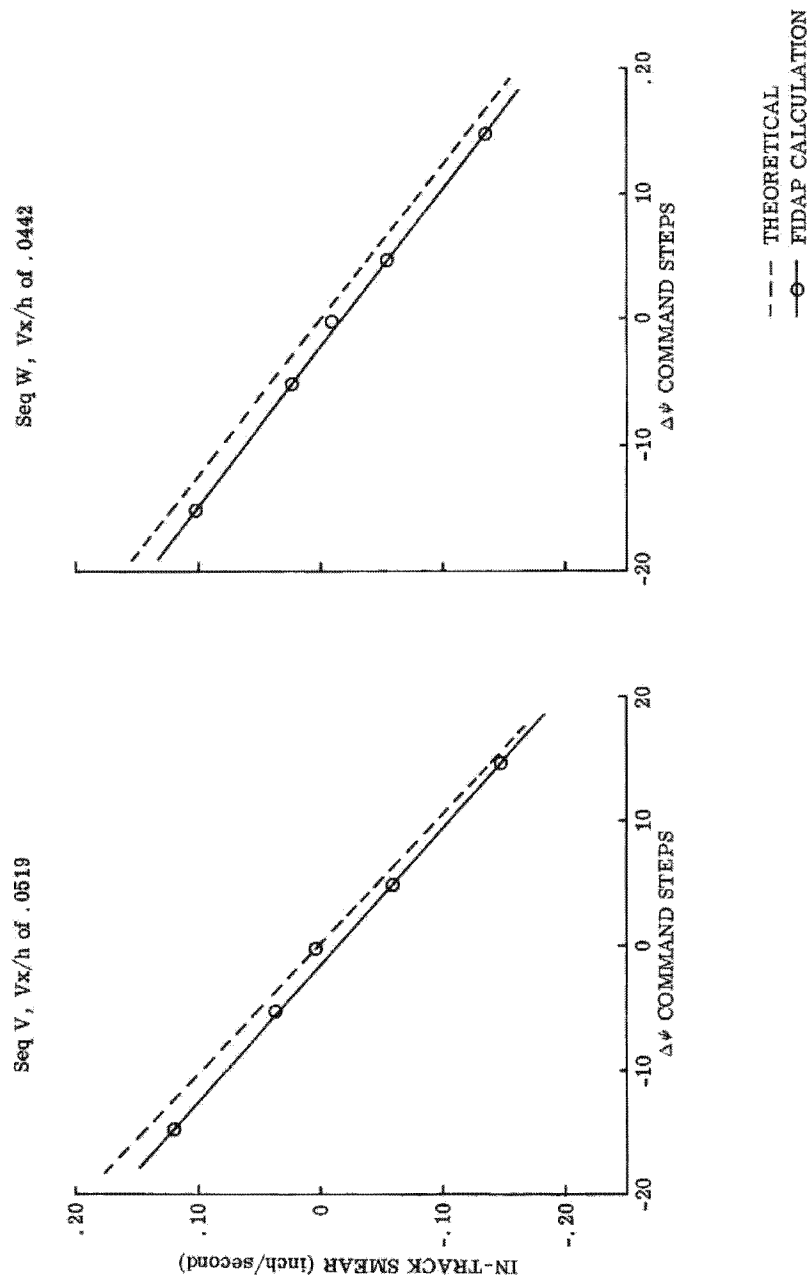


FIGURE 7-9

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## SECTION VIII

## PHYSICAL CHARACTERISTICS

## 8.1 EVALUATION RESULTS

8.1.1 Film Markings

The material was generally clean, with only a few scratches and abrasions being noted. Both the Forward and Aft Camera material exhibited some roller, "air-bar", low density dendritic static, and tarantula-type corona discharge markings. The Aft Camera appeared to be affected by a greater number of tarantula-type corona discharge markings than the Forward. The frequency of occurrence was similar to SV-7. The Forward Camera had relatively few static discharge marks.

8.1.2 Ancillary Data

The format markings including the scan angle, time track, SVT word, and start-of-frame/start-of-operations marks appear bright and well within specified size. The time track marks are of good quality and suitable for film velocity mensuration.

8.1.3 Fine Film Path Tracking

The index dot-to-film edge tracking measurements from the Chamber A-1 material (SO-255 only both cameras), were made on nearly all scan mode/scan center combinations using various Vx/h values. The tests were made utilizing rewind constants which ranged from -5 to -76 inches/second.

The A-1 test runs indicated only minor tracking variations on the Forward Camera. These variations ranged from 2.1mm to 2.3mm from the film edge and had a mean value of 2.2mm. However, the Aft Camera indicated a larger variation in tracking for the various scan modes, and in general tracked somewhat lower than the Forward Camera. Tracking variations ranged from 1.2mm to 2.5mm with a mean of 1.8mm.

Measurements of distances were made from Chamber A-2 material on Frames 001 thru 010 and 101 thru 110. The purpose was to verify whether there were beginning-of-operation tracking disturbances caused by film start-up, see Table 8-1. A comparison of past systems is shown in Table 8-2.

Both cameras indicate consistent tracking during the entire operation, deviating from the average tracking by only .1mm on the Forward Camera and .3mm on the Aft.

Tracking data obtained from the Horizontal Preship Test indicated that the Forward Camera average tracking for SV-8 is identical to SV-7, while the Aft Camera average tracking is somewhat lower than SV-7.

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TABLE 8-1

## FILM TRACKING MEASUREMENTS

(millimeters)

— Forward Camera —

| Frame   | Scan Angle/Scan Center (degrees) |                        |                        |                        |                        |
|---------|----------------------------------|------------------------|------------------------|------------------------|------------------------|
|         | 60/15<br>(Vx/h of .052)          | 90/0<br>(Vx/h of .052) | 90/0<br>(Vx/h of .044) | 30/0<br>(Vx/h of .052) | 30/0<br>(Vx/h of .052) |
| 001     | 2.2                              | 2.1                    | 2.1                    | 2.2                    | 2.2                    |
| 002     | 2.3                              | 2.2                    | 2.0                    | 1.8                    | 2.4                    |
| 003     | 2.2                              | 2.1                    | 1.9                    | 1.9                    | 2.1                    |
| 004     | 2.1                              | 2.0                    | 1.9                    | 2.0                    | 2.0                    |
| 005     | 2.1                              | 2.0                    | 2.0                    | 2.0                    | 2.3                    |
| 006     | 2.2                              | 2.0                    | 2.0                    | 2.0                    | 2.5                    |
| 007     | 2.1                              | 2.0                    | 2.1                    | 2.0                    | 2.5                    |
| 008     | 2.2                              | 2.1                    | 2.0                    | 1.8                    | 2.1                    |
| 009     | 2.2                              | 2.1                    | 1.9                    | 2.0                    | 2.0                    |
| 010     | 2.1                              | 2.1                    | 2.0                    | 2.0                    | 2.0                    |
| 101     | 1.9                              | 2.0                    | 2.0                    | 2.1                    | 1.9                    |
| 102     | 1.9                              | 2.0                    | 2.1                    | 2.0                    | 1.9                    |
| 103     | 1.9                              | 2.0                    | 1.8                    | 2.1                    | 1.9                    |
| 104     | 2.0                              | 2.1                    | 2.1                    | 2.2                    | 2.0                    |
| 105     | 1.9                              | 2.2                    | 2.1                    | 2.0                    | 1.9                    |
| 106     | 1.9                              | 1.9                    | 2.1                    | 2.1                    | 1.9                    |
| 107     | 1.9                              | 1.9                    | 2.0                    | 2.1                    | 2.0                    |
| 108     | 1.9                              | 2.0                    | 2.1                    | 2.0                    | 2.1                    |
| 109     | 1.9                              | 2.0                    | 2.0                    | 2.0                    | 2.1                    |
| 110     | 1.9                              | 1.9                    | 2.0                    | 2.1                    | 2.1                    |
| Average | 2.0                              | 2.0                    | 2.0                    | 2.0                    | 2.1                    |

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8-2

BYE 15250-74  
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FLIGHT READINESS REPORT  
SV-8 (SN-011)

TABLE 8-1 (CONT'D)

— Aft Camera —

| Frame   | Scan Angle/Scan Center (degrees) |                        |                        |                        |                        |
|---------|----------------------------------|------------------------|------------------------|------------------------|------------------------|
|         | 60/-15<br>(Vx/h of .052)         | 90/0<br>(Vx/h of .052) | 90/0<br>(Vx/h of .044) | 30/0<br>(Vx/h of .052) | 30/0<br>(Vx/h of .052) |
| 001     | 2.7                              | 3.0                    | 2.7                    | 3.3                    | 3.2                    |
| 002     | 2.5                              | 2.7                    | 2.8                    | 3.1                    | 2.9                    |
| 003     | 2.7                              | 3.0                    | 2.6                    | 2.9                    | 3.1                    |
| 004     | 2.7                              | 2.9                    | 2.7                    | 3.0                    | 3.4                    |
| 005     | 2.6                              | 3.0                    | 2.7                    | 2.9                    | 3.2                    |
| 006     | 2.7                              | 2.7                    | 2.8                    | 3.0                    | 3.1                    |
| 007     | 2.6                              | 2.8                    | 2.7                    | 3.4                    | 3.2                    |
| 008     | 2.7                              | 3.0                    | 2.7                    | 3.3                    | 3.2                    |
| 009     | 2.8                              | 2.8                    | 2.7                    | 3.0                    | 3.1                    |
| 010     | 2.7                              | 3.0                    | 2.9                    | 3.2                    | 3.1                    |
| 101     | 2.7                              | 2.8                    | 2.7                    | 2.9                    | 2.9                    |
| 102     | 2.7                              | 2.8                    | 2.6                    | 2.7                    | 3.1                    |
| 103     | 2.7                              | 2.9                    | 2.5                    | 2.7                    | 3.1                    |
| 104     | 2.5                              | 3.0                    | 2.7                    | 3.0                    | 3.0                    |
| 105     | 2.7                              | 2.9                    | 2.8                    | 3.0                    | 3.0                    |
| 106     | 2.7                              | 2.8                    | 2.7                    | 3.1                    | 3.0                    |
| 107     | 2.8                              | 2.8                    | 2.7                    | 2.8                    | 3.0                    |
| 108     | 2.6                              | 2.9                    | 2.8                    | 2.9                    | 3.0                    |
| 109     | 2.7                              | 2.8                    | 2.7                    | 3.2                    | 2.9                    |
| 110     | 2.6                              | 2.9                    | 2.6                    | 3.1                    | 2.9                    |
| Average | 2.7                              | 2.9                    | 2.7                    | 3.0                    | 3.0                    |

## 8.2 CONCLUSIONS

A. All the markings (format ancillary data) are of proper size, density, location, and within specifications.

B. Both cameras exhibited minor electrostatic discharge and roller marks.

C. Neither camera shows any tracking problems associated with the start-of-operations.

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TABLE 8-2  
TRACKING COMPARISON OF RECENT SYSTEMS  
AS MEASURED IN THE HORIZONTAL PRESHIP TEST  
(millimeters)

| System         | — Forward Camera —               |       |       |       |       |       |       |       |         |
|----------------|----------------------------------|-------|-------|-------|-------|-------|-------|-------|---------|
|                | Scan Angle/Scan Center (degrees) |       |       |       |       |       |       |       |         |
|                | 30/30                            | 60/15 | 90/15 | 30/30 | 60/15 | 90/15 | 120/0 | 120/0 | Average |
| SV-3           | 2.2                              | 1.9   | 2.0   | 2.6   | 2.0   | 1.9   | 1.8   | 1.9   | 2.0     |
| SV-4           | 3.0                              | 3.1   | 2.0   | 2.6   | 2.8   | 2.0   | 2.8   | 2.0   | 2.5     |
| SV-5           | 2.3                              | 2.3   | 2.5   | 2.4   | 2.4   | 2.4   | 2.6   | 2.5   | 2.4     |
| SV-6           | 1.9                              | 1.7   | 2.6   | 2.1   | 1.7   | 2.5   | 2.8   | 2.8   | 2.2     |
| SV-7           | 2.4                              | 2.4   | N/A   | 1.9   | 2.3   | N/A   | 1.8   | 1.8   | 2.1     |
| SV-8           | NA                               | 2.3   | 2.1   | 2.0   | 2.1   | 2.0   | 2.1   | 2.1   | 2.1     |
| — Aft Camera — |                                  |       |       |       |       |       |       |       |         |
| SV-3           | 3.4                              | 2.0   | 2.8   | 3.0   | 2.8   | 2.4   | 2.2   | 2.4   | 2.6     |
| SV-4           | 3.3                              | 3.1   | 2.6   | 3.0   | 3.1   | 2.6   | 2.8   | 2.8   | 2.9     |
| SV-5           | 1.7                              | 3.0   | 1.2   | 1.7   | 2.7   | 0.9   | 1.6   | 2.0   | 1.9     |
| SV-6           | 2.2                              | 2.1   | 2.1   | 1.9   | 2.0   | 1.9   | 1.5   | 1.5   | 1.9     |
| SV-7           | 2.4                              | 2.4   | N/A   | 2.5   | 2.3   | N/A   | 2.3   | 2.3   | 2.4     |
| SV-8           | NA                               | 2.5   | 2.0   | 2.0   | 2.6   | 2.0   | 2.1   | 2.0   | 2.1     |

NOTE: These measurements are averages of all frames in the sequence as measured from the film edge to the center of the SVT index dots.

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