[redacted]

TOP SECRET [redacted]

[redacted]

#14000 66420

# CORONA J

## PERFORMANCE EVALUATION REPORT

**MISSION 1021-1 and 1021-2**

**FTV 1615; J-21**

**7 January 1966**

[redacted]

Approved: [redacted]
Mgr.
Advanced Projects

Approved: [redacted]
Mgr.



TOP SECRET [redacted]

# FOREWORD

This report details the performance of the payload system during the operational phase of the Program [redacted] Flight Test Vehicle 1615.

Lockheed Missiles and Space Company has the responsibility for evaluating payload performance under the Systems Integration and "J" System contracts.

This document is the final payload test and performance evaluation report for Missions 1021-1 and 1021-2 which was launched on 18 May 1965.

# TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF ILLUSTRATIONS

# INTRODUCTION

This report presents the final performance evaluation of Missions 1021-1 and 1021-2 of the Corona Program. The purpose of this report is to define the performance characteristics of the J-21 payload system, to identify the source of in-flight anomalies and recommend the appropriate corrective action.

The performance evaluation was jointly conducted by representatives of Lockheed Missiles and Space Company (LMSC) and ITEK at the facilities of NPIC and AFSPPL. The off-line evaluation using Corona engineering photography acquired over the United States was performed at the individual contractors plants.

The quantitative data used for this report is obtained from government organizations. The diffuse density data, visual RES values and MTF/AIM resolution are produced by AFSPPL. The vehicle attitude error values, frame correlation times are made at NPIC who also supply the Processing Summary and MTF/AIM resolution reports published by [redacted]

Computer programs developed by A/P are utilized to calculate and plot the frequency distribution of the various contributors to image smear to permit analysis and correlation of the conditions of photography to the information content and quality of the acquired pictures. Computer analysis of the exposure, processing and illumination data provides the necessary data to analyze the exposure criteria selected for the mission.

## SECTION 1

## SYSTEM PERFORMANCE

### A. MISSION OBJECTIVES

The payload section of Mission 1021, placed into orbit by Flight Test Vehicle # 1615 and SLV-2A booster #438, consisted of two panoramic cameras, two Stellar-Index cameras, two Mark 5A recovery capsules and a space structure to enclose the cameras and provide mounting surfaces for all equipments. Figure 1-1 presents an inboard profile of the J-21 payload system. This Corona "J" system was the first to be designed to acquire search, and mapping photography of selected areas of the earth from orbital altitudes. In order to accomplish these multiple objectives, the system was launched in the morning and flown on orbit in a nose first orientation. The planned mission was two, five day photographic periods with no deactive period.

### B. MISSION DESCRIPTION

The payload was launched from Vandenberg Air Force Base (VAFB) at 1802:39 Z (1102:39 PDT) on 18 May 1965. Ascent and injection were normal and the achieved orbit within nominal tolerances. Tracking and command support was effected by the Air Force Satellite Control Facility consisting of tracking and command stations at [redacted] under central control of the Satellite Test Center at Sunnyvale, California. Mission 1021-1 consisted of five days operation and was completed by air recovery on 23 May 1965. Mission 1021-2 also consisted of five days operation, and was completed by air recovery on 28 May 1965.

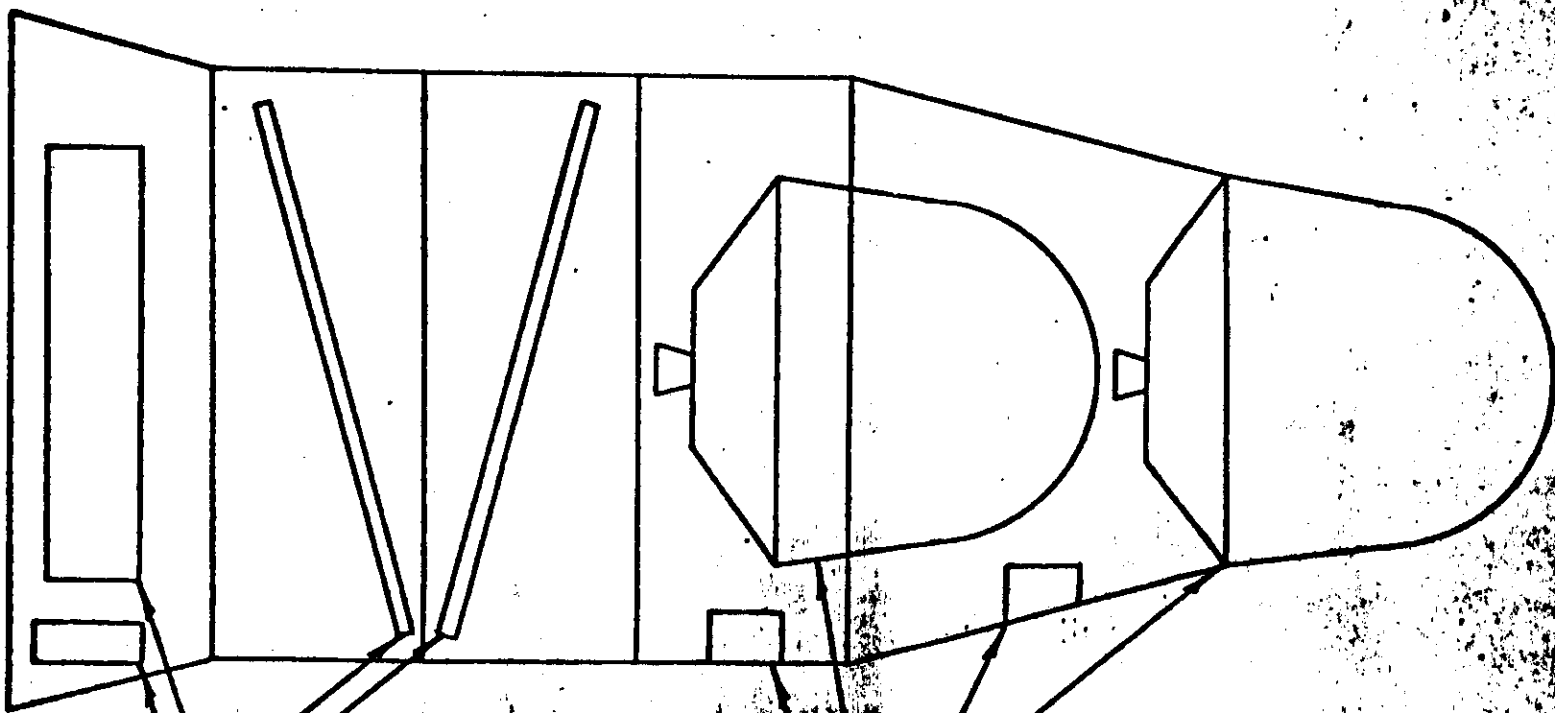
The comparison of the planned and actual orbit parameters is tabulated as follows:

ORBITAL PARAMETERS

| Parameter | Predicted | Actuals (Orbit 40) |
|---|---|---|
| Period (Min.) | 89.87 | 89.81 |
| Perigee (N. M.) | 109.99 | 109.17 |
| Apogee (N. M.) | 182.51 | 180.06 |
| Inclination (Deg.) | 75.00 | 75.02 |
| Perigee Latitude (Deg. N.) | 22.30 | 24.29 |
| Eccentricity | 0.00988 | 0.00988 |

SCHEMATIC INBOARD PROFILE - CORONA J SYSTEM

MISSION 1021



Master Camera No: 166

Slave Camera No: 167

Supply Cassette No: SC-32

Clock No: 529

Yaw Programmer No: N/A

"A" Recovery Subsystem No: 674

"A" Stellar-Index Camera No: D63/69/69

"B" Recovery Subsystem No: 670

"B" Stellar-Index Camera No: D25/27/25

Pressure Make-up Unit No: 1001

FIGURE

## C. PANORAMIC CAMERAS

Both panoramic cameras performed satisfactorily through the first mission. A cut in the supply film caused the master camera to fail on the first operation of the second mission. The slave camera continued to operate satisfactorily through the second mission. The cloud cover and atmospheric haze observed in the photography was nominal.

## D. STELLAR-INDEX CAMERAS

The Stellar/Index camera for the first mission performed normally for 380 frames and then experienced a failure of the film transport function on the last 37 frames. The Mission 1021-2 Stellar/Index camera performed normally throughout the second mission.

## E. OTHER SUB-SYSTEMS

The telemetry and command system performance was satisfactory throughout the flight with one exception; the cycle counters on both panoramic cameras were intermittent.

The clock and the pressure make-up system operated normally throughout both missions. Both recovery units were successfully air-recovered however, the first unit was recovered by means of the secondary capsule programmer.

## F. CONCLUSIONS

Missions 1021-1 and 1021-2 achieved the objectives of acquiring high quality mapping and reconnaissance photography from orbital altitudes. The concept of nose-first orientation and morning launches for mapping objectives has proved feasible.

## G. RECOMMENDATIONS

The evaluation and analysis of the data produced by the mission has resulted in the following recommendations.

1. The splicing techniques and procedures used by the film manufacturer should be reviewed to preclude the re-occurrance of splice associated failures.

2. A film chute should be added to the Corona system between the Slave camera main-plate and the intermediate roller assembly. It does not appear possible to eliminate the camera drum light leak hence a protective chute merits consideration.

3. The slur pulse now presented on the Master camera film to denote Stellar-Index camera operation should also be displayed on the Slave camera film. It is recognized that the pulse would not always be present due to the lack of camera synchronization however this modification would permit partial time correlation of the S/I camera when the Master camera time track is inoperative.

4. The binary data lamps should be adjusted to permit automatic readout at all processing levels. Primary processing has been used to a much greater degree during recent missions.

5. Develop a light leak specification for the ablative shells and investigate measures to preclude existing light leaks.

6. Investigate the abrasion pattern on the Stellar and Index film.

## SECTION 2

## PRE-FLIGHT SYSTEMS TESTS

### A. ENVIRONMENTAL TESTING

1. Test Objective

As a standard procedure, the J payload systems are subject to thermal/altitude environmental testing which simulates orbital environment. One of the purposes of this test is to demonstrate the system susceptability to corona discharge. Such discharge fogs the film thus degrading the operational photography.

2. Test Summary

The J-21 payload system was sent to the TASC chamber on 10 February 1965. Active testing was conducted during the day shift only. The test procedure was prepared to simulate an entire flight, including: The "A" bucket sequence, of 16 active orbits, cut and wrap, a deactive soak period, a "B" bucket sequence of 16 active orbits, and a "B" recovery sequence.

The J-21 payload system was the first system to incorporate the new 5 volt temp. system. Two self-heating tests were conducted to check the efficiency of the new system to reduce self-heating effects. The results of the two self-heating tests indicate no self-heating due to power consumption in the sensors. At initial turn-on of power to the temp sensor system, the gain of the differential amplifier appeared to be slightly non-linear. This non-linear amplification became linear after a brief period in which the differential amplifier stabilized itself.

The pressure makeup system (PMU) failed during orbit 4 of the "A" bucket sequence.

The clock showed erratic errors during the "B" bucket sequence. An analysis of the time errors indicated an increasing error towards the end of the "B" Sequence.

An analysis of the analog T/M data indicates a satisfactory performance of the panoramic instruments. Cycle rate errors did not exceed 1.75 percent. There were a few scattered instances of noise on the instrument's take-up and supply idler telemetry monitors but it was not of sufficient intensity or frequent enough to imply detrimental instrument behaviour.

The test was completed on 19 February 1965, after 8 consecutive days of simulated orbital pressures. The J-21 payload system was returned to the A/P facility on 20 February 1965.

3. Panoramic Camera Performance

Satisfactory instrument operation was observed throughout the test on channels 6, 8, 9 and 10, which monitor such functions as payload transport and clamping, 99/101 clutch operation, lens rotation, and center of format. Instrument operation at start and shutdown was normal. Cycle rate errors did not exceed 1.75%, and the majority of the random cycle rate readings indicated errors of approximately 1% or less.

There appeared to be dirty contacts on the Master instrument supply idler monitor. The supply idler channels and the clock channel exhibited a strange pulse when the instrument operate command was given. This unusual pulse was similar to the pulse caused by ground loops during a center of format pulse. However, this pulse was not evident during pre-TASC functional testing, and previous payload systems have not exhibited these same pulses.

Evaluation of the test film showed that both cameras produced minor start-up corona marking which was well within the acceptance criteria. The J-21 system was recommended for flight.

4. Stellar-Index Camera Performance

T/M data indicated satisfactory performance by both the number one and number two S/I units.

At the conclusion of the test the J-21 "A" S/I unit was switched to the J-20 payload system, and the J-20 "A" S/I unit was switched to become the J-21 "A" S/I. The J-20 "A" S/I unit indicates no malfunctions during its test history.

Stellar/Index units D-69 (installed in SRV #1) and D-25 (installed in SRV #2) showed generally good performance. Acceptable levels of corona discharge and edge static were observed in the stellar portion of D-25, while the remaining units were free of corona marking.

5. Clock Performance

The serial readouts of the clock were carefully monitored during the "B" bucket phase of the test. On the basis of a time correlation between clock readouts and the IRIG "C" time at the TASC chamber, it would appear that the clock off-set was increasing with time. This clock off-set was not a linear off-set that could possibly be eradicated by re-nulling the clock.

This clock has a history of problems that dates back to the J-11 payload system, to which it was originally assigned.

6. Instrumentation Performance

The instrumentation performance was satisfactory during the test. The supply idler monitor of the master instrument had noise that implied dirty contacts or a dirty wiper. An instrumentation change was incorporated that switches both fairing temp sensors 1 and 6 to forward barrel temp sensor 1 at first recovery.

This change was incorporated to provide compatibility with the differential amplifier in the 5 volt temp system. Prior to the test a jumper was installed incorrectly, and the resistance from the commutator point to ground was changed. This gave the T/M indication of an improper switching.

7. Pressure Makeup System Performance (PMU)

Power to the payload system was shutdown during orbit #4. This power shutdown was programmed to allow the first of the two self-heating tests to be conducted. Upon conclusion of the first self-heating test, power was applied to the payload system and the PMU system did not operate at the first instrument on command. Prior to the power shutdown the PMU system had performed satisfactorily.

The internal pressure curve, presented in Figure 2-1, indicates instrument startup and tail-off pressures recorded from an alphatron gage. The shaded area indicates a minimum and maximum startup pressures for all operations for each associated orbit. The dotted line curve indicated the maximum pressure attained by one operation per orbit.

The PMU system did not operate again during the remainder of the TASC test.

8. Temperature Summary

The J-21 payload system was the first system to use the new 5 volt temperature system. Two self-heating tests were conducted to determine the amount of self-heating. Little or no self-heating was observed in either of the two tests. The amplifier appears to have a short time interval of instability when power is initially applied. In flight self-heating tests may add data that will allow for a more conclusive deduction concerning self-heating effects. Tests on future payload systems will also add new data.

The temperature data from the TASC test indicated no major anomalies; however, one temperature sensor was reading low throughout the test. T/S 108 read 6 to 8 degrees below the master instrument average temperature. A post TASC clean room check at ambient temperature indicated that T/S 108 was still reading 6 to 8 degrees low.

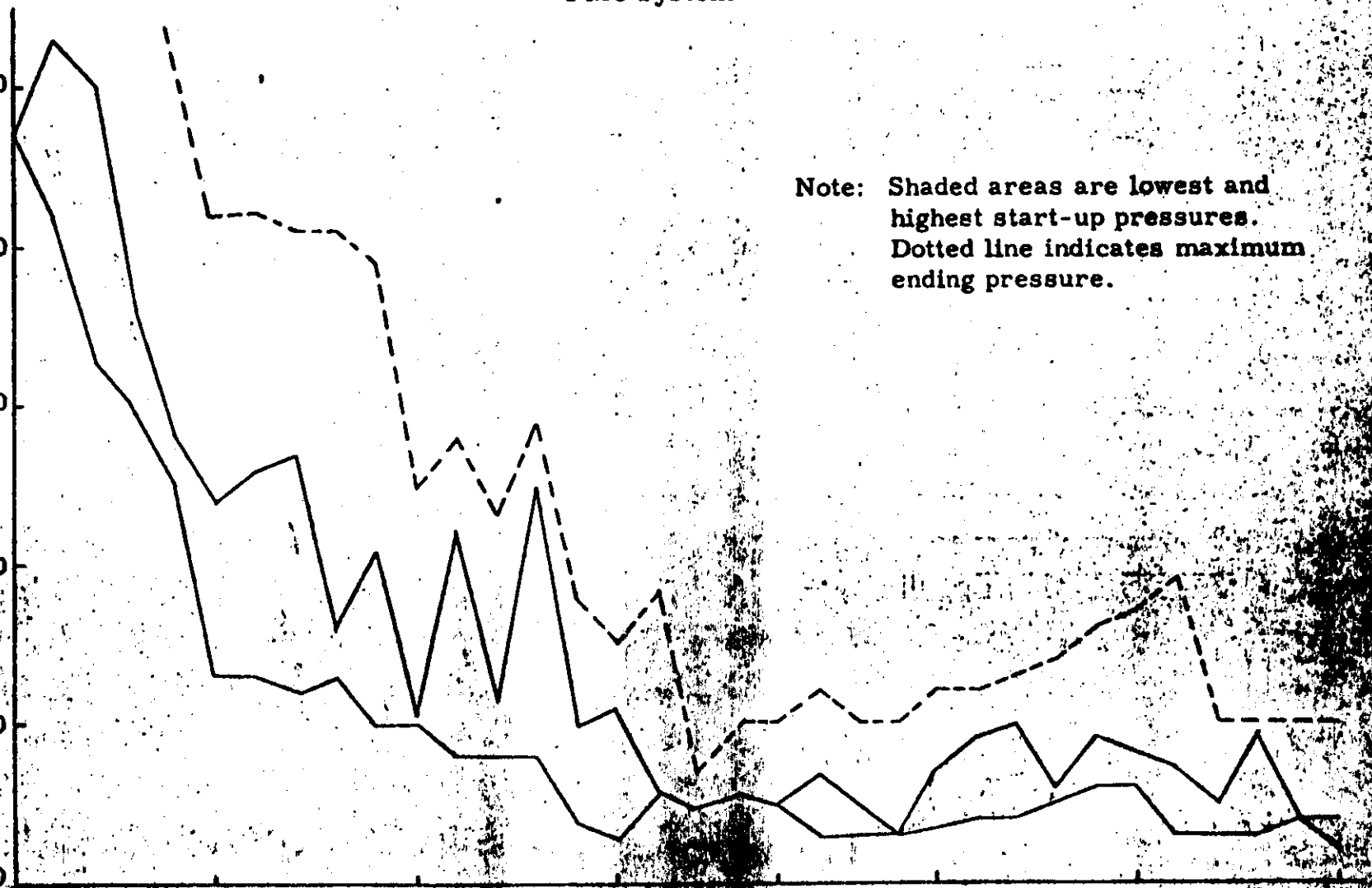
B. RESOLUTION TEST

The dynamic resolution test of the J-21 payload system was performed at the A/P facility on 24 March 1965. Each panoramic camera photographed high and low contrast resolution targets. The resulting through focus resolution data is shown in Figure 2-2 for the Master camera and in Figure 2-3 for the Slave camera.

C. LIGHT LEAK TEST

The examination of the film threaded in the J-21 system during the light leak test determined that only trace film fogging was present. The light leak integrity of the system was considered acceptable for flight.

J-21 TASC TEST
PMU System

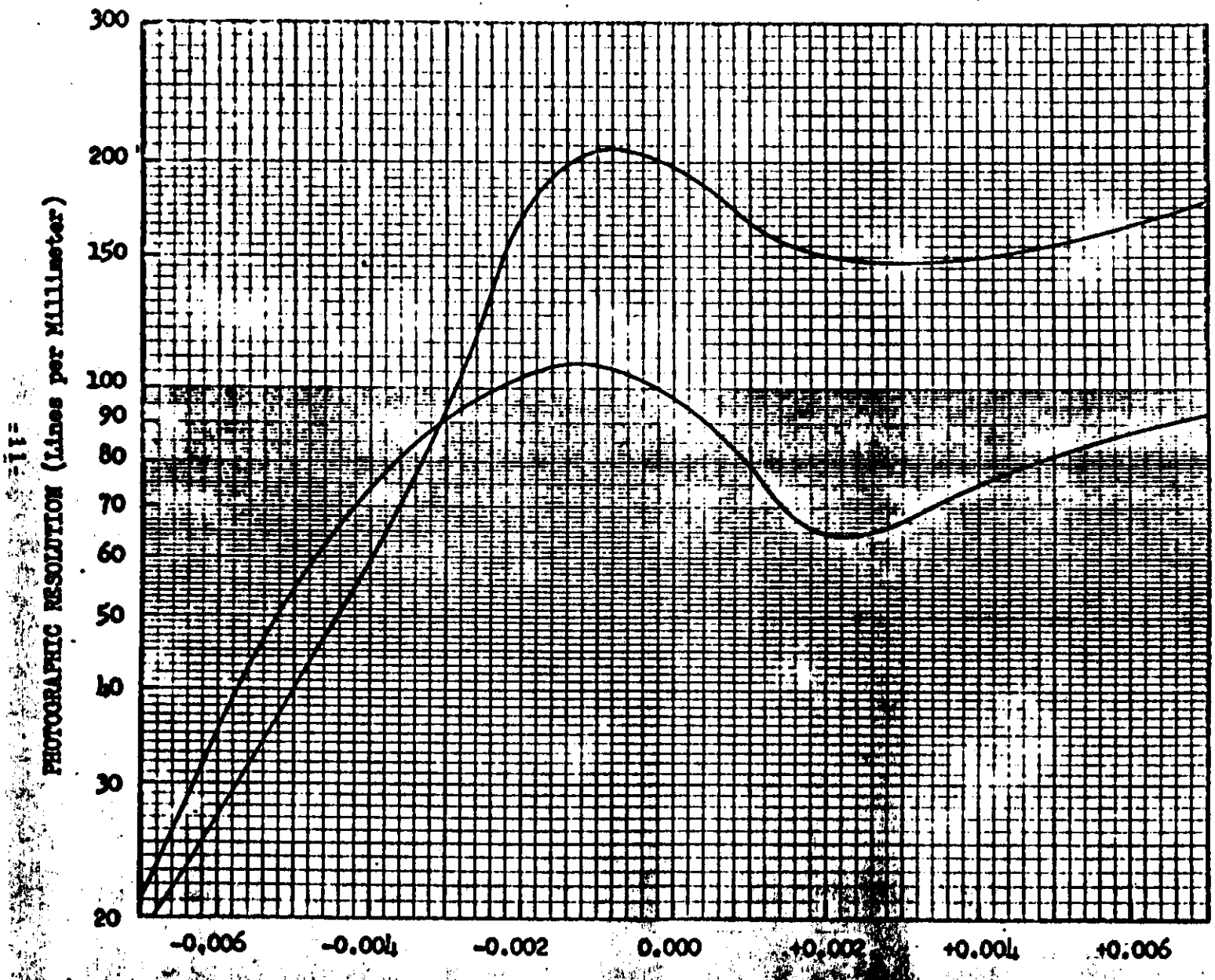



Note: Shaded areas are lowest and highest start-up pressures. Dotted line indicates maximum ending pressure.

FIGURE

TOP SECRET [redacted]

PRE-FLIGHT DYNAMIC RESOLUTION




Camera No: 166

Payload No: J-21

Resolution (l/mm)

High Contrast: 208

Low Contrast: 107

Film Type: 3404

Test Date: 24 March 1

TOP SECRET [redacted]

Figure 2-2