

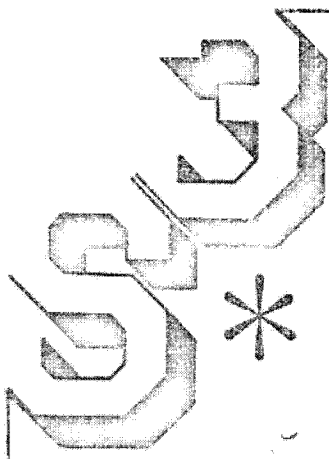
PRO AL6f



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BIF 007-0607-75

This document consists of 71 pages

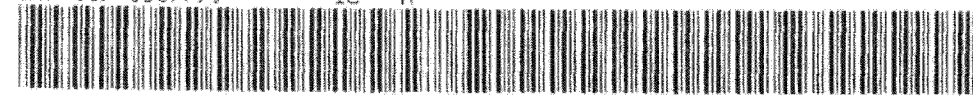


TECHNICAL REVIEW

BIF-007-0607/75

1C H

S



WARNING NOTICE - SENSITIVE INTELLIGENCE
SOURCES AND METHODS INVOLVED.

NATIONAL SECURITY INFORMATION
UNAUTHORIZED DISCLOSURE
SUBJECT TO CRIMINAL SANCTIONS

CLASSIFIED BY BYEMAN 1
EXEMPT FROM GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
EXEMPTION CATEGORY 5B (1), (3), OR (4)
AUTOMATICALLY DECLASSIFIED ON: _____
IMPOSSIBLE TO DETERMINE

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SERIES C
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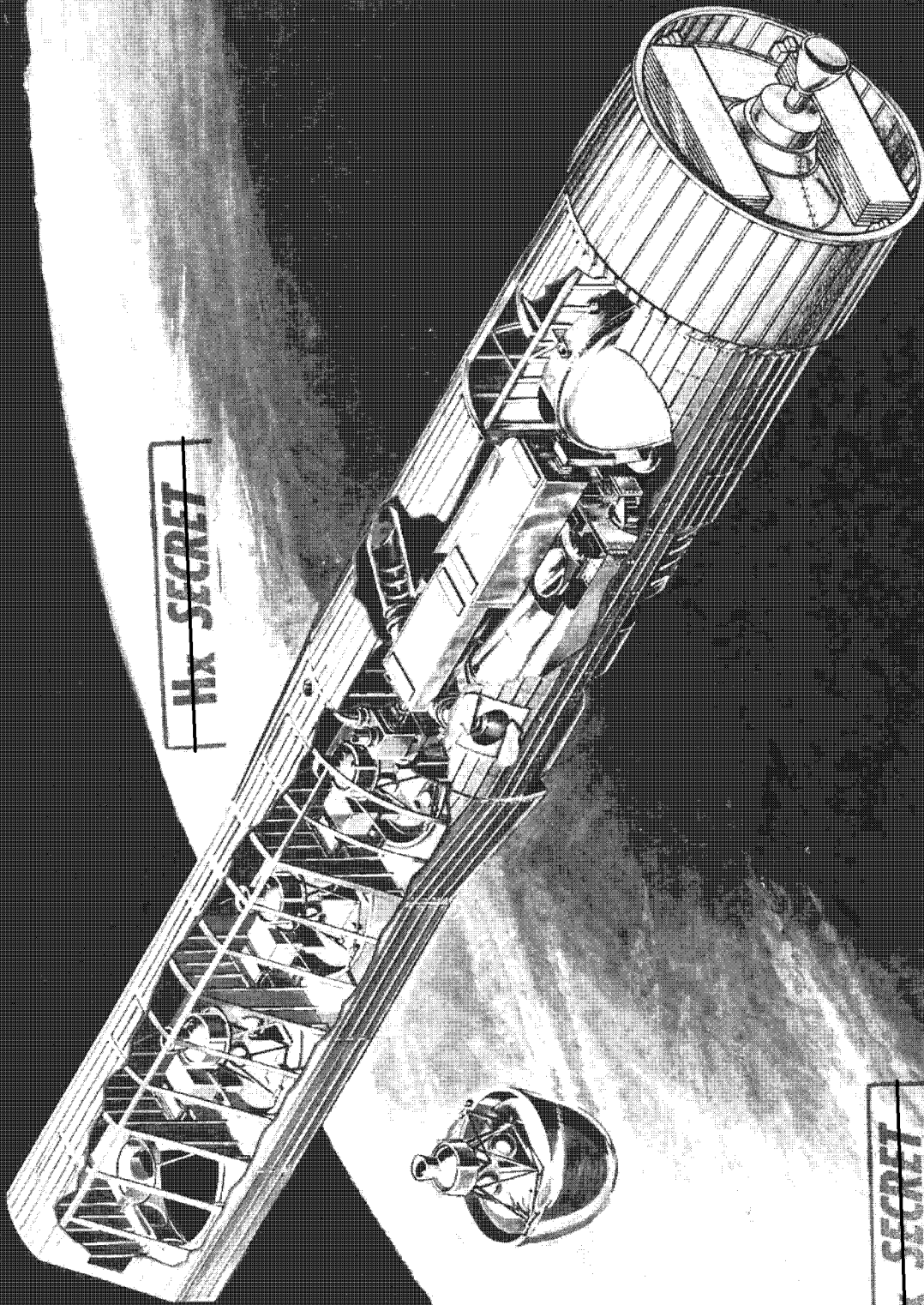
BIF 007-0607-75

AGENDA

1. S³ SUBSYSTEM INTRODUCTION
2. PROGRAM HIGHLIGHTS
3. ACCURACY VERIFICATION TESTS
 - STELLAR SENSOR POINTING ERRORS
 - INTERLOCK CALIBRATION ERRORS
 - ENVIRONMENTAL STABILITY ERRORS
4. SYSTEM DESIGN AND PERFORMANCE TESTS
 - MECHANICAL DESIGN
 - INTERFACE
 - ELECTRICAL
5. SCHEDULE
6. SUMMARY

10/13/75 WEK

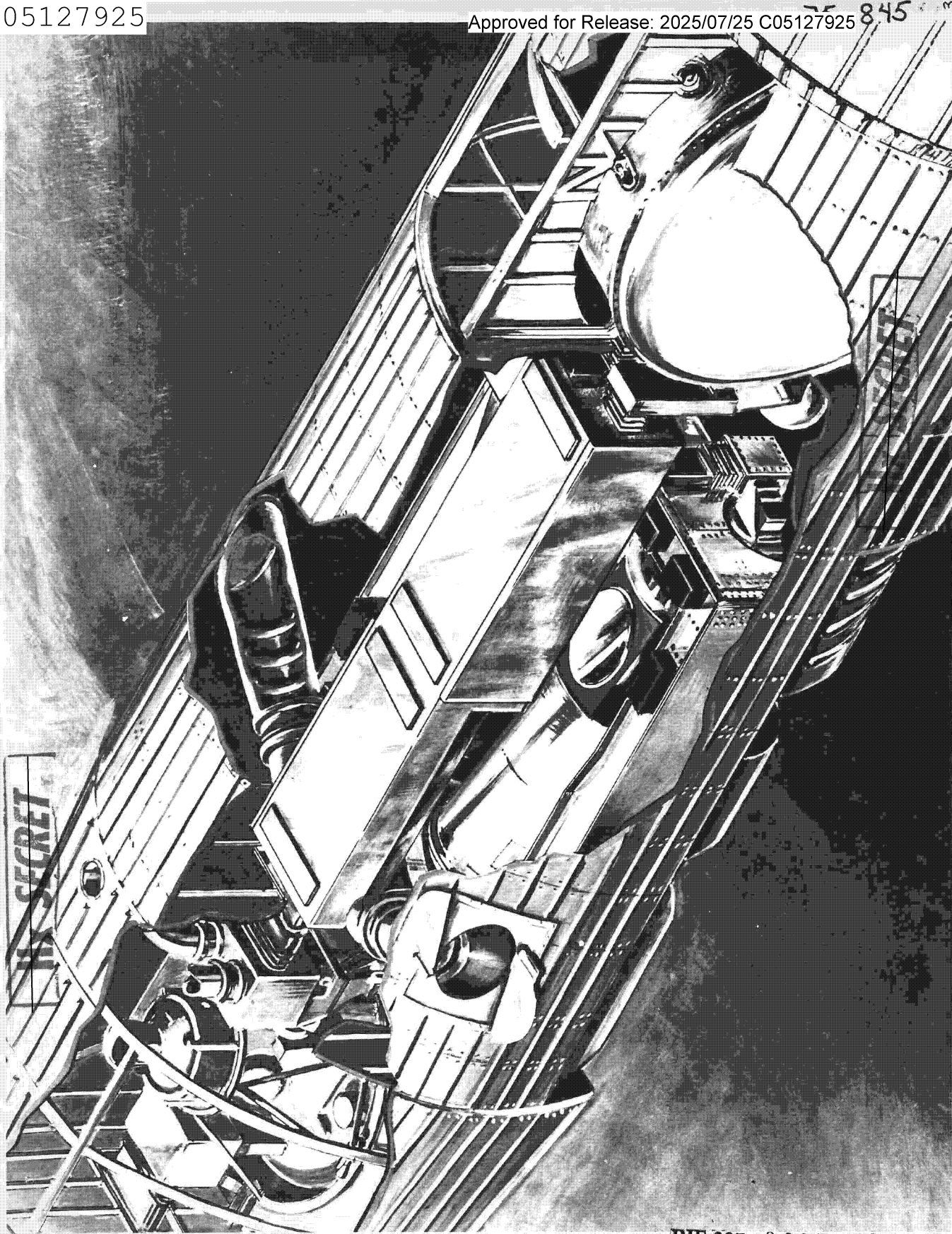
SENSOR SUBSYSTEM



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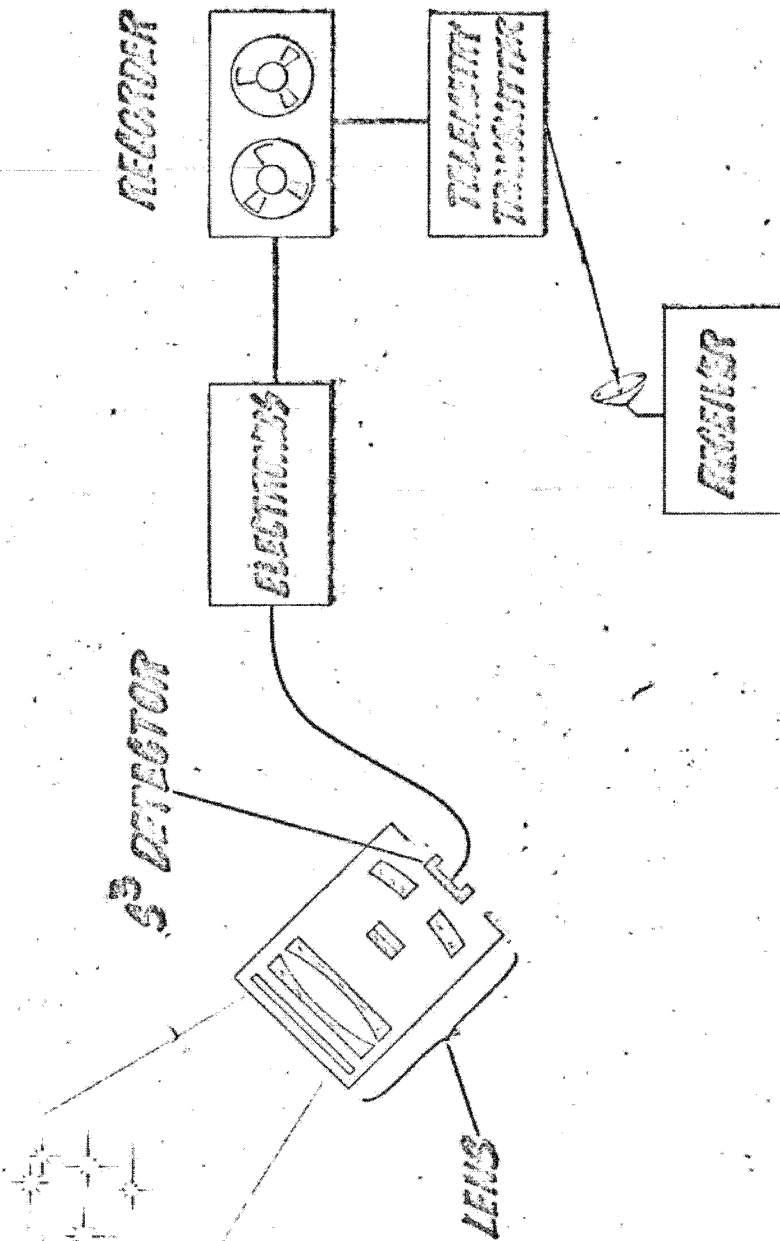
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WELLS VISION & CAMERA SYSTEM

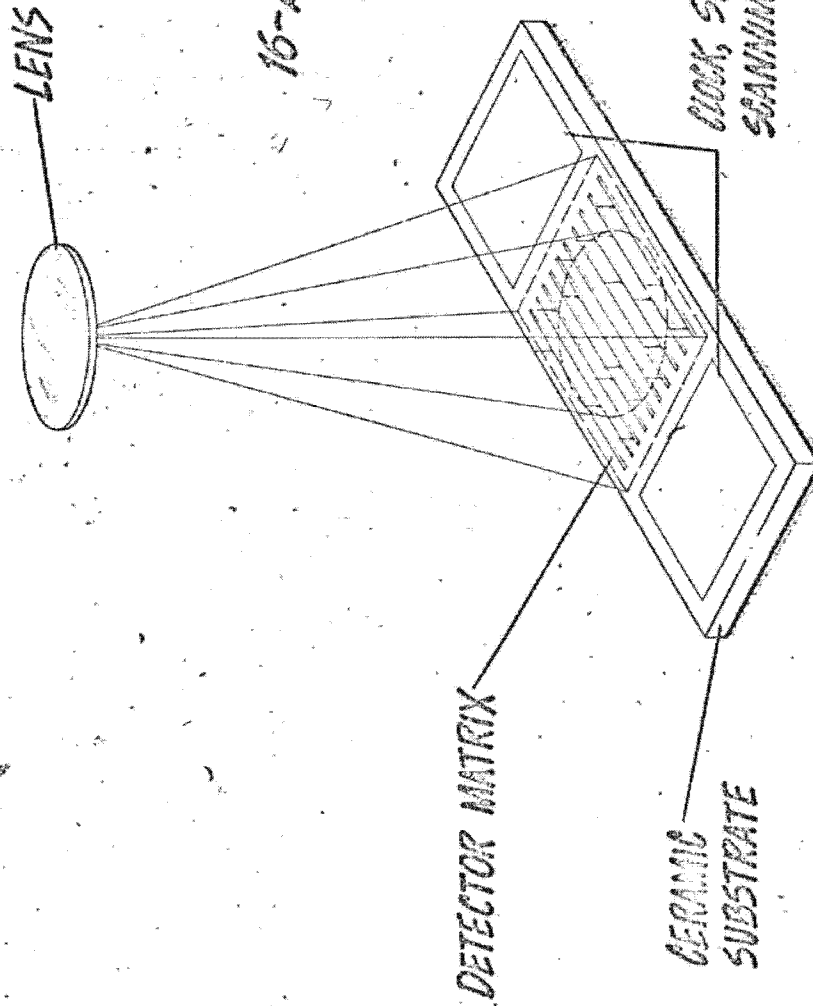


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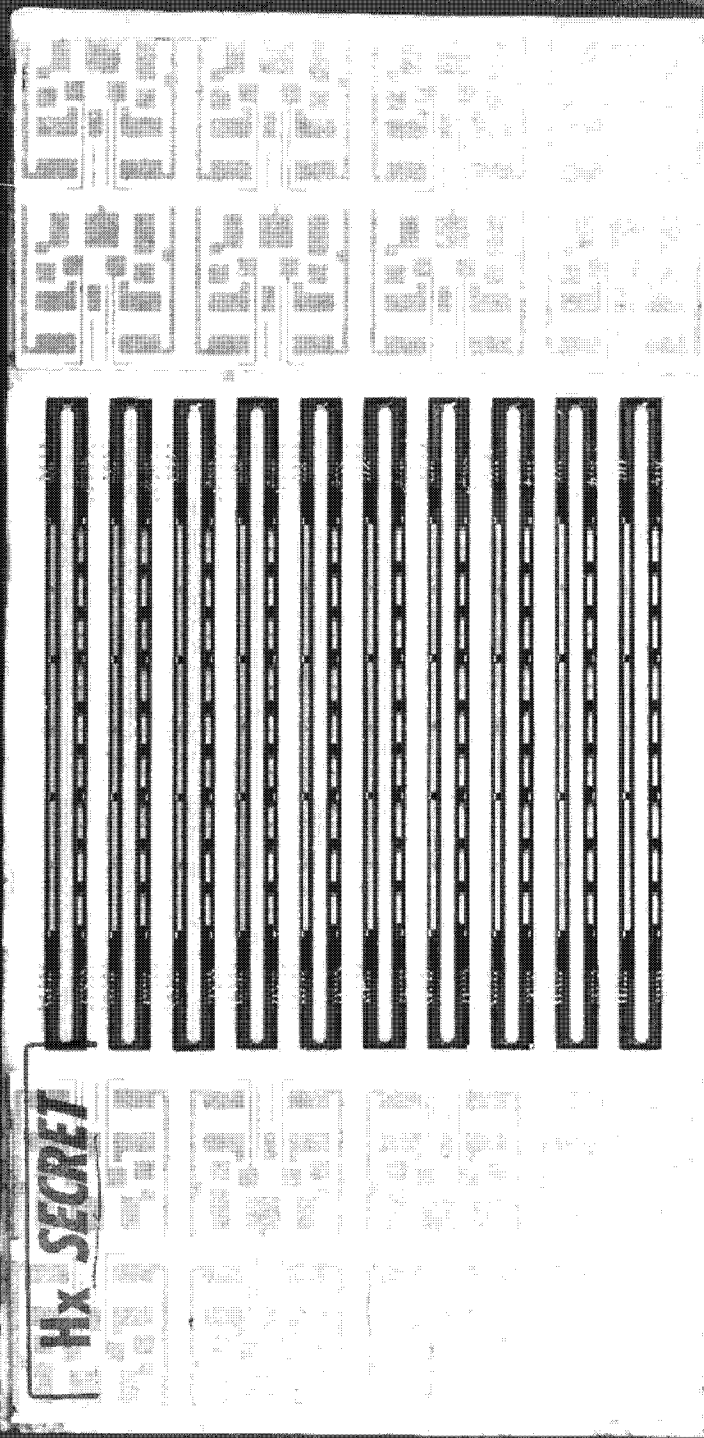
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ST FOCAL PLANE



CO-75-CC-3

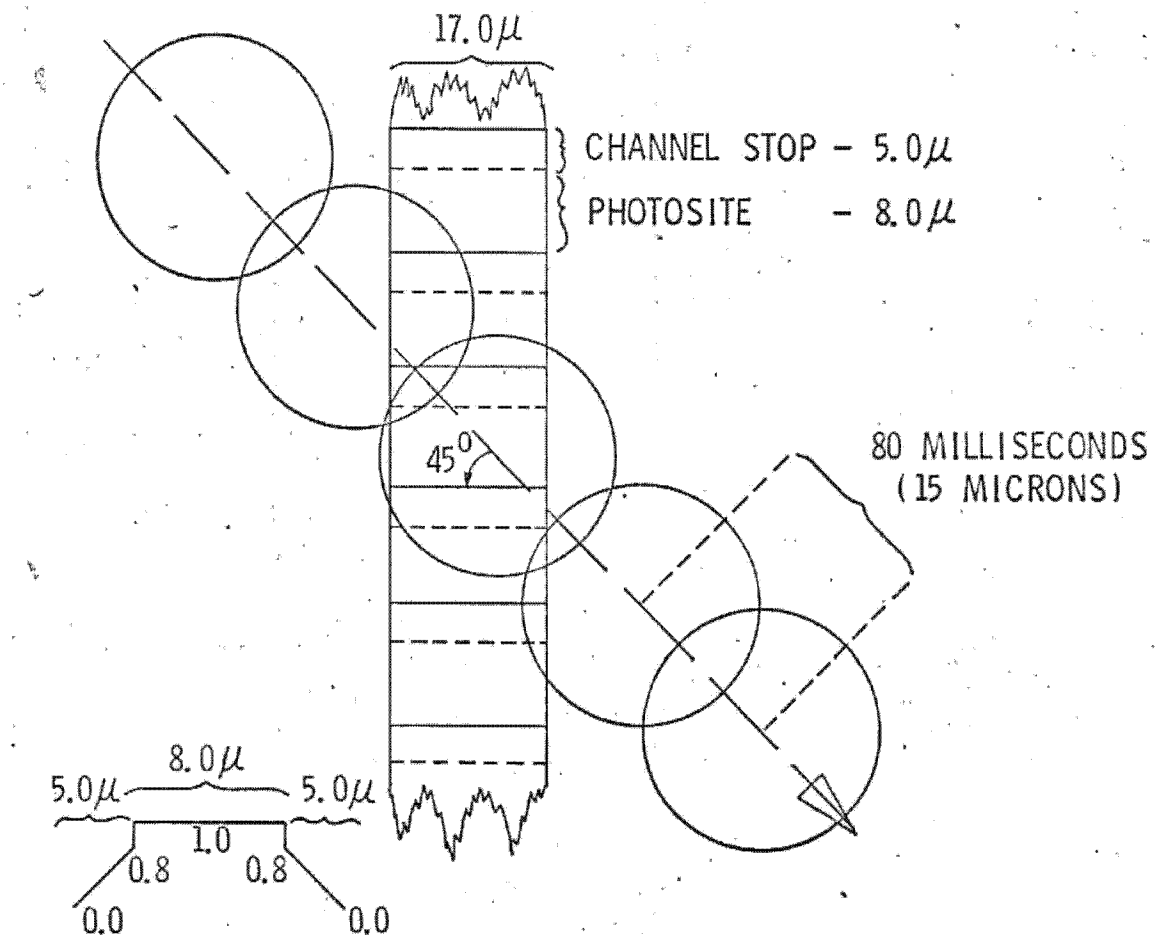


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CENTROID GEOMETRY 1728 LINEAR ARRAY



PIXEL RESPONSE PROFILE

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SV TIME TIES IT ALL TOGETHER

RECONNAISSANCE PAN PHOTOGRAPHY

- SV TIME FROZEN 5° INTO FRAME.
- SV TIME PRINTED AT CENTER OF FRAME.
- IMAGE TO SV TIME MEASUREMENTS ACCURATE TO 0.34 ARC-SEC (1σ) WITH P-14 IMPROVEMENTS.

S³ LOS DATA

- S³ TELEMETRY DATA
 - PHOTODETECTOR ID
 - AMPLITUDE
 - SV ATTITUDE DATA
 - SV TIME
- GROUND DATA REDUCTION
 - DETERMINE STAR LOCATIONS ON FOCAL PLANE AS FUNCTION OF SV TIME.
 - ESTIMATE NOMINAL STAR LOCATIONS ON FOCAL PLANE AS A FUNCTION OF SV TIME.
 - DIFFERENCE IS ATTITUDE ERROR.

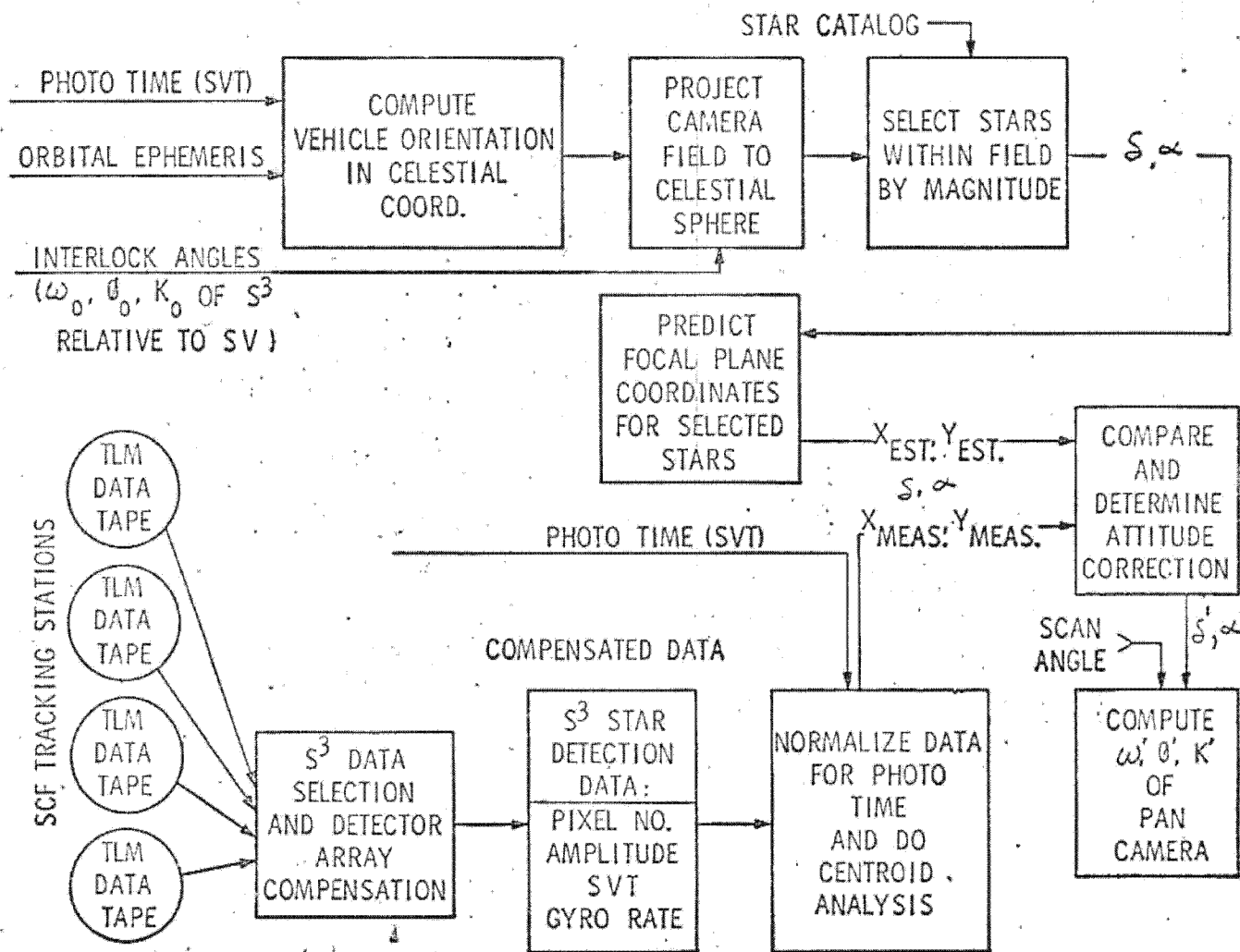
SV TIME

TIES TOGETHER THE RECONNAISSANCE PAN PHOTOS
AND

S³ ATTITUDE ERROR DATA

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GROUND DATA PROCESSING



6/11-12/75 WEK

WHY A SOLID STATE STELLAR (S³) CAMERA ON HEXAGON?

- AREA PHOTOGRAPHED IS ABOUT SEVEN TIMES AREA PHOTOGRAPHED BY PRESENT SI CAMERA.
- MORE ACCURATE MAPS MADE MORE EASILY
 - PAN CAMERA PROVIDES HIGH RESOLUTION IMAGERY.
 - RPIE SYSTEM BEING DEVELOPED TO OVERLAY HIGH RESOLUTION PAN PHOTOGRAPHY ONTO SI CAMERA IMAGERY.
 - MAPS AND ORTHOPHOTOS ARE MADE FROM PAN PHOTOGRAPHY.
 - ACCURATE POINTING DATA ON PAN PHOTOGRAPHY ELIMINATES NEED TO TRANSFER PAN PHOTOGRAPHY ONTO SI PHOTOGRAPHY.
 - OUTPUT DATA IS DIGITAL AND EASY TO USE IN OFF-LINE DATA PROCESSING.
- EASY AND SAFE MODIFICATION.
- INEXPENSIVE

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BEGINNING

MEETING IN AUTUMN OF 1972 TO DISCUSS PAYLOAD MODIFICATIONS
TO IMPROVE MAPPING CAPABILITY

- SYSTEM PROGRAM OFFICE
- DEFENSE MAPPING AGENCY
- SENSOR SYSTEM CONTRACTOR
- DUANE BROWN ASSOCIATES.

RESULT WAS CHANGES TO MAKE REFERENCE MARKS ON FILM MORE
ACCURATE AND CALIBRATE OPTICAL BAR LINE-OF-SIGHT TO OPTICAL
BAR ENCODER.

- DEFENSE MAPPING AGENCY HAD FOUND PAN
PHOTOGRAPHY PROVIDED EXCELLENT RELATIVE
MAPPING DATA.
- ADDING ATTITUDE MONITOR AS PART OF PAN
CAMERA WOULD PROVIDE ABSOLUTE MAPPING
CAPABILITY.

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S³ PROGRAM HIGHLIGHTS

1. PROGRAM DEFINITION PHASE

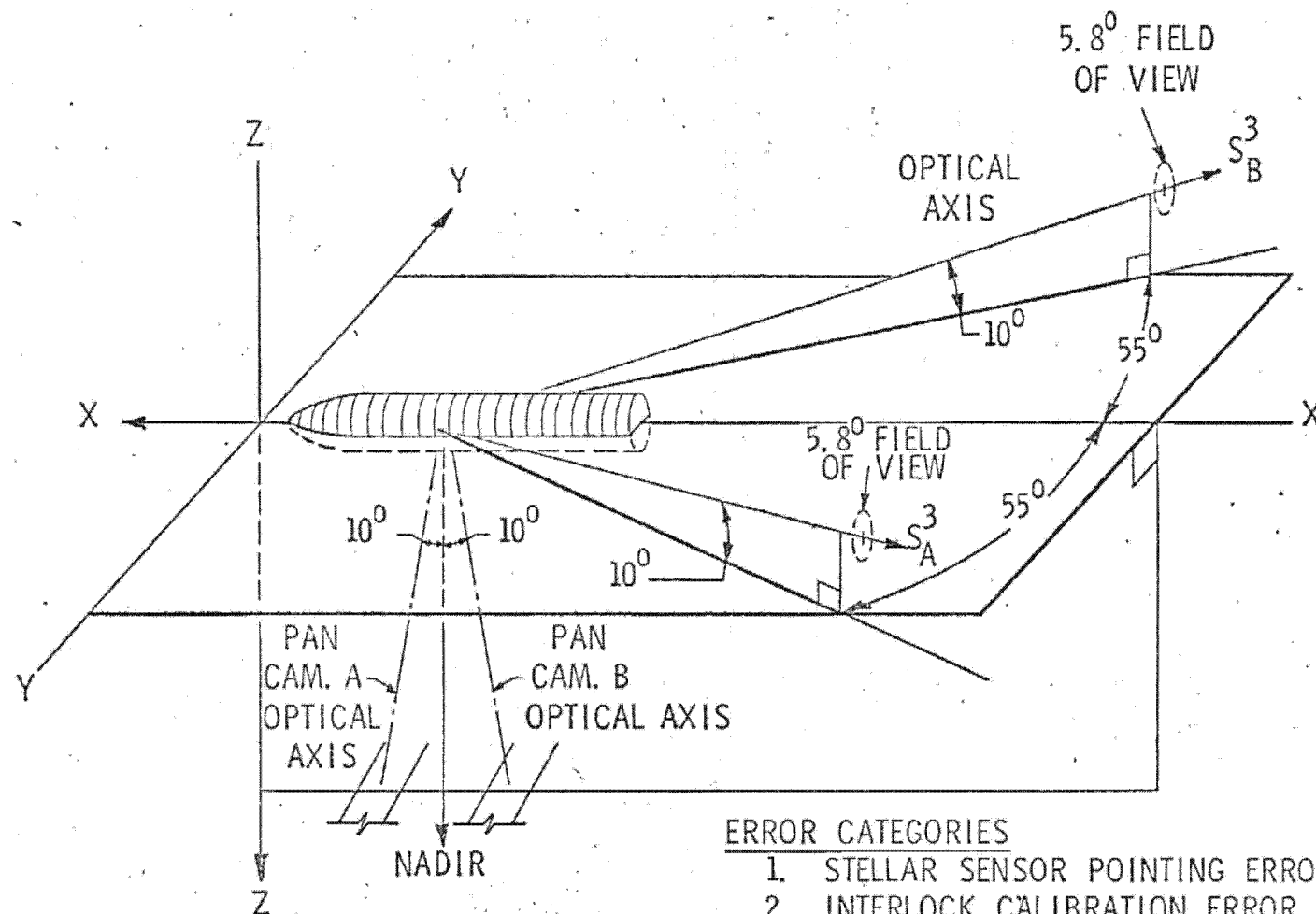
- SYSTEM CONFIGURATION STUDIES
- OPTICAL DESIGN STUDIES
- TECHNICAL RISK EVALUATION PLANS
- EQUIPPED PHOTODETECTOR TEST LABORATORY
- ERROR BUDGET ANALYSIS

2. RISK EVALUATION PHASE

- INTERFACE MEETING WITH SBAC
- SV-9 ON-ORBIT CALIBRATION TESTS
- FRAME DEFORMATION TESTS
- MIDSECTION DEFORMATION TESTS
- FOCAL PLANE COOLER PERFORMANCE TESTS
- PHOTODETECTOR PERFORMANCE TESTS

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S³ OPTICAL AXES



ERROR CATEGORIES

1. STELLAR SENSOR POINTING ERROR
2. INTERLOCK CALIBRATION ERROR
3. ENVIRONMENTAL STABILITY ERROR

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STELLAR SENSOR POINTING ERRORS

1. HARDWARE CALIBRATION ERRORS

• PHOTODETECTOR LOCATION

- LABORATORY TESTS DEMONSTRATE PIXEL POSITION DETERMINATION TO BETTER THAN 1.7 MICRONS

- PRECISION POSITION TABLE

- 7-MICRON SPOT

- ERROR BUDGET: 2 MICRONS

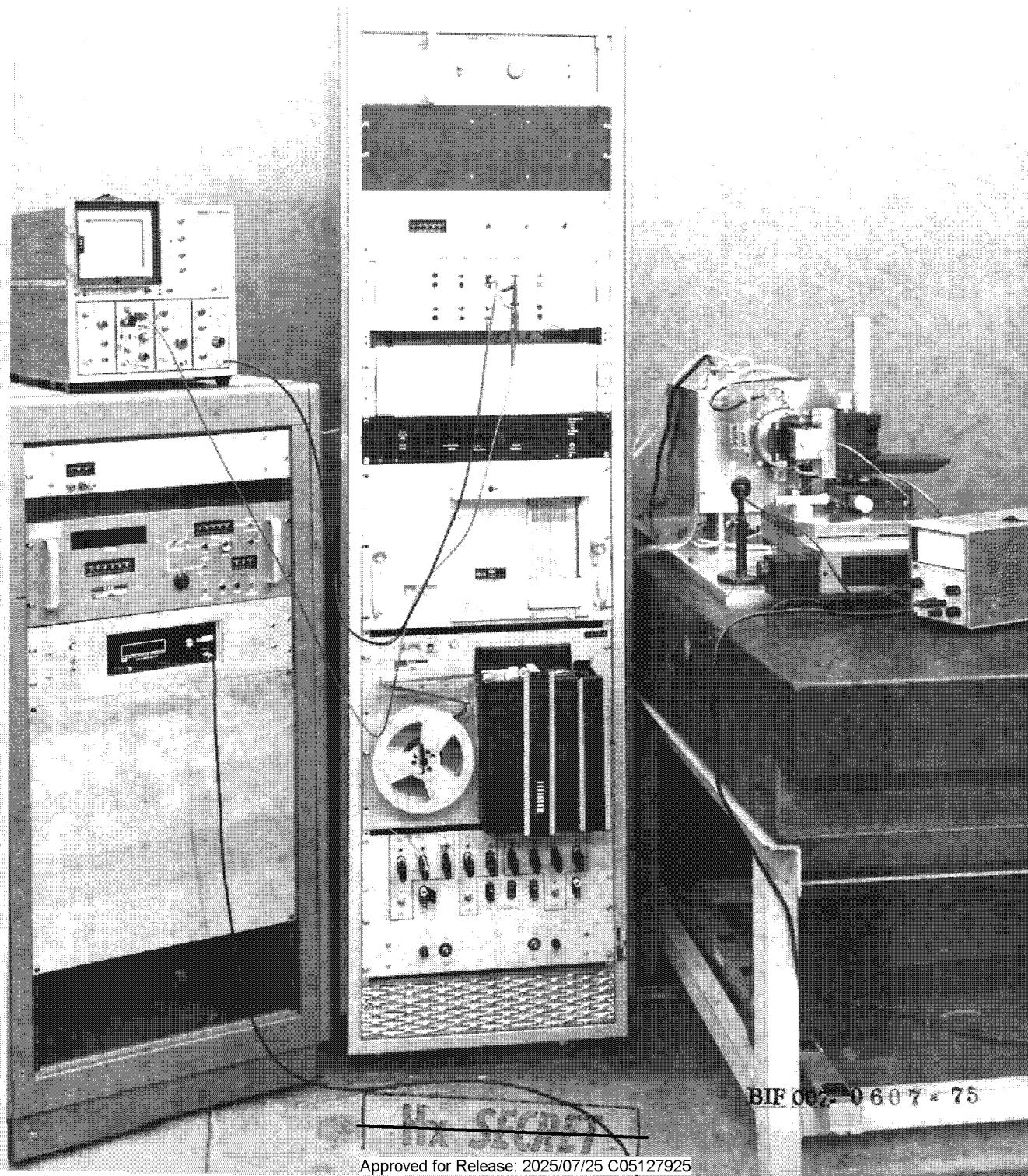
• OPTICS DISTORTION AND FOCAL LENGTH

- ERROR BUDGET ALLOWS ERRORS EQUIVALENT TO 2 MICRONS ON FOCAL PLANE.

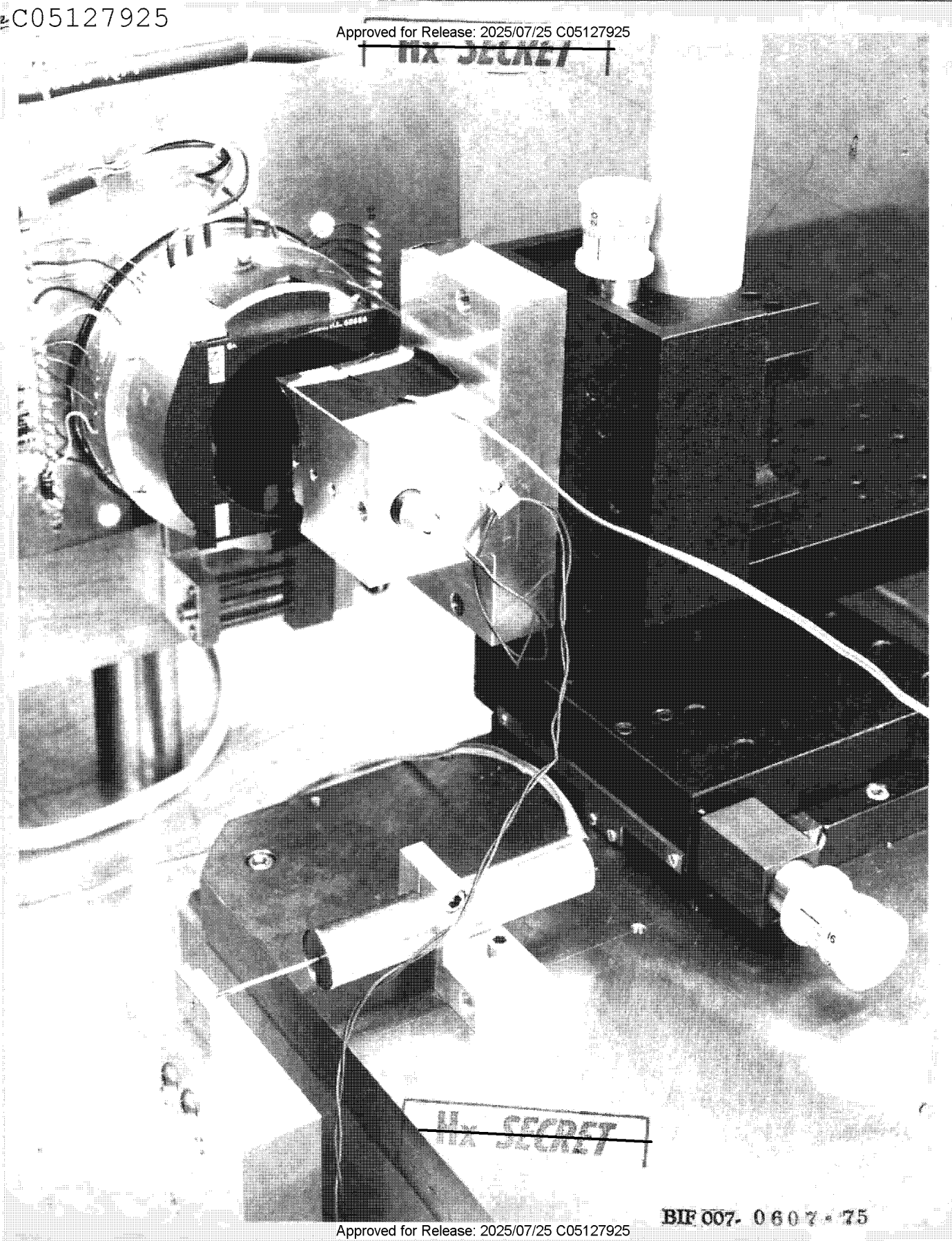
- PRESENT STELLAR CAMERA HAS BIGGER FIELD OF VIEW AND HAS ERROR OF ONLY 2 MICRONS.

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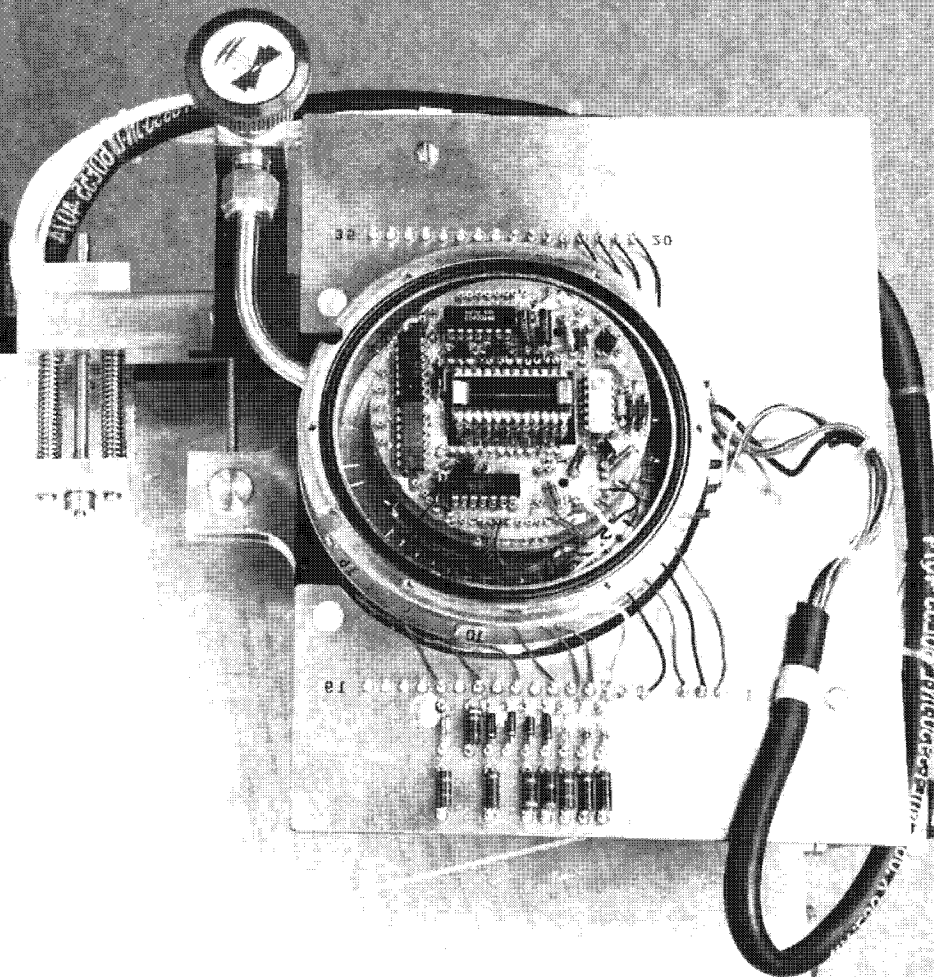
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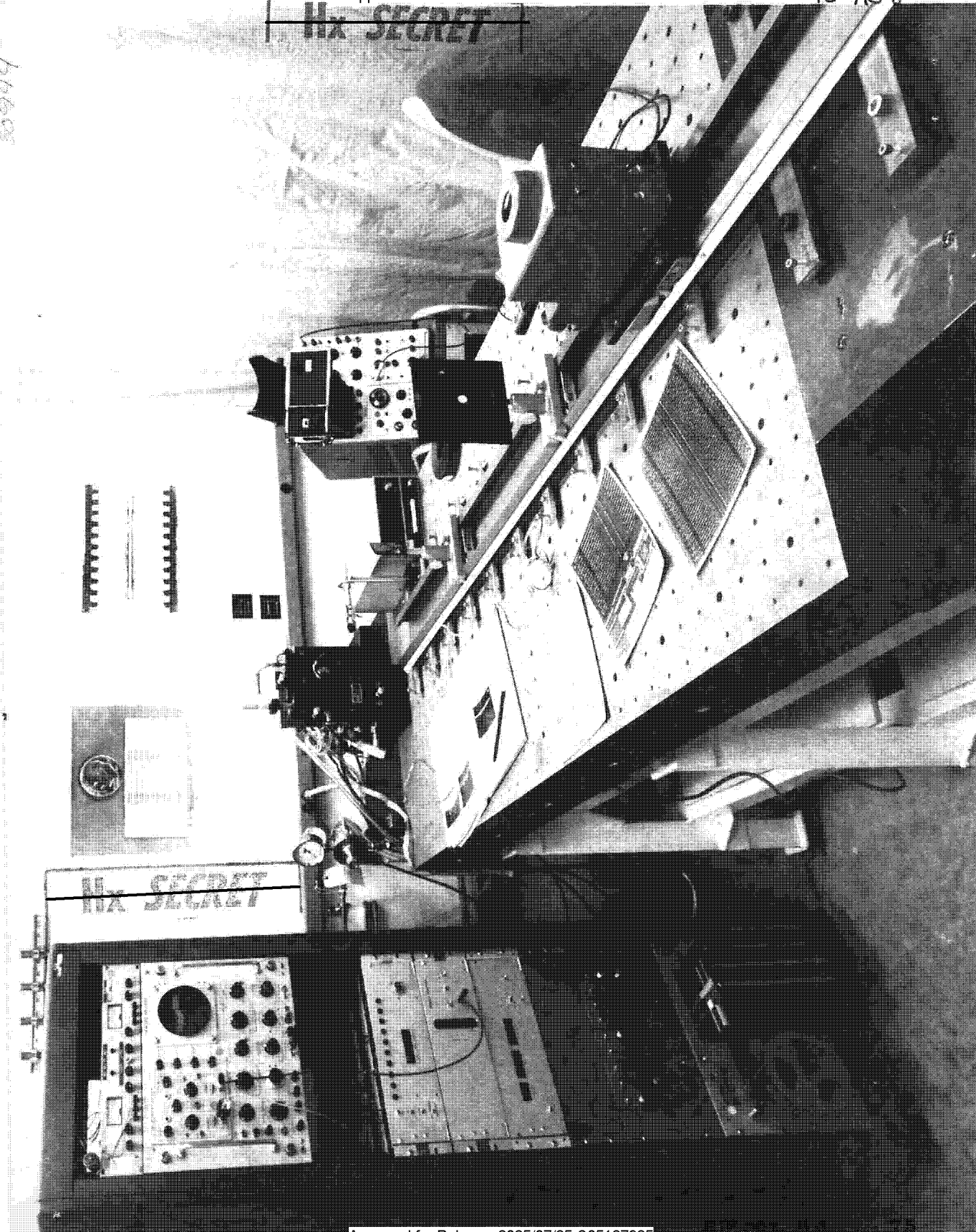


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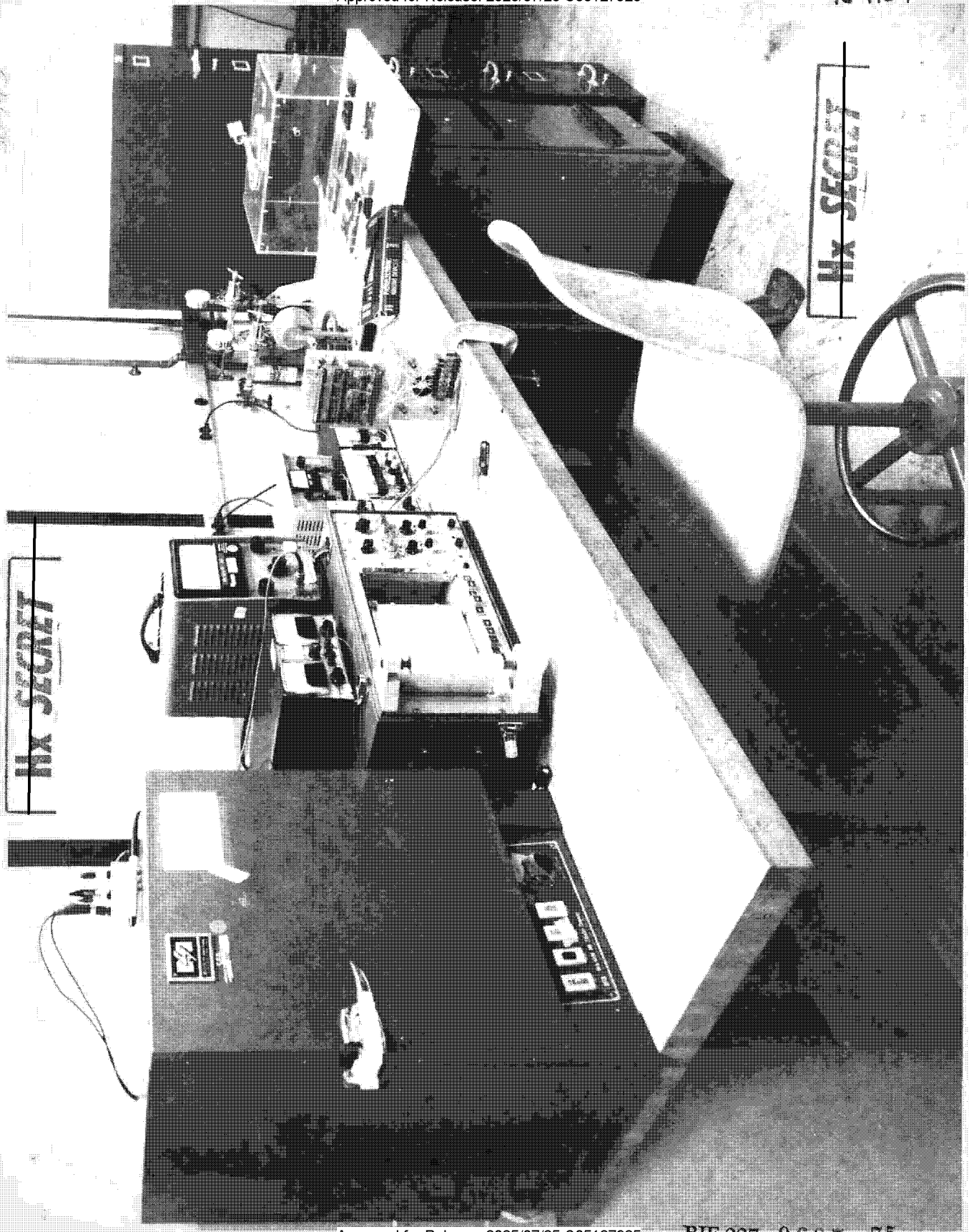
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STELLAR SENSOR POINTING ERRORS (CON'T)

2. HARDWARE PERFORMANCE ERRORS

• ATTITUDE CONTROL SYSTEM

- ACS DATA USED TO INTERPOLATE
- USING ACS SPEC. VALUES YIELDS ERROR 1.2 ARC-SECONDS
- MEASURED PERFORMANCE IS 0.5 ARC-SECONDS
- ERROR BUDGET: 1.2 ARC-SECONDS

• FOCAL PLANE DETECTION AND DATA REDUCTION

• DETAILED ANALYSIS MODEL

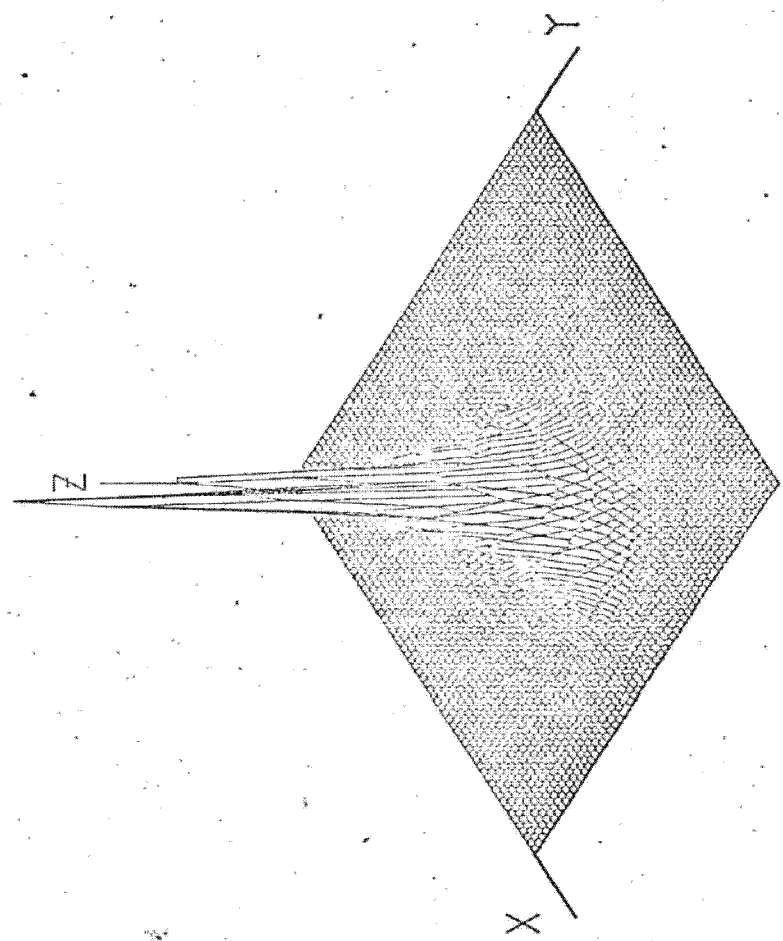
- OPTICS AND OPTICAL ERRORS
 - FOCAL PLANE DETECTORS AND DETECTOR ERRORS
 - ANALOG TO DIGITAL CONVERTER AND ELECTRONIC ERRORS
 - TELEMETRY ERRORS
-
- MODEL PREDICTS 1.5 MICRONS (1 σ) FROM PERFORMANCE DATA
 - LABORATORY TESTS DEMONSTRATE 1.6 MICRONS OR LESS
 - ERROR BUDGET: 1.5 MICRONS

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ST 1675 DESIGN B-O CLASS STAR IMAGE



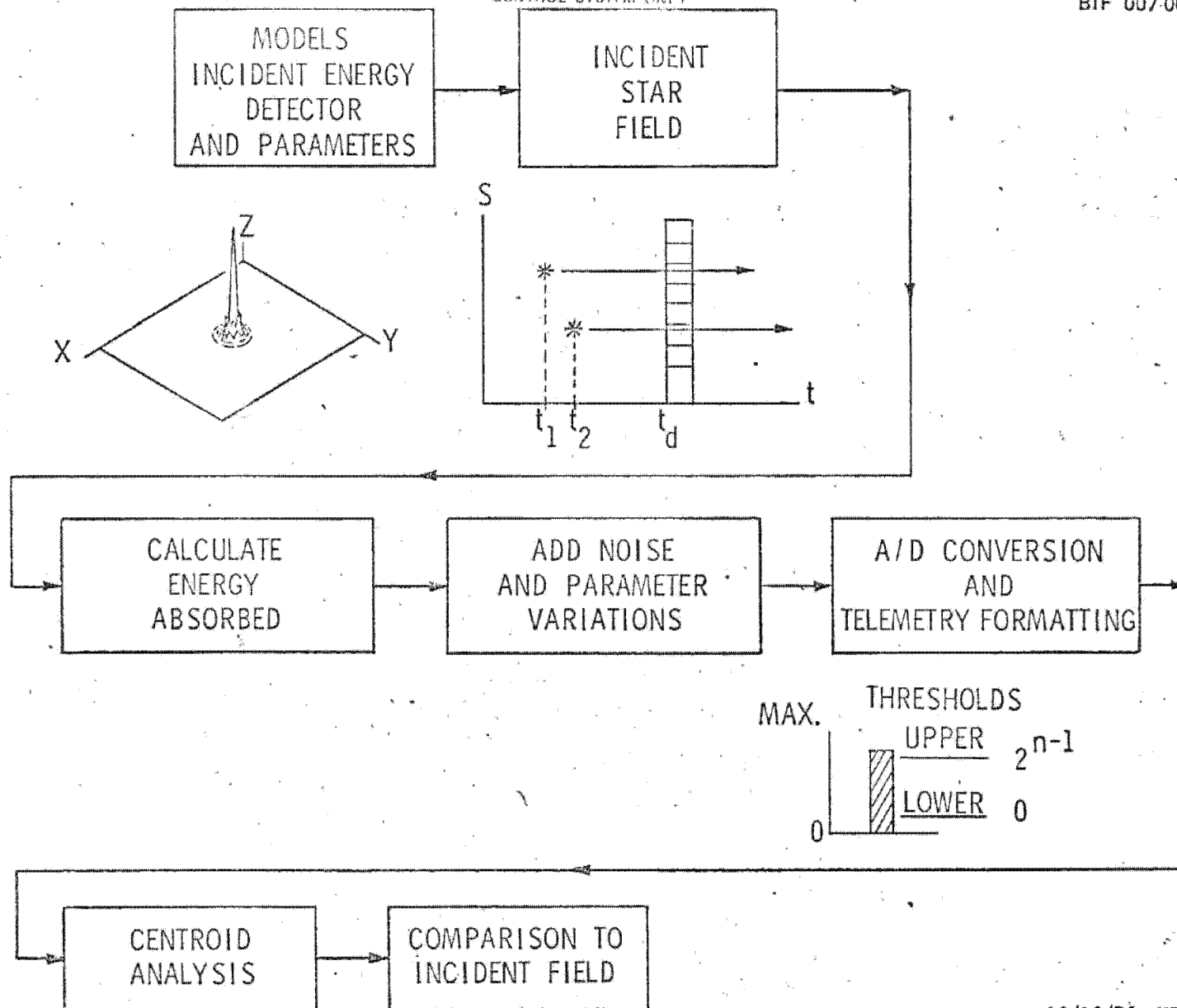
POLYCHROMATIC POINT SPREAD FUNCTION

Y 2.4150 0.0000
10.6657 -0.0000

FIELD POSITION 35.8408

WAVELENGTH	SENSITIVITY
0.5500	0.2800
0.6500	0.2000
0.7500	0.2400
0.8500	0.1500
0.9500	0.0700

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STELLAR SENSOR POINTING ERRORS (CON'T)

3. STAR CATALOG ERROR

- SMITHSONIAN CATALOG ACCURATE TO 0.5 ARC-SEC TO 12th MAGNITUDE.
- USE STARS TO 8th MAGNITUDE.
- ERROR BUDGET: 0.5 ARC-SECONDS.

4. CONCLUSION

- ERRORS COMBINE TO OVER 3 ARC-SECONDS.
- LARGE NUMBER AVERAGING $\left(\frac{1}{\sqrt{N}}\right)$ DUE TO MULTIPLE STARS.
- FINAL RESULT: 1.8 ARC-SECONDS.

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ON-ORBIT CALIBRATION

- CALIBRATE INTERLOCK ANGLES ON-ORBIT.
- MANEUVER SV TO ACQUIRE STARS WITH PAN CAMERAS AND S³ SENSORS SIMULTANEOUSLY.
- ALTERNATE PROCEDURE IS TO PHOTOGRAPH A CALIBRATED GROUND TEST RANGE IN THE NORMAL PHOTOGRAPHIC MODE WHILE OPERATING S³ SENSORS.
- ON-ORBIT CALIBRATION ELIMINATES LAUNCH RESIDUAL DEFORMATION ERRORS, GRAVITY RELEASE DEFORMATION ERRORS AND INITIAL THERMAL GRADIENT ERRORS.

2/12/75 LK

MECHANICAL REPEATABILITY TESTS (SN 017)

● GRAVITY REVERSAL

ROTATION OF TCA

TCA TEST POINTS RETURNED WITHIN 2 ARC-SECONDS
MEASUREMENT ACCURACY.

● OB MOUNTS

175-POUND LOAD PLACED ON OB

OB RETURNED WITHIN ACCURACY OF MEASUREMENT

< 1 ARC-SECOND, THEODOLITE

< 0.0001 INCH ~ 0.5 ARC-SECOND, DIAL INDICATOR.

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SV-9 STELLAR PHOTOGRAPHY EXPERIMENT

PURPOSES:

- DEMONSTRATE THE ABILITY TO ACQUIRE STELLAR IMAGERY ON THE PAN PHOTOGRAPHY.
- VERIFY PHOTOMETRIC ANALYSES TO ENABLE EXTRAPOLATION FOR THE VARIOUS CALIBRATION MODES.

CONCLUSIONS:

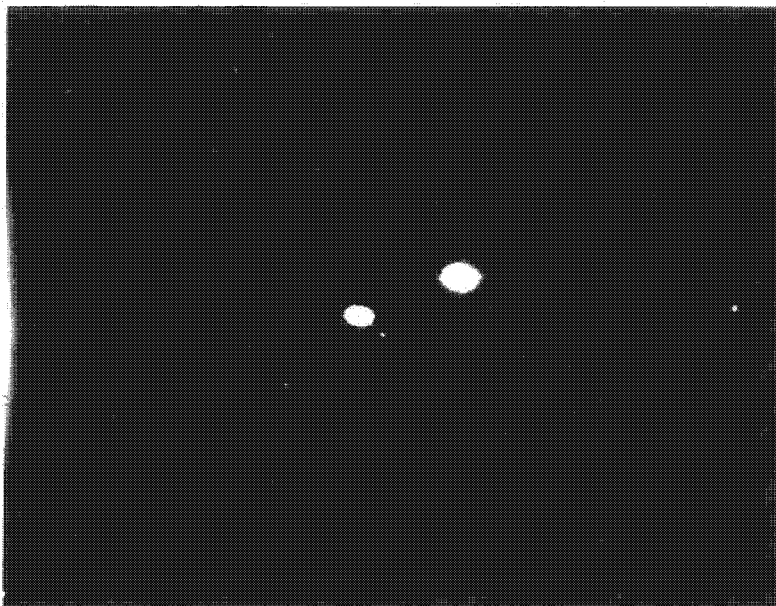
- ACQUIRED STARS AGREED WITH ANALYSIS PREDICTIONS.
- INTERLOCK CALIBRATION CAN BE PERFORMED USING STELLAR PHOTOGRAPHY ON THE PAN CAMERAS.
- DISTORTION CALIBRATION OF THE PAN CAMERAS CAN BE PERFORMED IF MORE SENSITIVE FILM IS USED.

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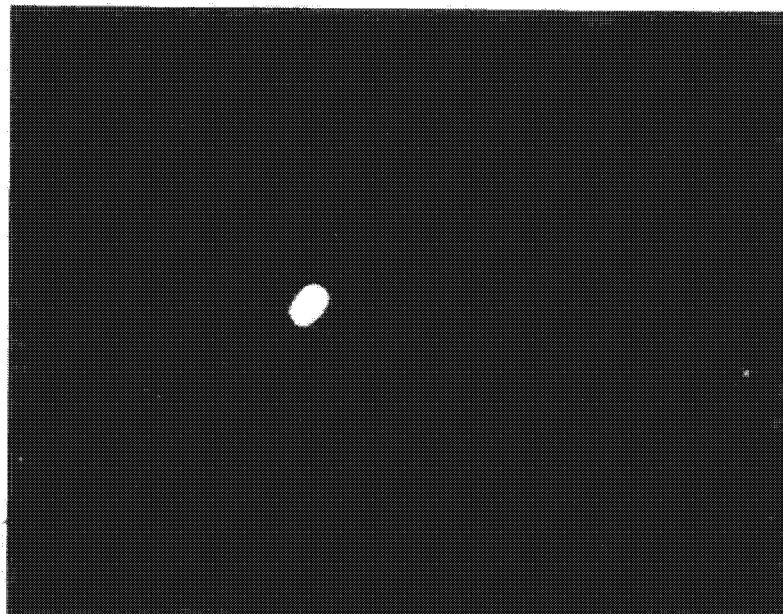
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STAR IMAGES



ALPHA CENTAURI

M 0.3, 1.7



CANOPUS

M -0.9

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76-718

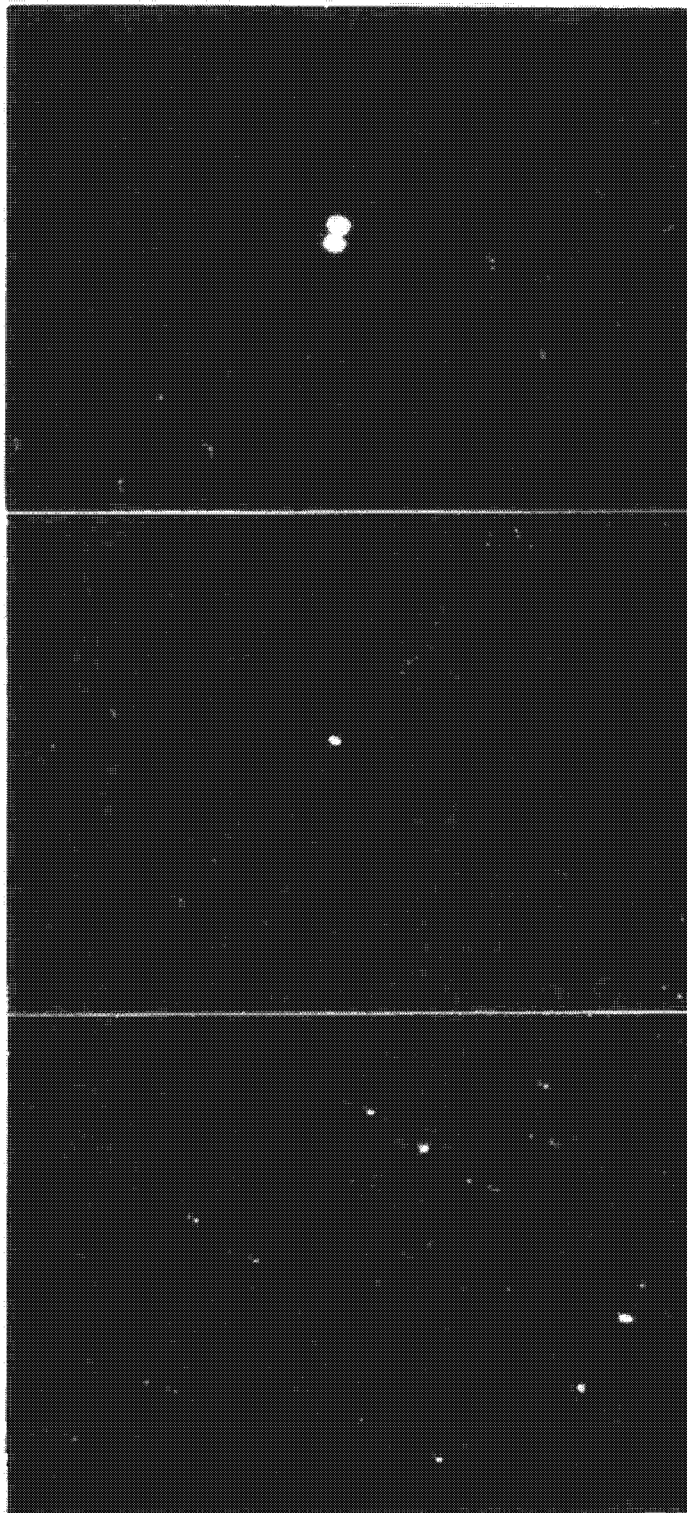
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30496

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STAR IMAGES

50 MICRONS



SPURIOUS
ARTIFACTS

BOSS # 16551
M 4.3

ALPHA CRUCIS
M 1.6, 2.1

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INTERLOCK CALIBRATION ERROR
STELLAR/PAN CAMERAS

ERRORS IN THE CALIBRATION OF THE ANGLES BETWEEN THE
S³ CAMERAS LINE-OF-SIGHT AND PAYLOAD CAMERAS LINE-OF-SIGHT

1. PAN CAMERA IMAGE MEASUREMENT ERRORS

• IMAGE PLACEMENT ERRORS

• OPTICAL BAR WOBBLE MEASURED ON 5076

- IN-TRACK 8 MICRONS (1 σ) (7.6 MICRONS $\rightarrow$ 1 ARC-SECOND)
- CROSS-TRACK 4 MICRONS (1 σ)
- ERROR BUDGET: IN-TRACK 12 MICRONS; CROSS-TRACK 5 MICRONS

• PLATEN SERVO ERROR

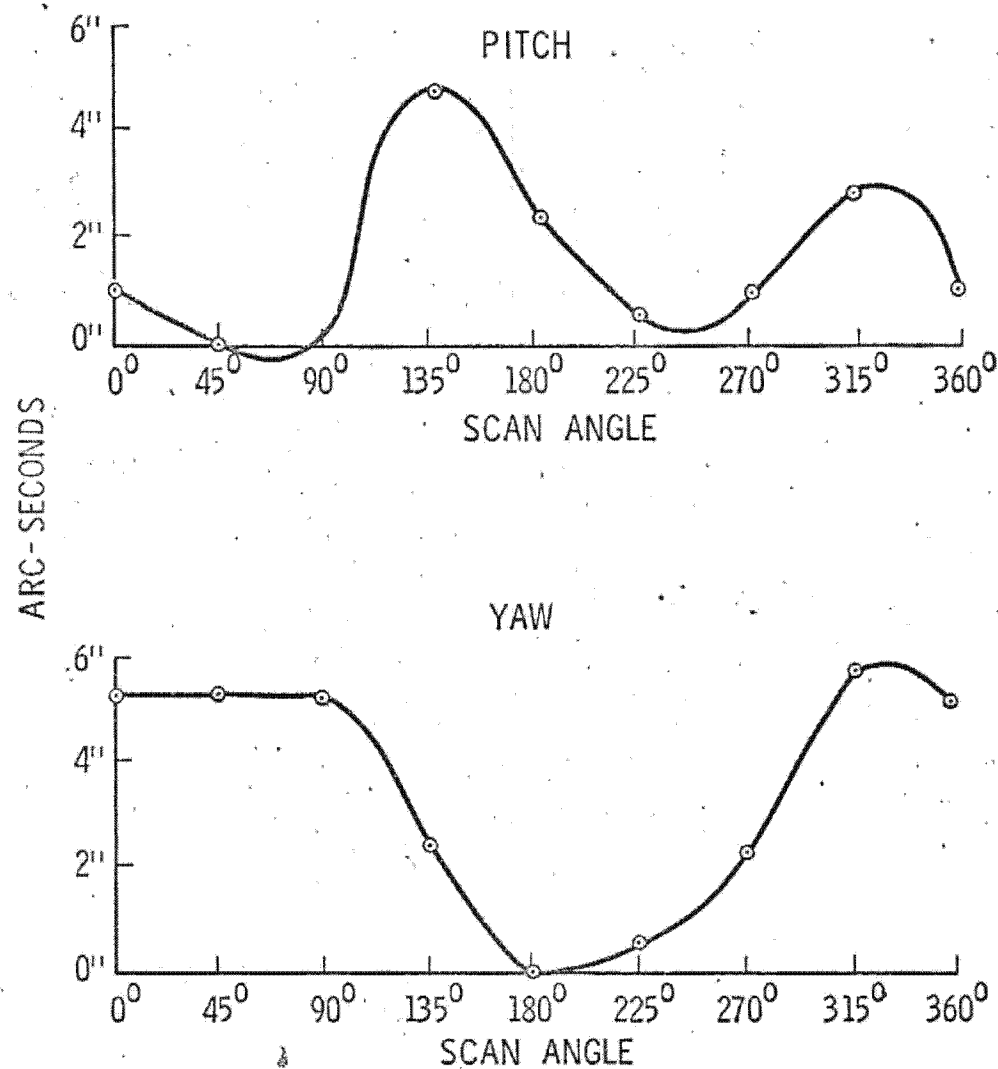
- SPEC. PERFORMANCE 30 ARC-SEC YIELDS 9 MICRONS BUDGET
- MEASURED PERFORMANCE IS LESS THAN 20 ARC-SECONDS OR LESS THAN 6 MICRONS.

• FOCAL LENGTH CALIBRATION AND OPTICAL BAR DISTORTION

- MEASUREMENTS ON 5080 SHOWED 2 MICRONS.
- ERROR BUDGET: 5 MICRONS

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OB 5076 LOS "WOBBLE" WITH OB VERTICAL



INTERLOCK CALIBRATION ERROR (CONT'D)

1. PAN CAMERA IMAGE MEASUREMENT ERRORS (Continued)

• IMAGE MEASUREMENT ERRORS

- MEASUREMENTS MADE USING MAN ENGINE YIELD ACCURACY BETTER THAN 3 MICRONS.
- MICRODENSITOMETER EXPECTED TO BE BETTER.
- ERROR BUDGET: 3.5 MICRONS (1σ).

- LARGE NUMBER AVERAGING $\left(\frac{1}{\sqrt{N}}\right)$ REDUCES MEASUREMENT ERRORS

ASSUMING 4 STARS YIELDS ERROR BUDGET: 0.6 ARC-SECONDS.

2. ANGULAR VIBRATION OF TCA

- CHAMBER A DATA MEASURED 1 ARC-SECOND PEAK.
- SBAC STRUCTURAL ANALYSIS PREDICTS 1 ARC-SECOND.
- ERROR BUDGET: 1 ARC-SECOND.

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INTERLOCK CALIBRATION ERROR (CONT'D)

3. SATELLITE VEHICLE TIME CORRELATION

- SVT ACCURATE TO 1 MILLISECOND.
- $0.001 \times 240 \text{ ARC-SECONDS/SECOND (t)} = 0.24 \text{ ARC-SECONDS.}$
- ERROR BUDGET: 0.3 ARC-SECONDS.

4. STELLAR SENSOR POINTING ERROR

- PREVIOUSLY DISCUSSED TO BE 1.8 ARC-SECONDS.

CONCLUSION

- ERROR BUDGET RESULTS IN 2.2 ARC-SECONDS PREDICTED ERROR.
- MEASURED DATA SHOWS BETTER PERFORMANCE.

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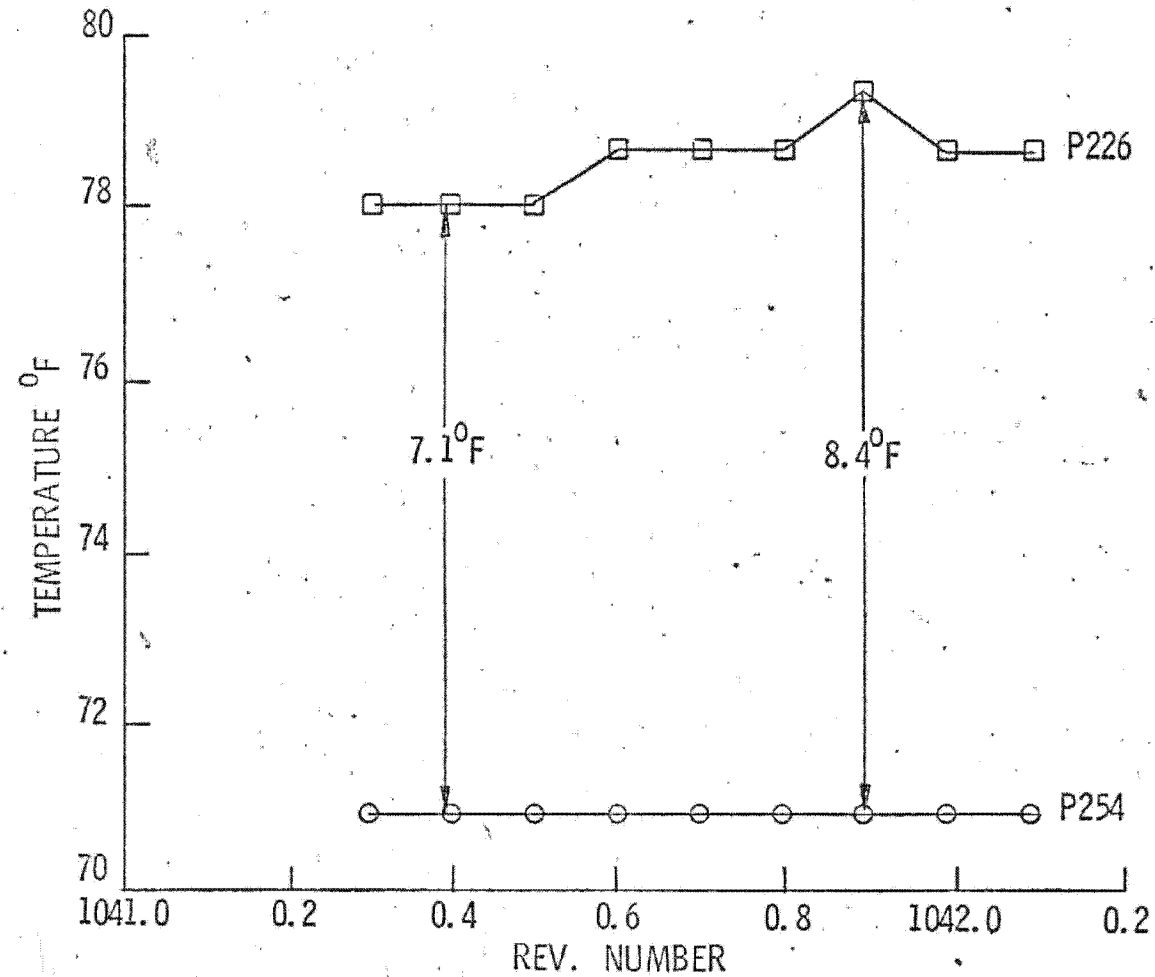
ENVIRONMENTAL EFFECTS

1. THERMAL

- SIDE TO SIDE TWO CAMERA ASSEMBLY GRADIENT
 - ICD SPECIFIES 1.5°F CHANGE DURING MISSION
 - ERROR BUDGET ALLOWS 2°F
 - SV-4; $\beta > 30^{\circ}$; CHANGE WAS 1.3°F
- FRONT TO REAR TWO CAMERA ASSEMBLY GRADIENT
 - ICD SPECIFIES 2°F CHANGE DURING MISSION
 - ERROR BUDGET ALLOWS 3°F
- TOP TO BOTTOM TWO CAMERA ASSEMBLY GRADIENT
 - ICD SPECIFIES 0.2°F CHANGE DURING MISSION
 - ERROR BUDGET ALLOWS 0.25°F
- NASTRAM MODEL USED FOR ANALYSIS
 - VERIFIED BY THERMAL BENDING TEST

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SIDE-TO-SIDE TEMPERATURE DIFFERENCE ON TCA FRAME FOR SELECTED REV. OF SV-4

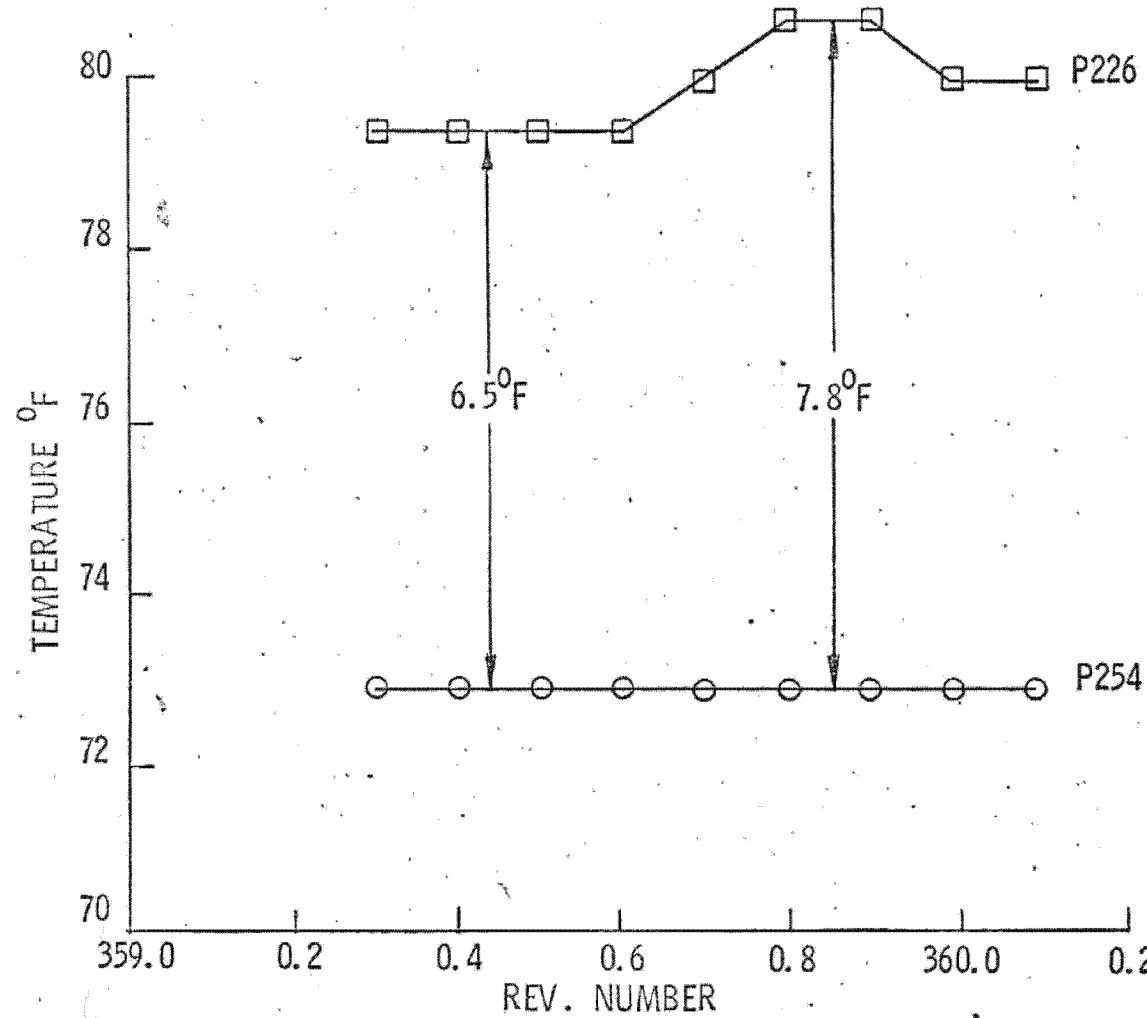


REV. NUMBER 1041 ($\beta = 33^\circ$)

2/12/75 LK

SECRET
HANDOUT VIA CYCLOPS
SIDE-TO-SIDE TEMPERATURE DIFFERENCE ON
TCA FRAME FOR SELECTED REV. OF SV-4

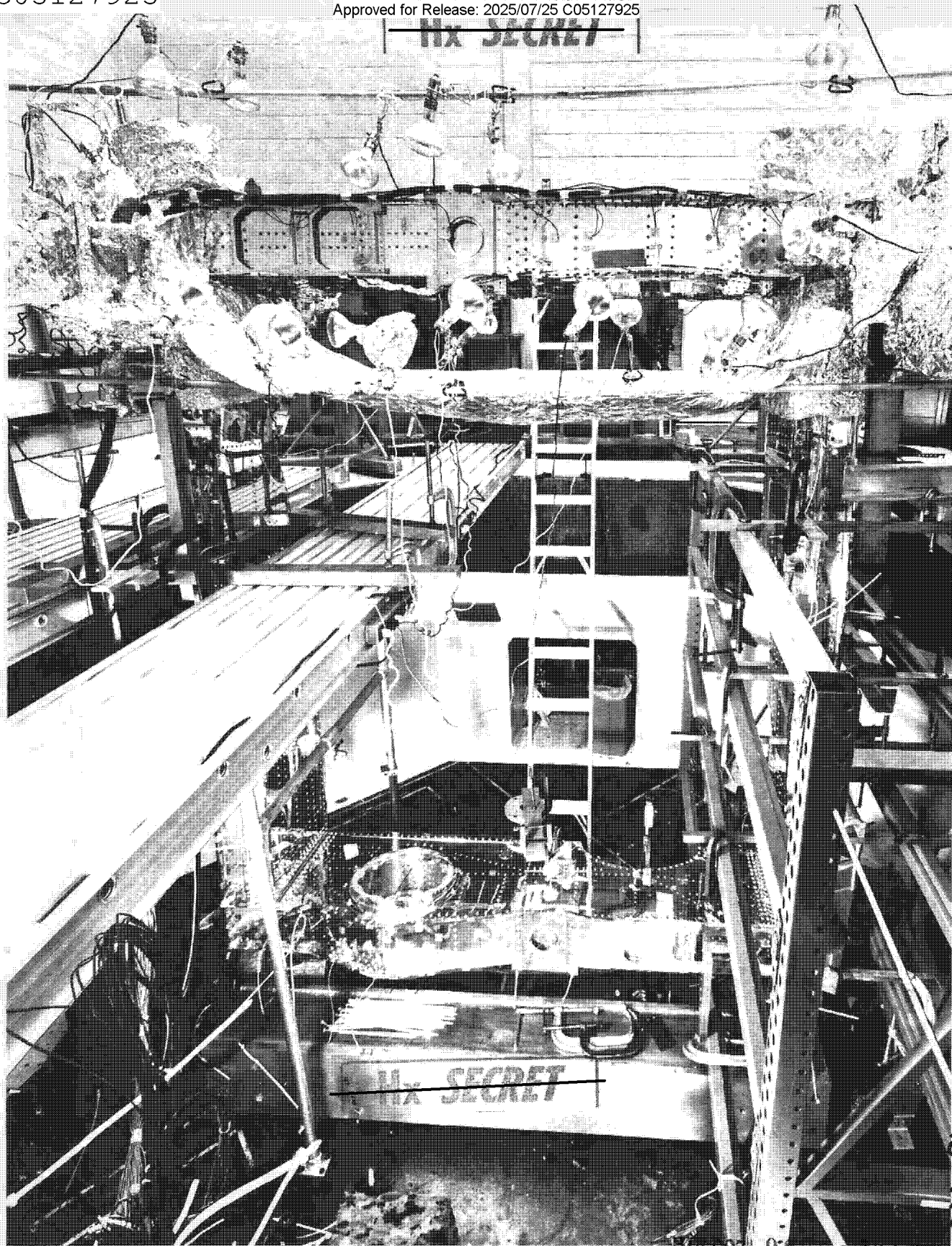
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REV. NUMBER 359 ($\beta = 31^\circ$)

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75-710

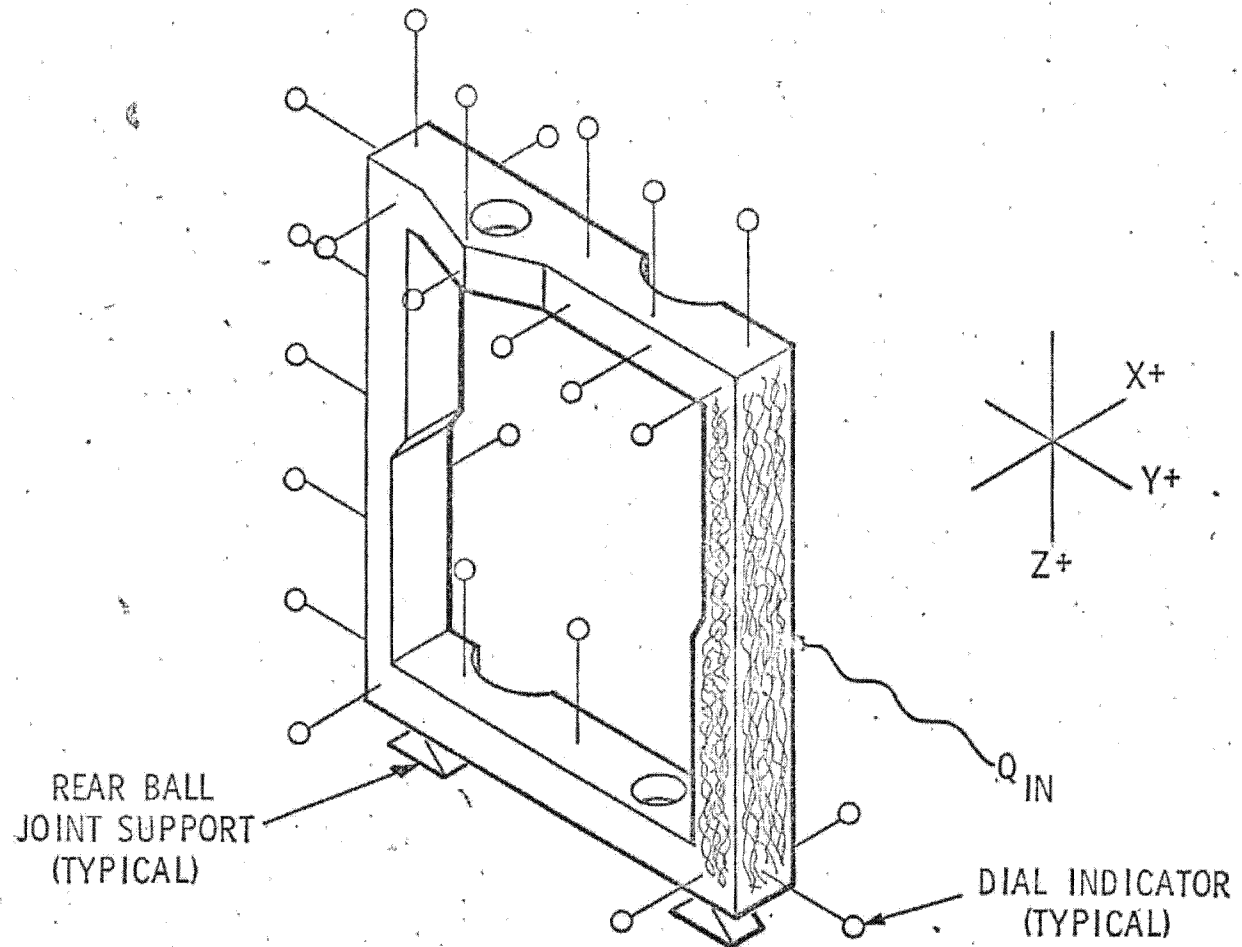
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FRAME BENDING TEST DIAL INDICATOR DATA HEAT SYMMETRICALLY APPLIED INTO B-SIDE FRAME



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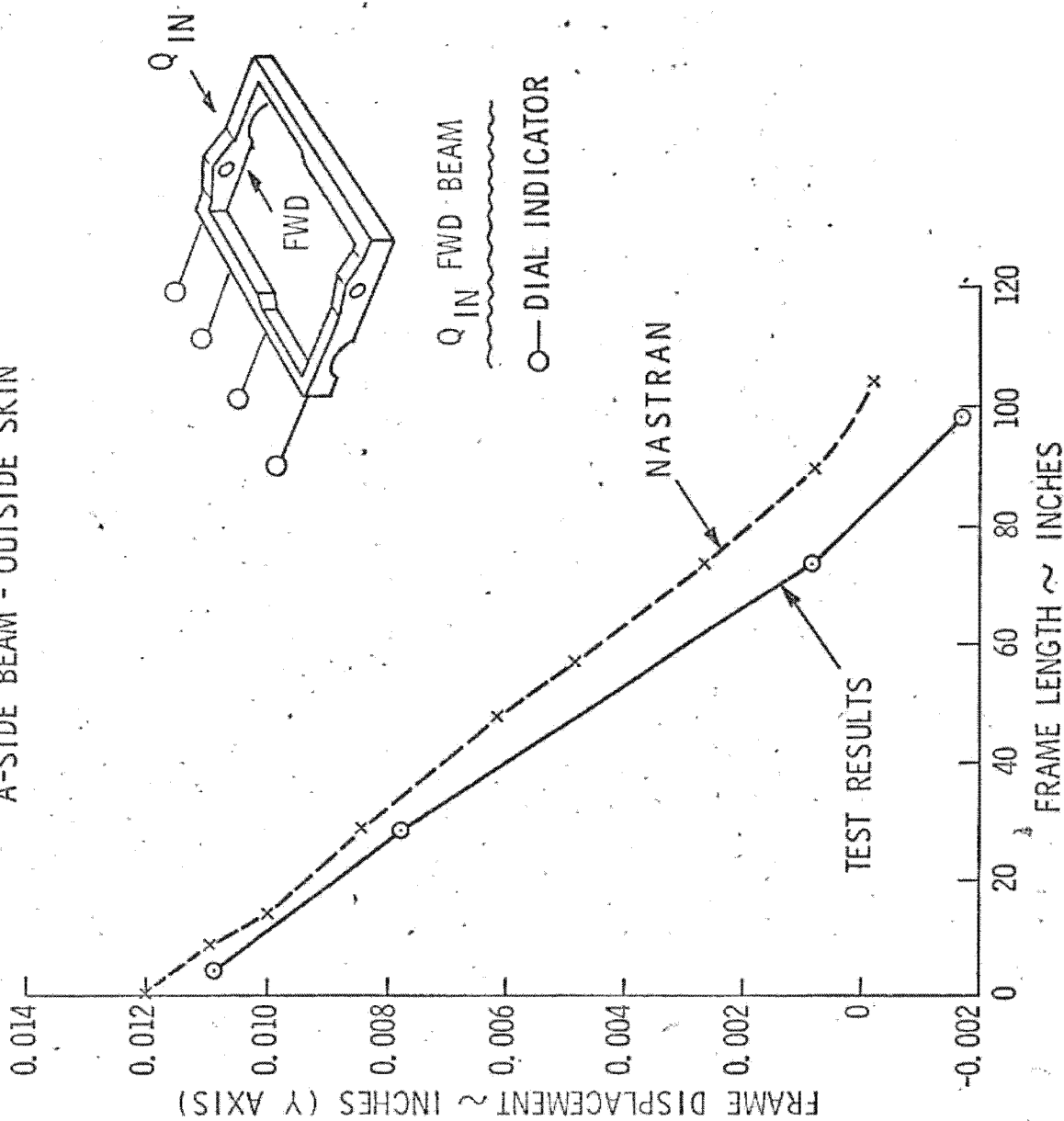
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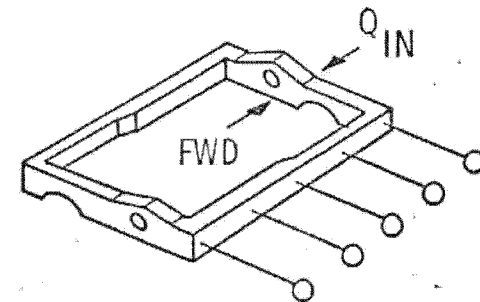
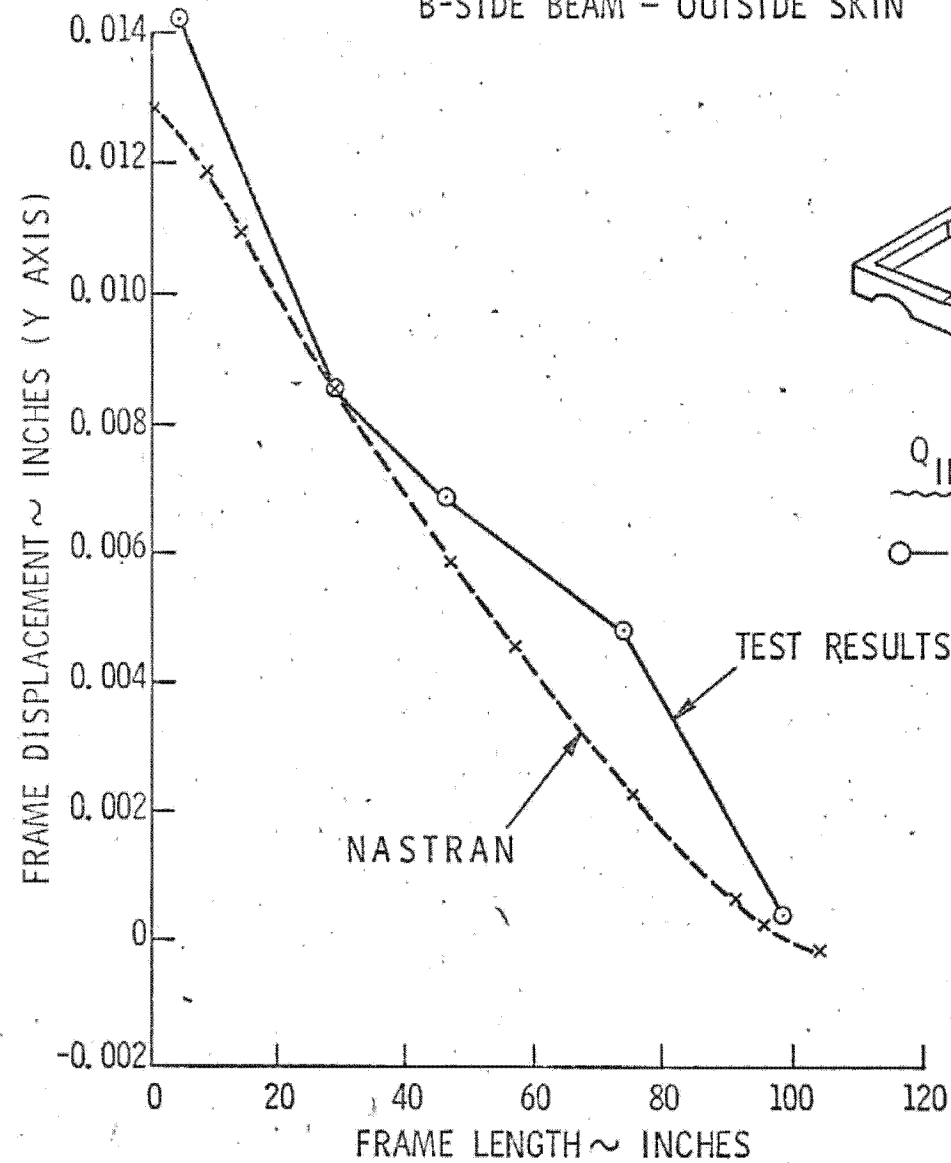
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A-SIDE BEAM - OUTSIDE SKIN



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B-SIDE BEAM - OUTSIDE SKIN



Q IN FWD BEAM

○ DIAL INDICATOR

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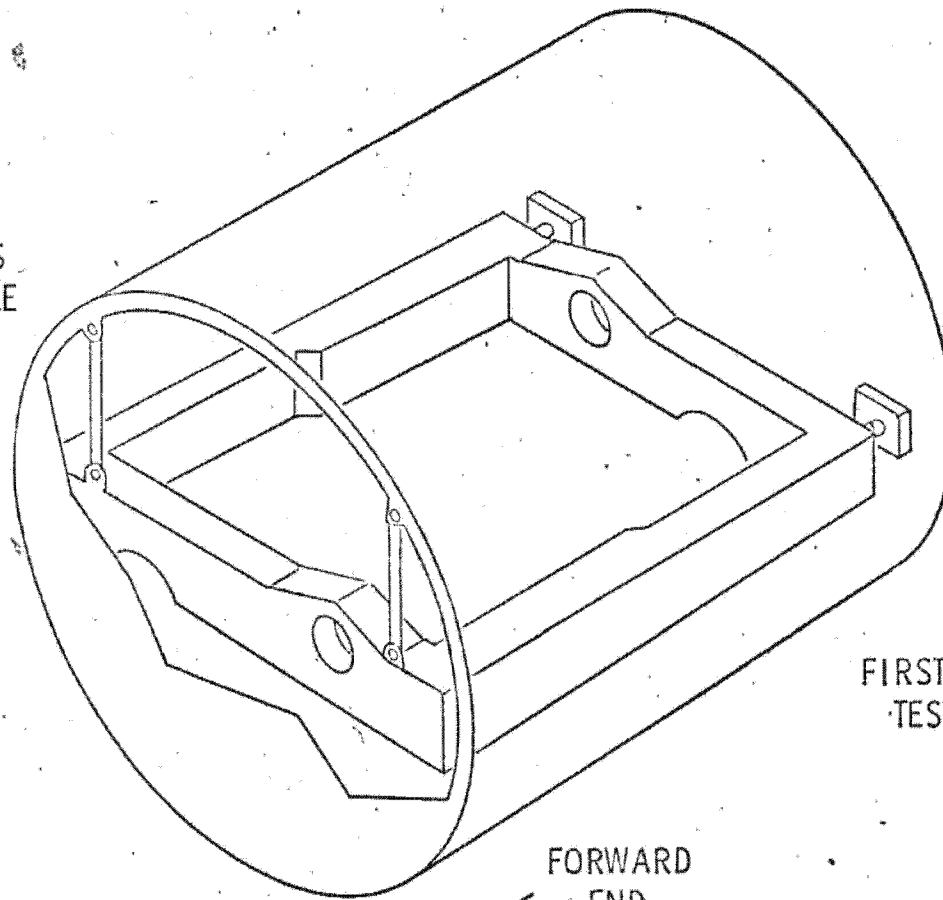
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ENVIRONMENT EFFECTS (CONT'D)

VEHICLE DISTORTION

TCA TWISTS
WHEN VEHICLE
TWISTS

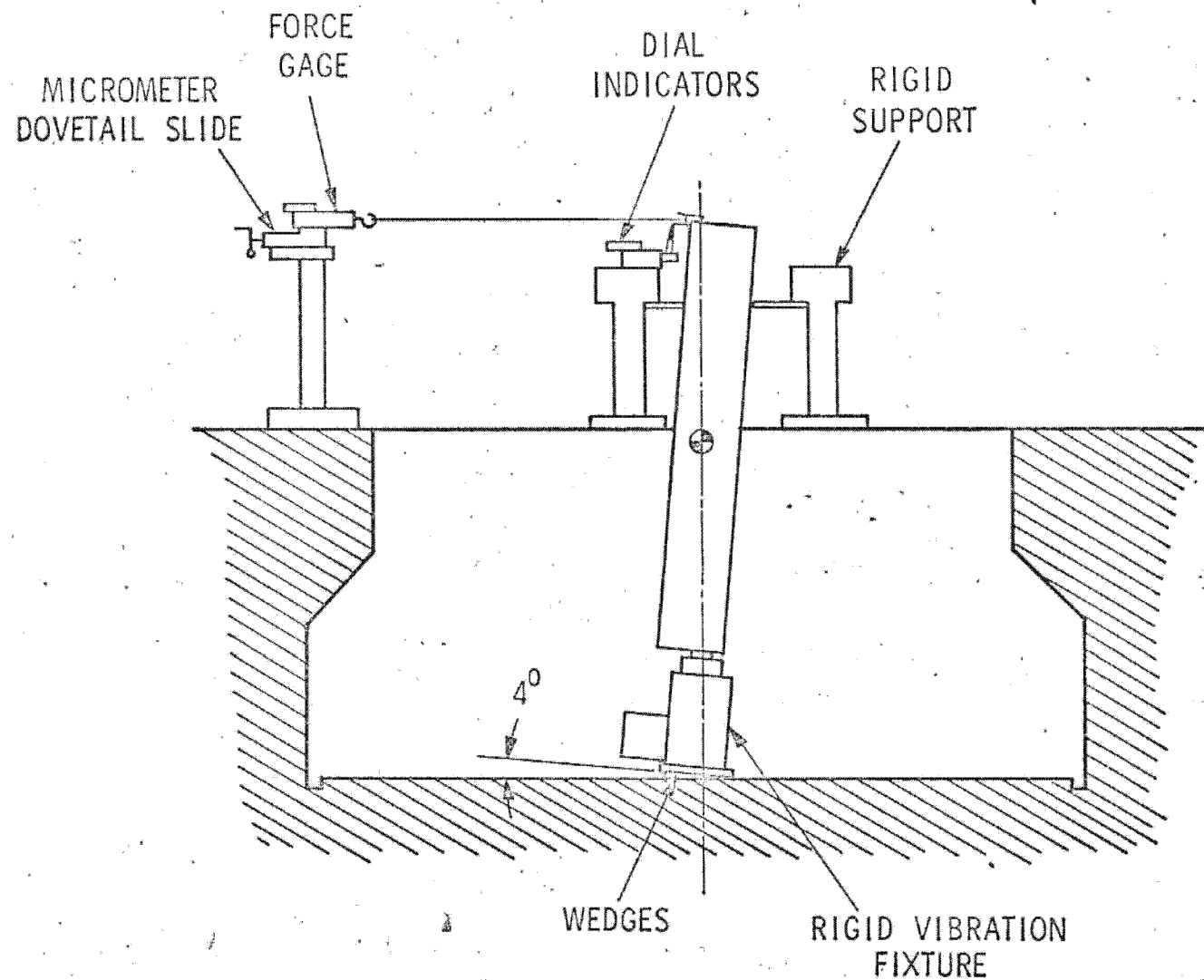


FIRST CHAMBER A
TEST VERIFIED
MOTION

FORWARD
END

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TEST SETUP IN ENVIRONMENTAL LAB PIT



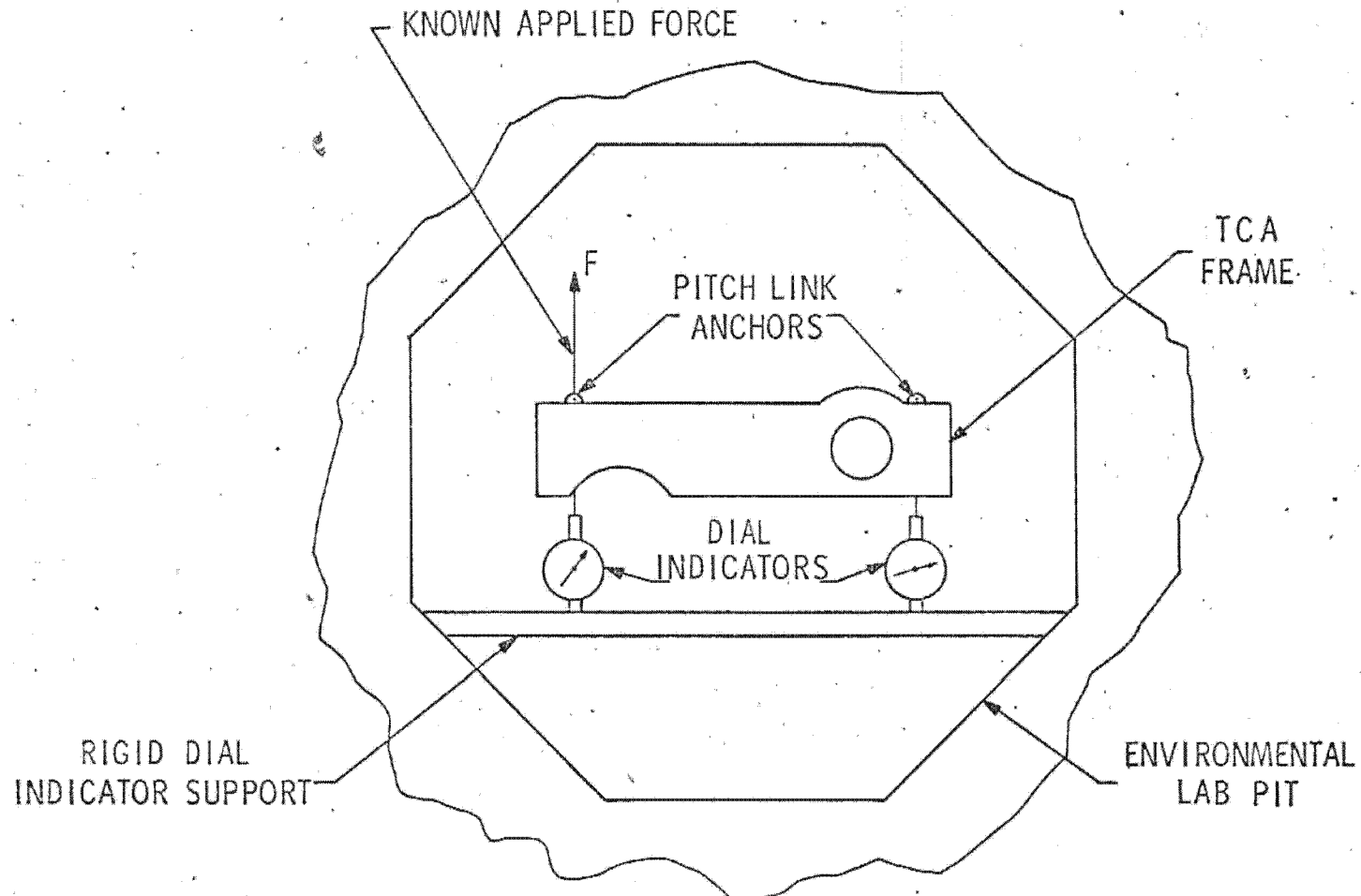
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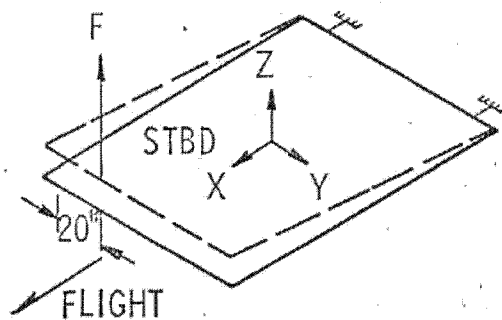
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SCHEMATIC REPRESENTATION OF TCA FRAME TEST

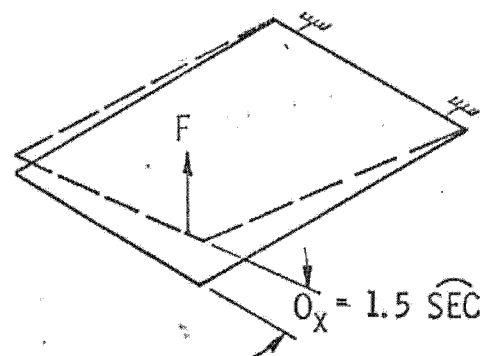


NOTE: DIFFERENCE IN DIAL INDICATOR READINGS FOR A KNOWN APPLIED FORCE PERMITS AN EVALUATION OF TCA FRAME TWIST ABOUT THE ROLL AXIS.

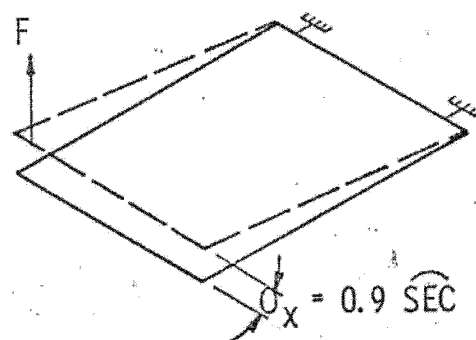
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CASE 2A - Z-AXIS DISPLACEMENT OF
FORWARD FRAME MEMBER AT CENTER
OF COMPLIANCE. (NO TWIST ABOUT
THE X-AXIS.)



CASE 2B - Z-AXIS DISPLACEMENT OF
0.004 INCH AT PORT PITCH LINK
ANCHOR. (CAUSES 1.5 SEC TWIST
ABOUT X-AXIS.)

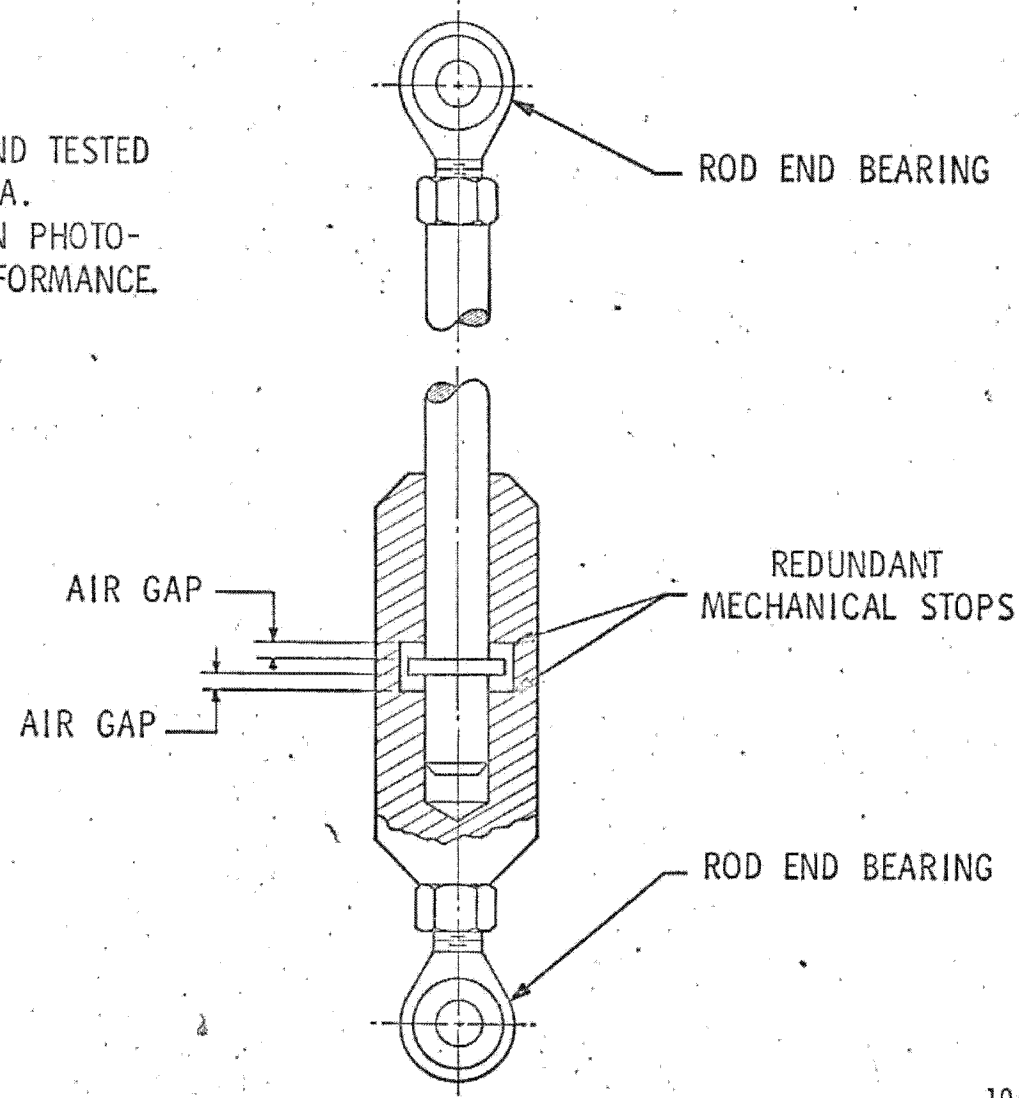


CASE 2C - Z-AXIS DISPLACEMENT OF
0.004 INCH AT STARBOARD PITCH LINK
ANCHOR. (CAUSES 0.9 SEC TWIST
ABOUT THE X-AXIS.)

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SCHEMATIC REPRESENTATION OF MODIFIED PITCH LINK

SIMULATED AND TESTED
IN CHAMBER A.
NO EFFECT ON PHOTO-
GRAPHIC PERFORMANCE



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ENVIRONMENT EFFECTS (CONT'D)

1. THERMAL (CONT'D)

• VEHICLE DISTORTION (CONT'D)

- ONLY ERROR REMAINING DUE TO FRICTION IN BALL JOINTS.
- ERROR BUDGET ALLOWS 1.5 SEC ROLL AND 1.0 SEC PITCH.

• OPTICAL BAR PRIMARY MIRROR TILT

- ICD SPECIFIES 0.5° F CHANGE DURING MISSION
- ERROR BUDGET ALLOWS 0.5° F (0.4 ARC-SECONDS ERROR)

• FOLD FLAT TILT

- ICD SPECIFIES 2° F CHANGE DURING MISSION
- ERROR BUDGET ALLOWS 2° F (0.7 ARC-SECONDS ERROR)

• S³ CAMERA

THERMAL EFFECTS ALLOWANCE 1.9 ARC-SECONDS (1σ)

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ENVIRONMENTAL EFFECTS (CONT'D)

2. ANGULAR VIBRATION OF TCA RELATIVE TO ARM

ERROR IS 1 ARC-SECOND BY SBAC ANALYSIS AND
MEASURED IN CHAMBER A.

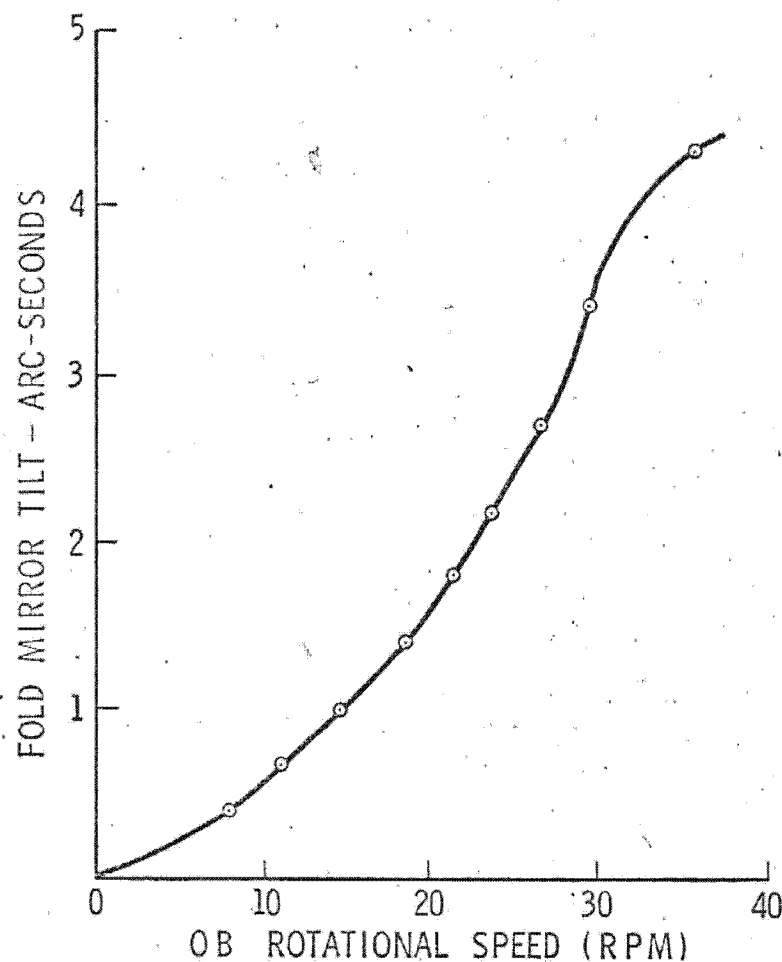
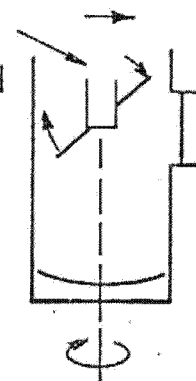
3. FOLD FLAT STABILITY

- TEST CONDUCTED ON OPTICAL BAR 5076.
- TO BE CALIBRATED.
- ERROR BUDGET ALLOWS 1.5 ARC-SECONDS.

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FOLD MIRROR DEFLECTION Vs. SPEED WITH OB VERTICAL

IMAGE MOTION AND
TILT DIRECTION WITH
DECREASING SPEED



NOTE: TILT OCCURRED IN-TRACK ONLY.

THE LOS VARIATION WOULD BE
TWICE THE MIRROR TILT SHOWN
ABOVE.

DISPLACEMENT IN FOCAL PLANE
IS $\sim 2 \times 5 \times 10^{-6} \times 60 \times 25.4 \times 10$
 $15 \mu / \text{ARC-SECOND}.$

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ENVIRONMENT EFFECTS (CONT'D)

4. CONCLUSION

- ENVIRONMENTAL ERRORS COMBINE AS FOLLOWS:

<u>ROLL</u>	<u>PITCH</u>	<u>YAW</u>
3.3 SEC	4.0 SEC	4.4 SEC

- ALL ERROR CATEGORIES COMBINE AS FOLLOWS:

	<u>ROLL</u>	<u>PITCH</u>	<u>YAW</u>
STELLAR SENSOR POINTING ERROR	1.4 SEC	1.8 SEC	1.3 SEC
INTERLOCK CALIBRATION ERROR	1.9 SEC	2.2 SEC	1.8 SEC
ENVIRONMENTAL STABILITY	3.3 SEC	4.0 SEC	4.4 SEC
RSS	4.1 SEC	4.9 SEC	4.9 SEC

- PRACTICAL SOLUTIONS HAVE BEEN FOUND.

- VERIFICATION TESTS SUPPORT ERROR BUDGET.

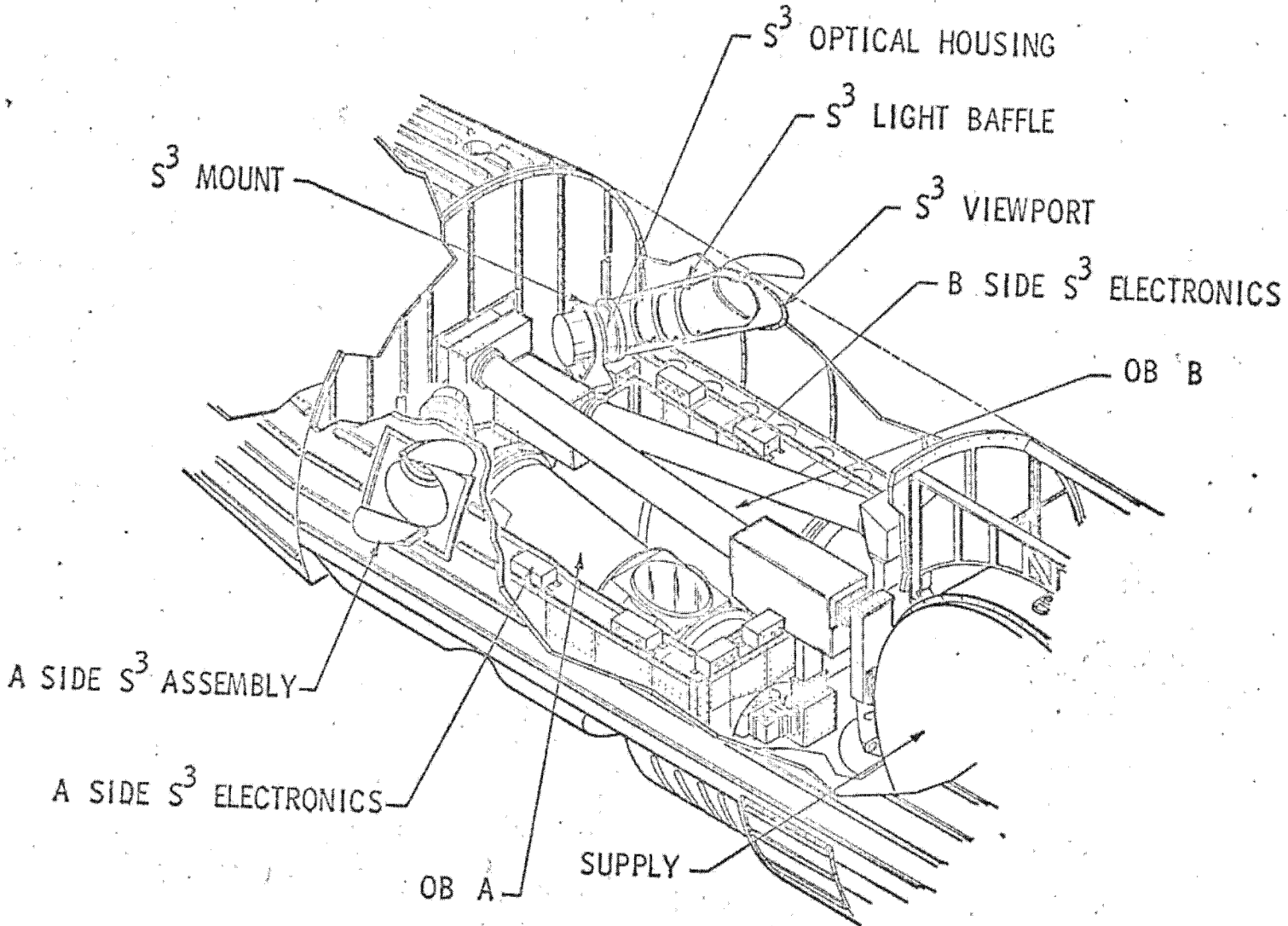
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SOLID STATE STELLAR (S³) CAMERA



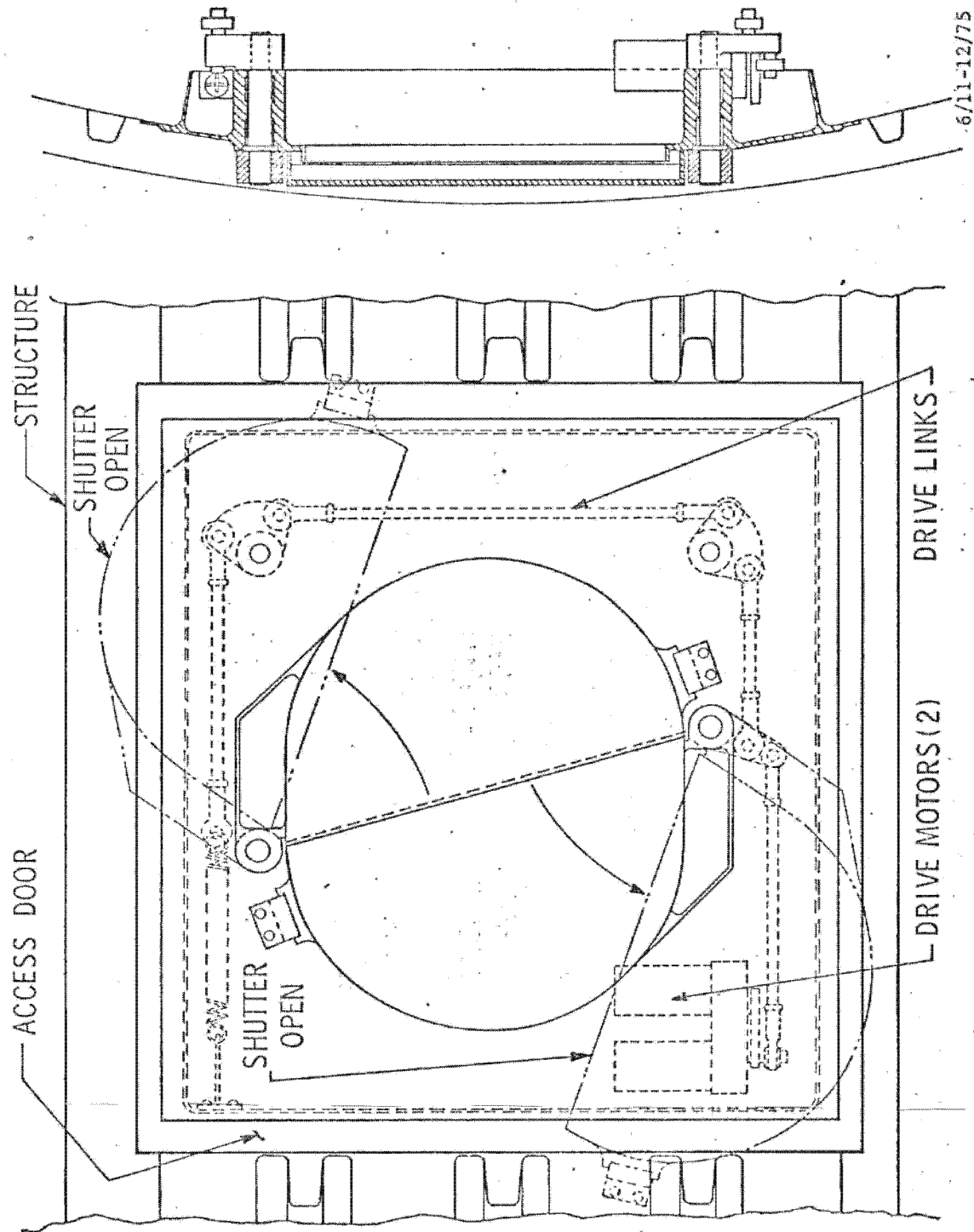
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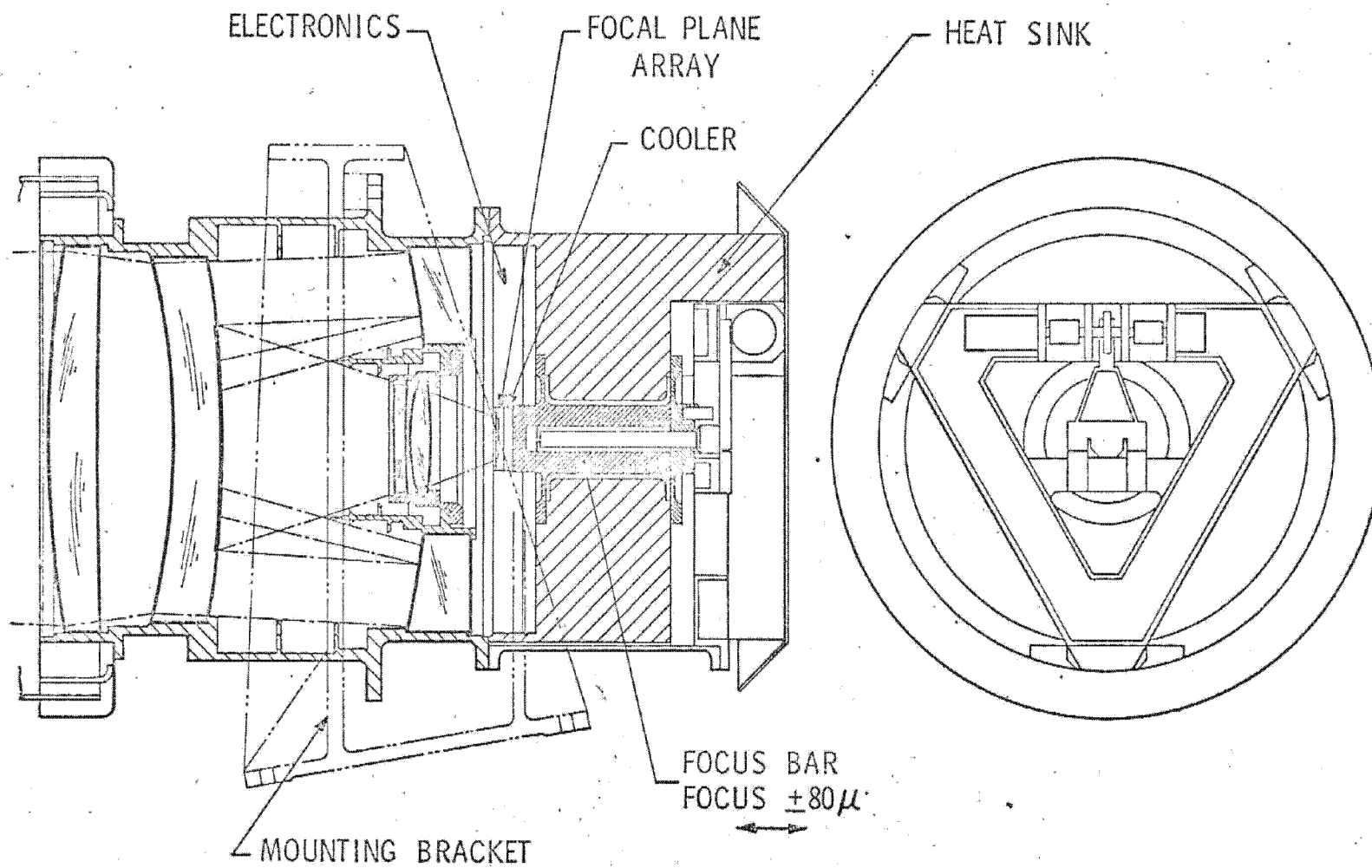
HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

S³ VIEWPORT SHUTTER ASSEMBLY



6/11-12/75 CFW

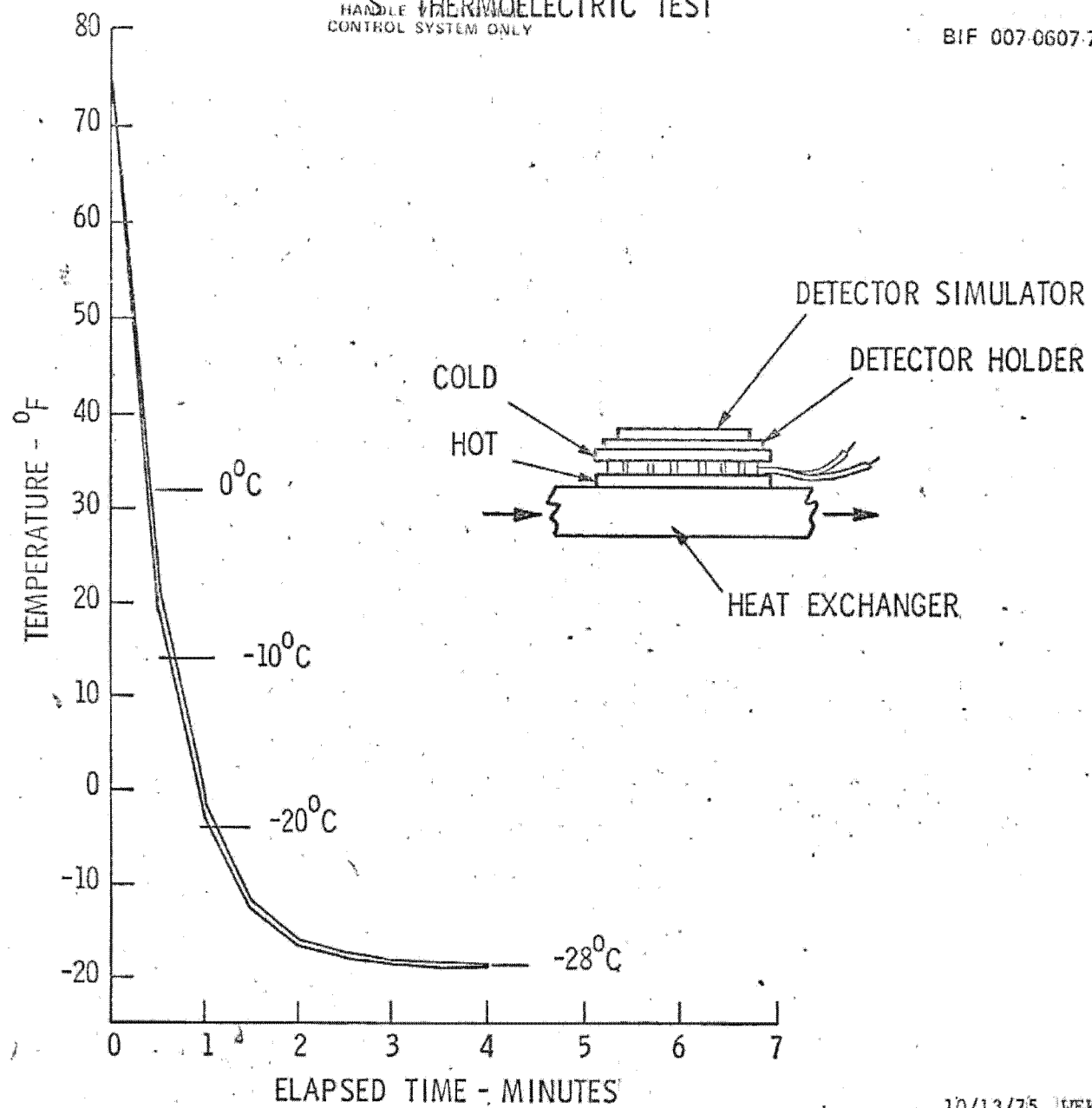
S³ LENS ASSEMBLY



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INTERFACE CHANGES

I. REVIEW WITH SBAC FEB 20, 1975

- ALL THE CHANGES WERE DISCUSSED
- ALL CHANGES WERE DETERMINED TO BE PRACTICAL AND REASONABLE TO ACCOMMODATE
- ADDING S³ REQUIRES REMOVING SOME OTHER PAYLOAD
 - COMMAND PROGRAMMER IS COMPLETELY COMMITTED
 - BOOSTER CAPABILITY IS COMPLETELY COMMITTED.

II. MECHANICAL

- TCA VOLUME INCREASE
 - LENS ASSEMBLIES MOUNTED ON FRAME
 - SUN SHIELD MOUNTED BETWEEN FRAME AND DOOR
- M-2 AND M-3 ACCESS DOOR MODIFICATIONS
 - SHUTTER
 - SHUTTER DRIVE MECHANISM

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INTERFACE CHANGES (Cont'd.)

III. ELECTRICAL

A. TELEMETRYS³ A STELLAR DATA 32 BITS 40 SPSS³ B STELLAR DATA 32 BITS 40 SPS2560 BITS/SECONDSTATUS DISCRETES, TEMPERATURE
MONITORS AND ELECTRONIC MONITORS 500 BITS/SECOND3060 BITS/SECONDB. COMMANDSS³ A ON/OFFS³ B ON/OFFS³ A CAPPING SHUTTER OPEN / CLOSEDS³ B CAPPING SHUTTER OPEN / CLOSEDS³ A FOCAL PLANE ADVANCE / RETREATS³ B FOCAL PLANE ADVANCE / RETREATC. POWER

192 WATTS.

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INTERFACE CHANGES (Cont'd.)

IV. MASS PROPERTIES

132 POUNDS/CAMERA

264 POUNDS/SX

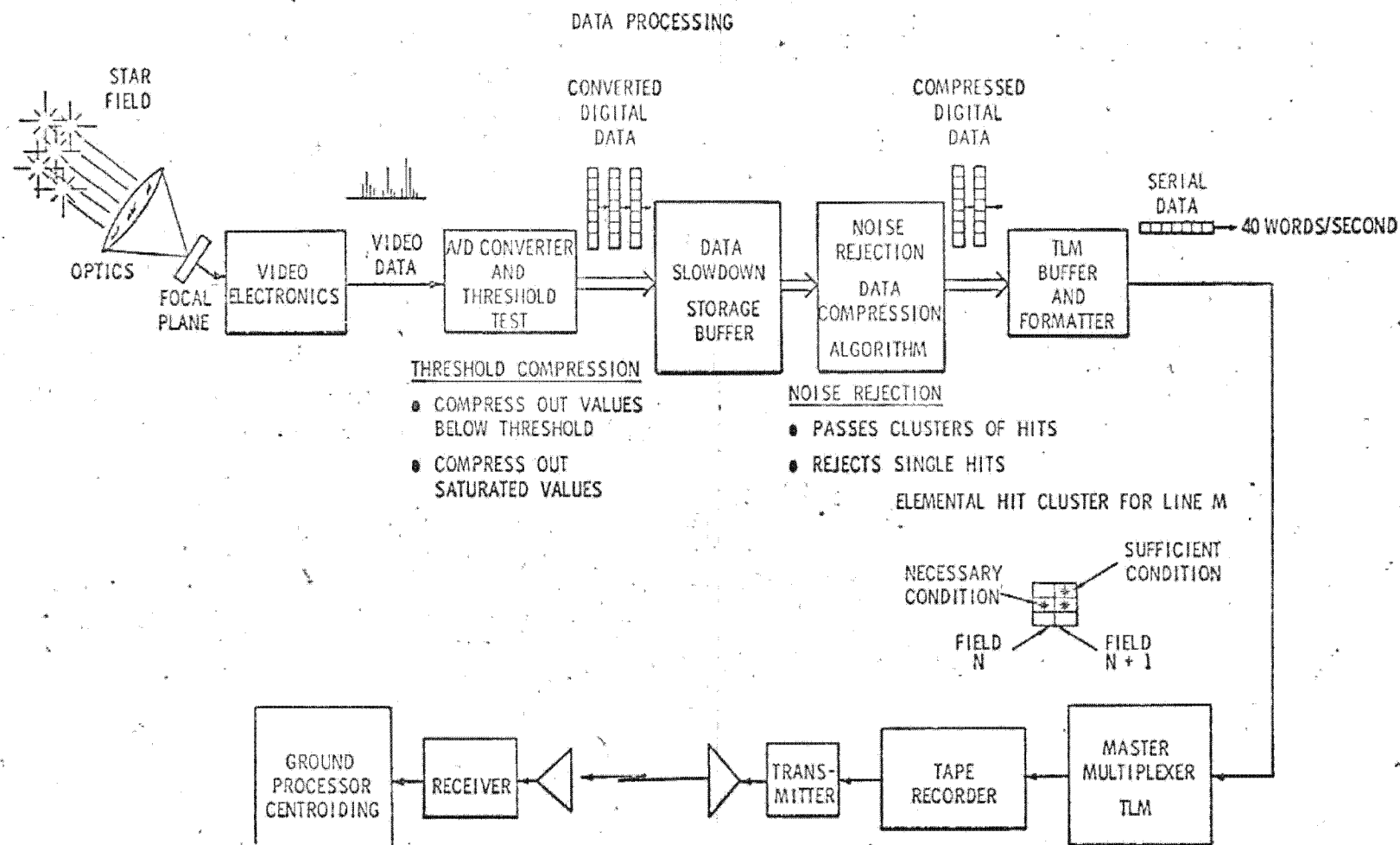
V. THERMAL

A. MODIFICATION TO M-2 AND M-3 DOOR INSULATION.

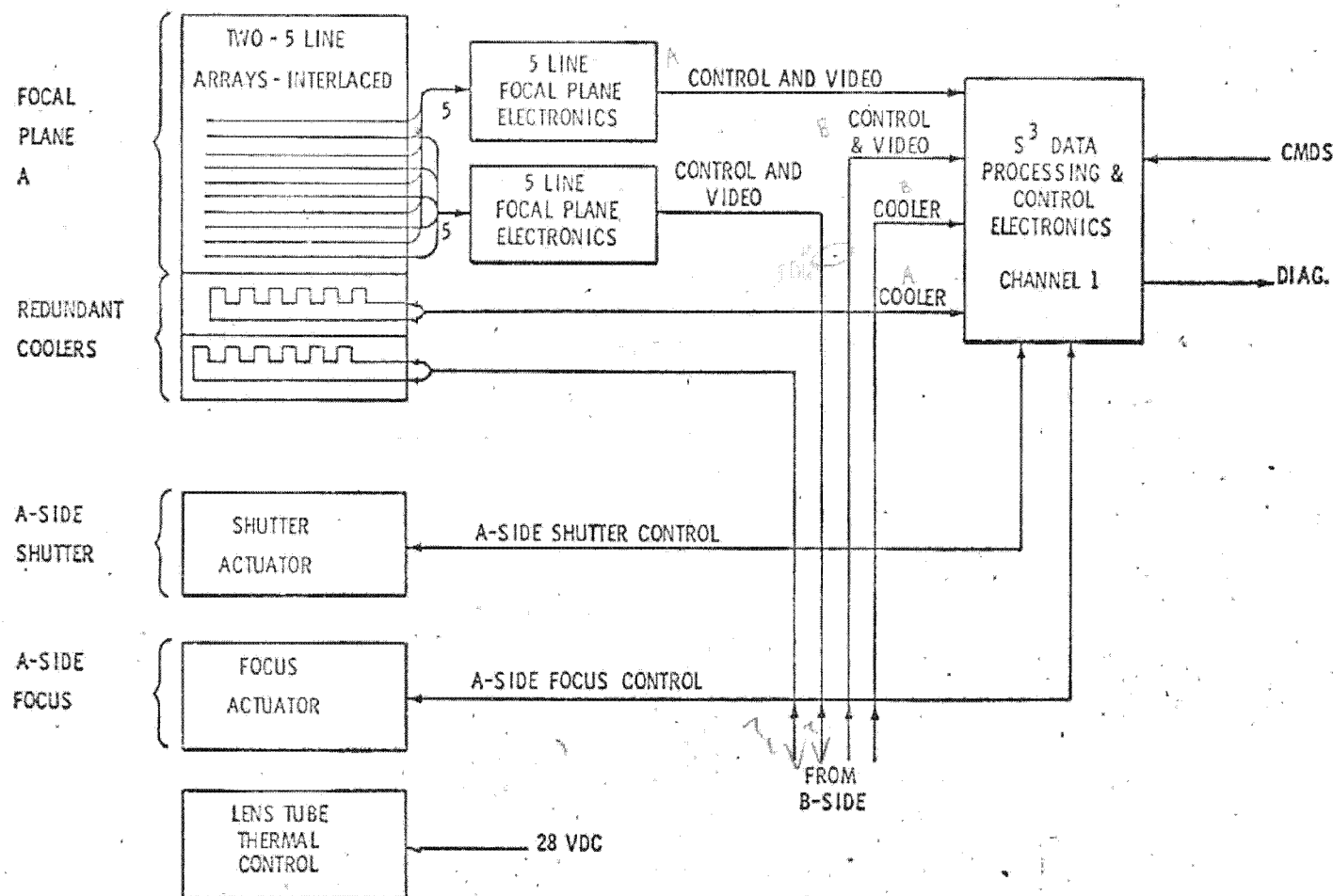
B. ADDITION OF INSULATION BLANKETS AROUND SUN SHIELD
AND LIGHT BAFFLE.

C. ELECTRONIC POWER DISSIPATION.

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S³ ELECTRONICS



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FAIRCHILD LID 1728 BURIED CHANNEL CCD

FOCAL PLANE ELECTRONICS

(Provides Array Clocking Signals and Enhances S/N)

FAIRCHILD LID 1728 BURIED CHANNEL CCD

in a Thermoelectric Cooler Assembly

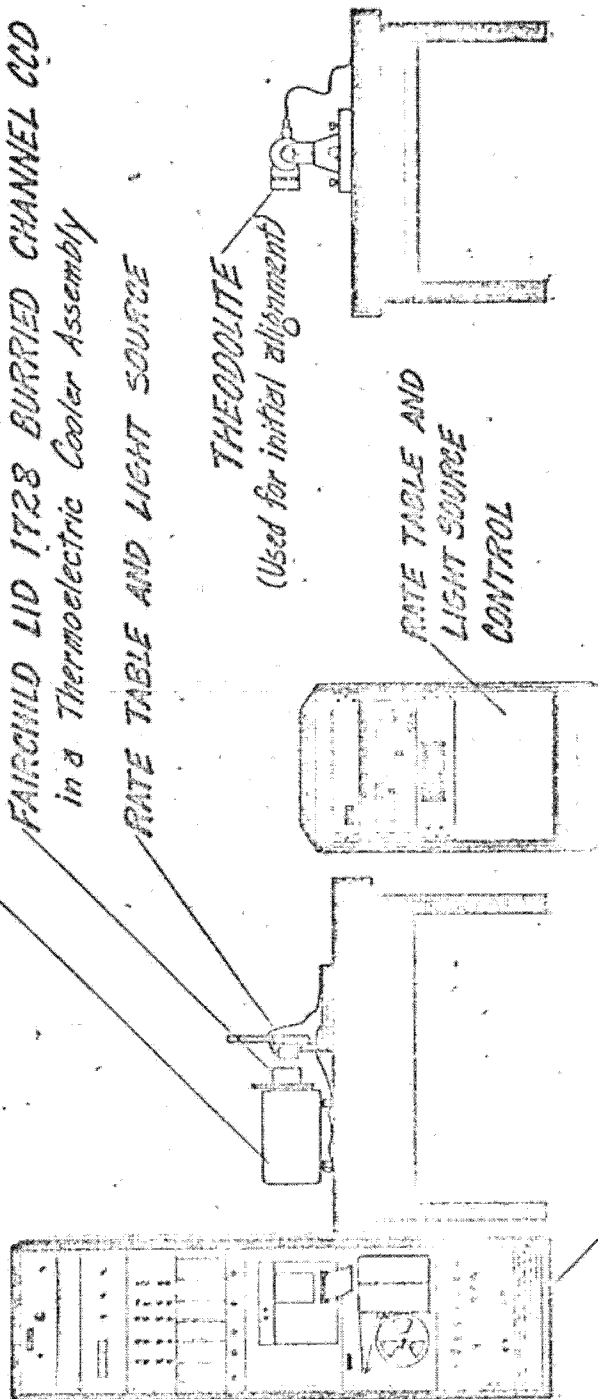
RATE TABLE AND LIGHT SOURCE

THEODOLITE

(Used for initial alignment)

RATE TABLE AND LIGHT SOURCE CONTROL

SIGNAL PROCESSING AND DATA REDUCTION ELECTRONICS

(Digitizes Data and Provides a Recorder Output)

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- RESPONSIVITY
- NOISE
- DARK CURRENT
- ARRAY TEMPERATURE CONTROL
- SIGNAL PROCESSING
- DARK CURRENT CORRECTION
- PIXEL CHARACTERIZATION
- CENTROIDING

FUNCTIONAL TESTS AND OBJECTIVES

- SINGLE LINE ARRAY AND FOCAL PLANE ELECTRONICS FUNCTIONAL TEST
 - MEASURE TIMING AND VOLTAGE LEVELS OF OUTPUT SIGNALS
 - MEASURE AND ADJUST RESPONSIVITY
 - MEASURE DARK NOISE AND DARK CURRENT
- SIGNAL PROCESSING AND DATA CONVERSION ELECTRONICS
 - VERIFY PROPER TIMING AND VOLTAGE LEVELS OF OUTPUT SIGNALS
 - VERIFY ANALOG/DIGITAL CONVERSION AND PRINTOUT
 - MEASURE AND ADJUST THRESHOLD LEVEL
 - VERIFY PRINTOUT OF PIXEL LOCATION, FIELD NUMBER, TABLE POSITION, AND RADIOMETRIC DATA
- INTEGRATED TEST
 - MEASURE DARK CURRENT AND PROGRAM DARK CURRENT CORRECTION MEMORY
 - VERIFY DARK CURRENT CANCELLATION
 - MEASURE RESPONSIVITY
 - MEASURE LINEARITY
 - MEASURE NOISE

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ENGINEERING TEST AND OBJECTIVES

- MEASUREMENT OF ARRAY CHARACTERISTICS
 - DETERMINE THE CENTER OF SELECTED PIXELS
 - DETERMINE PIXEL SENSITIVITY PROFILE
 - DETERMINE CROSS-TALK BETWEEN SELECTED PIXEL AND ADJACENT PIXELS
- CENTROIDING
 - DEMONSTRATE ACCURACY THAT CAN BE ACHIEVED BY THE PHOTODETECTOR ARRAY, ELECTRONIC BREADBOARD, AND DATA REDUCTION SOFTWARE

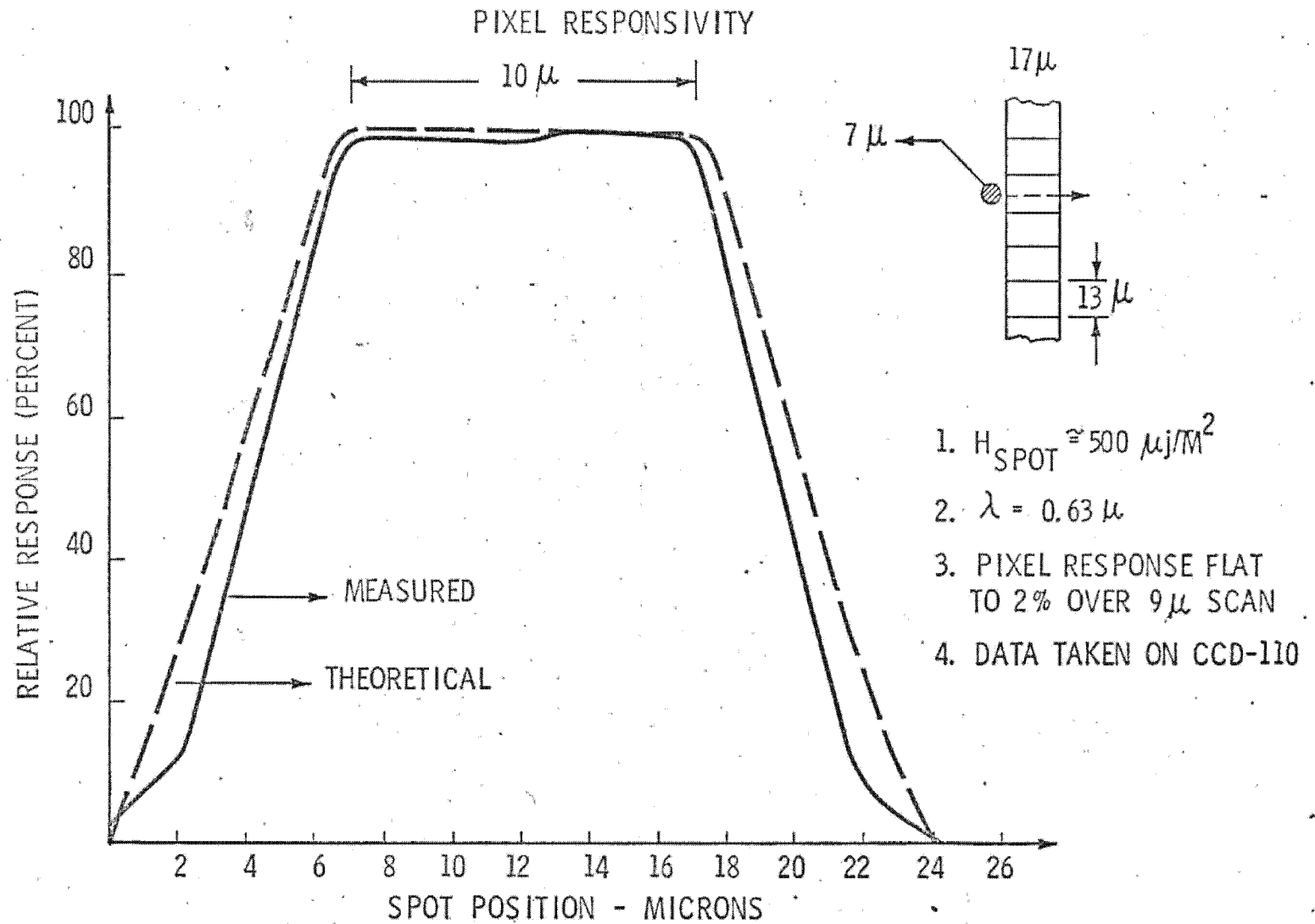
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NOISE SUMMARY
(ELECTRONS)²

PARAMETER	RETICON RL1872F	FAIRCHILD LID 1728
DARK SIGNAL @ -10°C	900	300
BULK STATE	N/A	136
ARRAY OUTPUT	$(400\sqrt{1})^2 = (400)^2$	$(400\sqrt{0.25})^2 = (200)^2$
PROCESSOR	$(400)^2$ *	— 40,000
RMS NOISE	566	78.3
NEE (CALC)	0.81 $\mu\text{j}/\text{M}^2$	0.31 $\mu\text{j}/\text{M}^2$
NEE (OBS)	1.2 $\mu\text{j}/\text{M}^2$	0.35 $\mu\text{j}/\text{M}^2$

* LOW NOISE CIRCUITRY TO BE DEVELOPED
CHIP DEVELOPMENT INCLUDES REDUCTION OF VIDEO LINE
CAPACITY AND RESISTANCE

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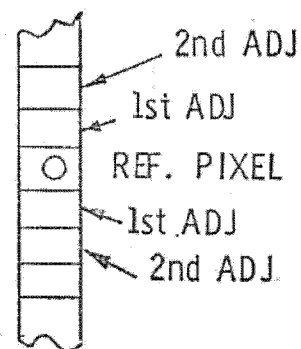
CROSSTALK MEASUREMENTS

WAVELENGTH (0.1 μ)	1 ST ADJ PIXEL		2 ND ADJ PIXEL	
	P-E	FC ^①	P-E	FC ^①
BLUE	$\lambda = 0.45$ $< 1\%$	$\lambda = 0.55$ 5%	$\lambda = 0.43$ 0	$\lambda = 0.55$ 0
$\lambda = 0.63$	6.7 %	7 %	0.9 %	1 %
$\lambda = 0.9$	20 %	21 %	6.5 %	7 %

1. FAIRCHILD REPORT - "SLOW SCAN OPERATION OF LONG LINEAR CCD ARRAYS"

2. ENERGY = 1/2 SATURATION

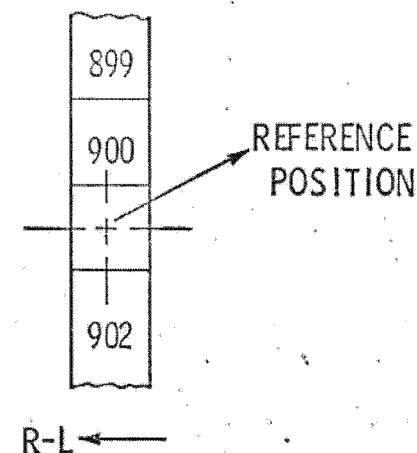
3. DATA FROM CCD-110 (LID 256)



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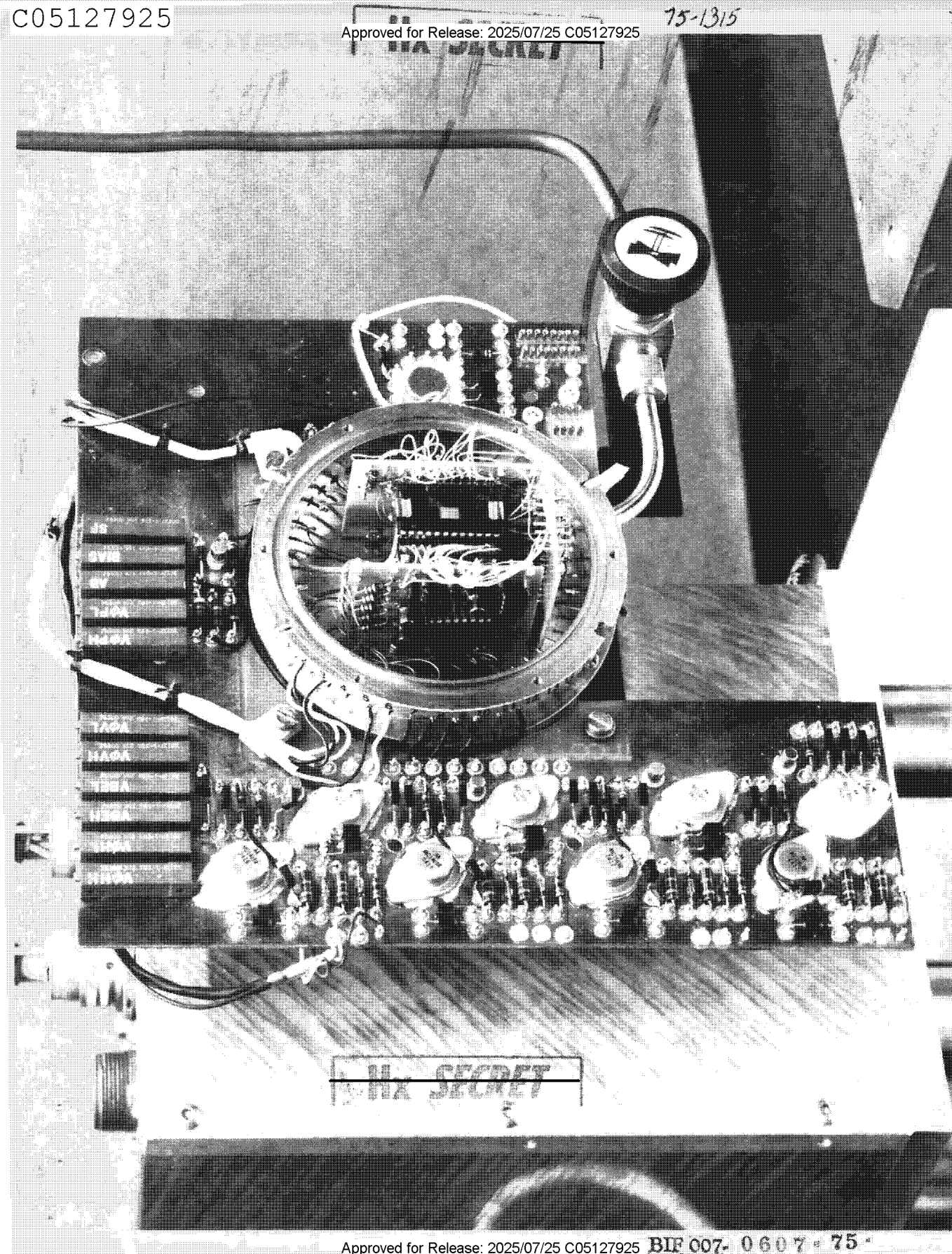
SUMMARY OF CENTROIDING RUNS

RUN NO.	ΔY	ΔX	SCAN	H_{SPOT}
1	$+0.13 \mu$	-0.42μ	L-R	$350 \mu j/M^2$
2	0.	$+1.62 \mu$	R-L	$350 \mu j/M^2$
3	0.	-0.35μ	L-R	$350 \mu j/M^2$
4	$+0.13 \mu$	$+1.59 \mu$	R-L	$350 \mu j/M^2$

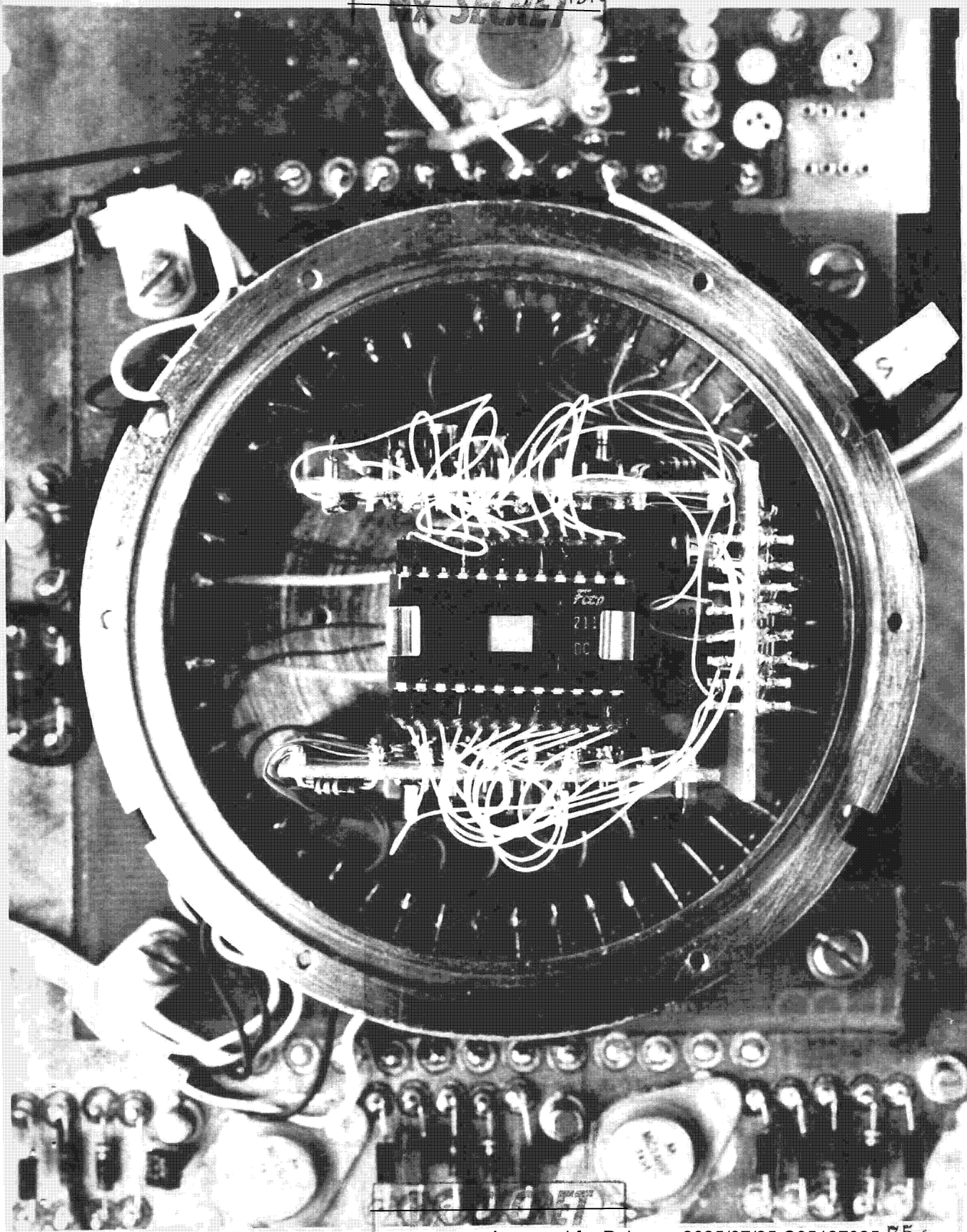


1. REFERENCE POSITION ESTABLISHED BY A MANUAL CENTROID WITH 2μ STEPS.
2. PREDICTED ERROR: 2.0μ RANDOM (1 SIGMA) (ΔX OR ΔY)

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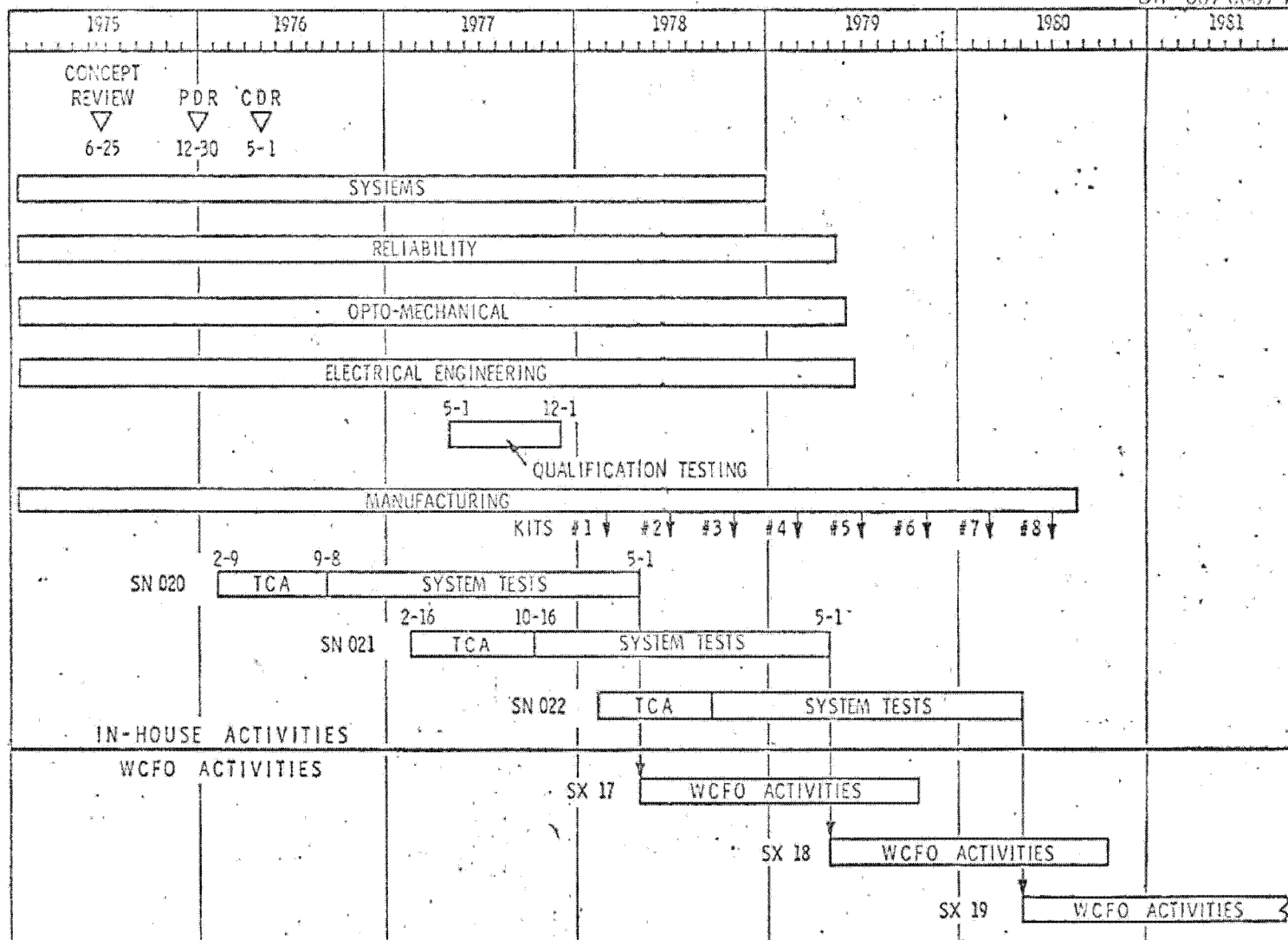


~~SECRET~~



S³ TOP LEVEL SUMMARY SCHEDULE
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S³ PLAN ACTIVITIESGFY '76 (7/01/75 - 6/30/76)

- COMPLETE FOCAL PLANE PROTOTYPE PROCUREMENT AND EVALUATION.
- COMPLETE PRELIMINARY DESIGN REVIEW AND ALSO COMPLETE THE CRITICAL DESIGN REVIEW.
- PREPARE TEST REQUIREMENTS AND DO THE DETAIL DESIGN OF ALL SPECIAL TEST EQUIPMENT, AND PREPARE ALL MANUFACTURING, QUALIFICATION, ASSEMBLY AND TEST PLANS.

GFY '76 (T) (7/01/76 - 9/30/76)

- START PRODUCTION.
- PROCURE TEST EQUIPMENT.
- PLACE ELECTRONICS SUBCONTRACTS.

GFY '77 (10/01/76 - 9/30/77)

- GO INTO PRODUCTION ON ALL SUBASSEMBLIES.
- DELIVER FIRST UNITS FOR ENGINEERING EVALUATION AND QUALIFICATION TESTS.
- START QUALIFICATION TESTS.

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S³ PLAN ACTIVITIES (CONTINUED)GFY '78 (10/01/77 - 9/30/78)

- FINISH QUALIFICATION TESTS, DELIVER FLIGHT S³ SUBSYSTEMS FOR SV 17 AND SV 18.
- DELIVER SV 17's MIDSECTION WITH S³ INSTALLED AND ACCEPTED.

GFY '79 (10/01/78 - 9/30/79)

- DELIVER SV 18's MIDSECTION.
- LAUNCH SV 17 AND SUPPORT OPERATIONS.

GFY '80 (10/01/79 - 9/30/80)

- FIELD SUPPORT AND LAUNCH OF SV 18.

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SUMMARY

- S³ ON HEXAGON IS AN ATTRACTIVE SOLUTION TO THE NATIONAL MAPPING REQUIREMENT.
- A PROGRAM IS DEFINED.
- A CONCEPT HAS BEEN CONFIGURED, ANALYZED AND VERIFICATION TESTS PERFORMED.
- PHOTODETECTORS ARE READY.
- P-17 IS EASILY ACHIEVABLE.

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