DWG NO. 564422 SH 1 REV –

APPLICATION			REVISIONS			
PART NO.	NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	APPROVED
-	-	IN0112A	–	INITIAL RELEASE	02/12/26	W. ANDERSON

As Run – final alignment post platform fix
6/4/03

691.37 & 691.39
C023382 ORS 691.41 & 691.43

(PER MIL-T 31000)

REVISION	-	-	-	-	-	-	-	-	-	-						CONCEPT. DES.	
SHEET	16	17	18	19	20	21	22	23	24	25						DEVELOP. DES	X
REVISION	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-	PRODUCT	
SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	COMMERCIAL	

REVISION STATUS OF SHEETS

UNLESS OTHERWISE SPECIFIED

BREAK SHARP EDGES –

INTERPRET DRAWING PER MIL-STD-100 AND PRODUCT STANDARD 25030

SURFACE TEXTURE EXCEPT AS NOTED 125 √

DIMENSIONS ARE IN INCHES
TOLERANCES

.XX	.XXX	X°
±.03	±.010	±1°

LAYOUT NO.

Ball Aerospace & Technologies Corp.
P.O. Box 1062
Boulder, CO 80306

APPROVED	DATE	APPROVED	DATE
THERMAL N/A		PREP BY L. HUNTER	02/12/26
STRL ANAL N/A		RESP ENGR L. HUNTER	02/12/26
MASS PROP N/A		I & T L. HUNTER	02/12/26
MATL & PRCS N/A		SYSTEM ENGR D. HAMPTON	02/12/26
N/A SAFETY		MECHANICAL DESIGN T. YARNELL	02/12/26
QA J KING	02/12/26	FIT/FUNC ANAL N/A	
LOGISTICS N/A		SYSTEMS N/A	
PROJECT N/A		C&DM N/A	

Instrument Platform Alignment Procedure

SIZE	CAGE CODE	DWG NO.	REV
A	13993	564422	–

CONTRACT NO.

SCALE NONE | WT NA | SHEET 1 OF 25

A9253_BR2281[42A] BR 2281 12/07/01

GODDARD SPACE FLIGHT CENTER

GSFC STI PUBLIC DISCLOSURE EXPORT CONTROL CHECKLIST

Title: Deep Impact - Integration and Test Instrument - Document No: 564422

Instructions – This checklist is used for the disclosures of STI, and ITAR or EAR controlled information.

For STI (scientific and technical information) disclosures subject to NPG 2200.2 (Guidelines for Documentation, Approval, and Dissemination of STI), this checklist should be forwarded with the NASA Form 1676 (NASA Scientific and Technical Document Availability Authorization (DAA)). For all other ITAR (International Traffic in Arms Regulations, 22 CFR 120-130) and EAR (Export Administration Regulations, 15 CFR 730-774) disclosures, this checklist should be forwarded with a copy of the information to the GSFC Export Control Office for review/approval. Completion of this checklist should minimize delays in approving most requests.

Background Information

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Generally, the export of information pertaining to the design, development, production, manufacture, assembly, operation, repair, testing, maintenance or modification of defense articles (e.g., space flight hardware, ground tracking systems, launch vehicles to include sounding rockets and meteorological rockets, radiation hardened hardware and associated hardware and engineering units for these items) are controlled by the State Department under the ITAR. The export of information with respect to ground based sensors, detectors, high-speed computers, and "dual use" (military/commercial) technology items are controlled by the Commerce Department under the EAR. A complete listing of items covered by the ITAR and the EAR can be accessed at http://export.gsfc.nasa.gov. If the information intended for release falls within the above categories but fits into one or more of the following exemptions, the information may be released.

EXEMPTION I – Public domain information

If your information is already in the public domain in its entirety through a non-NASA medium and/or through a NASA release previously approved by any NASA Export Control Office, the information is exempt. If the information falls into this category, you may attest that you are using this exemption by signing below.

Print Name and Code	Signature	Date

EXEMPTION II – Scientific data

If your information pertains exclusively to the release of scientific data (e.g., data pertaining to studies of clouds, soil, vegetation, oceans, planets, stars, galaxies and the universe) without the disclosure of information pertaining to articles controlled by the ITAR or EAR, such as flight instruments, high-speed computers, or launch vehicles, the information is exempt. If the information falls into this category, you may attest that you are using this exemption by signing below.

Print Name and Code	Signature	Date

GODDARD SPACE FLIGHT CENTER

GSFC STI PUBLIC DISCLOSURE
EXPORT CONTROL CHECKLIST *CONTINUED*

EXEMPTION III – General purpose information

If your information falls into the ITAR or EAR areas of concern as referenced above, but is offered at a general purpose or high level (e.g., poster briefs and overviews) where no detailed technical information (e.g., design, development, production, or manufacturing) pertaining to ITAR or EAR controlled items is offered, the information is exempt. If the information falls into this category you may attest that you are using this exemption by signing below.

Edwin J Grayzeck 690.1		Sept 28, 2005
Print Name and Code	Signature	Date

EXEMPTION IV – Software safety and assurance methodologies

If your information pertains exclusively to the release of software safety and assurance methodologies or studies, without disclosing information pertaining to articles controlled by the ITAR or EAR, the information is exempt. If the information falls into this category, you may attest that you are using this exemption by signing below.

Print Name and Code	Signature	Date

REQUEST FOR ITAR 125.4(b)(13) EXEMPTION – Technical data

If your information is not satisfied by the exemptions stated above, the information might be releasable using exemption 125.4(b)(13) of the ITAR. This exemption allows the release of ITAR controlled information into the public domain and does not require that the information be published in order to qualify. Use of this exemption is afforded only to agencies of the Federal Government. The GSFC Export Control Office will approve this exemption only after receiving assurance that such a release is a responsible action. The following guideline has been established regarding the use of this authority: The information may not offer specific insight into the design, development, production, or manufacture of an identified ITAR controlled item (reference paragraph 2 above) in sufficient detail (by itself or in conjunction with other information in the public domain) to allow potential adversaries to replicate the item, or exploit or defeat controlled U.S. technologies. All signatures of approval on NASA Form 1676 (and in the signature blocks below) expressly indicate concurrence with the responsible use of this exemption when it is requested. If you determine that you have met these criteria, you may attest your determination by signing below, and the GSFC Export Control Office will offer favorable consideration toward approving your request under this special exemption.

Print Name and Code	Signature	Date

If a NASA Form 1676 does not accompany this request, use of this exemption requires approval from a Branch-level or higher management official.

Print Name and Code	Signature	Date

The GSFC Export Control Office [✓] approves [ ] does not approve this exemption/request.

Thomas A. Weisz, Code 232.2	Thomas A. Weisz	9/28/05
Center Export Administrator (CEA)	Signature	Date

If your STI, ITAR, or EAR disclosure does not satisfy any of the above exemptions, please contact the GSFC Export Control Office for further clarification on the releasability of your information under the ITAR or EAR.

CONTENTS

1.0 SCOPE

This procedure describes the test processes for the Instrument Alignment of the MRI Assembly (Drawing #559698), HRI Assembly (Drawing #559699) and the co-alignment of the HRI to MRI. The operations performed in the course of this procedure will be used to align and focus the MRI Telescope to its CCD, the HRI telescope its CCD and the 2 Instrument's Boresights to each other.

1.1 Primary Operations

The purpose of this procedure is to provide adequate instructions to perform the following operation on the IP Assembly (Drawing #559700).

a. Provide the electromechanical and optical setup required for determination of the alignment of the CCD detector to the MRI Telescope optics.

b. Align the boresight of the HRI to the boresight of the MRI.

c. Provide the electromechanical and optical setup required for determination of the alignment of the CCD detector to the HRI Telescope optics.

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this procedure to the extent specified herein. Unless a specific issue or revision is listed, these documents shall be of the latest issue or revision in effect at the time of test. In the event of a conflict between this procedure and the reference documents the contents of this procedure shall govern.

2.1 Deep Impact Program Documents

561286	Deep Impact Integration and Test Plan
559698	Instrument Assembly-MRI
559699	Instrument Assembly-HRI
559700	Instrument Platform Assembly Flyby Spacecraft Assembly- Deep Impact
576700	CSTOL: MRI Power On
576701	CSTOL: MRI Power Off
564435	CSTOL: MRI VIS Detector Single Mode Dark Imaging
564436	CSTOL: MRI VIS Detector Single Mode Light Imaging

574498	CSTOL: HRI SIM Power on
574499	CSTOL: HRI SIM Power off
574506	CSTOL: HRI VIS Single Mode Dark Imaging
574507	CSTOL: HRI VIS Single Mode Light Imaging
574502	FUNCTIONAL TEST PROCEDURE, IRFPA
574503	FUNCTIONAL TEST PROCEDURE, CCD
575086	CSTOL: HRI IR Detector Single Mode Calibration
SPS 1930	Special Handling and Packaging for Infrared Detectors
SPS 3096	Electrostatic Discharge Protection, Components & Assemblies Sensitive to 50 Volts or less

3.0 TEST CONDITIONS AND REQUIREMENTS

3.1 Precautions

Failure to follow the procedures contained in this document may result in damage to flight hardware.

3.1.1 ESDS Equipment (if applicable). The test specimen contains electrostatic-discharge sensitive (ESDS) devices that may be exposed at the electrical interfaces. Therefore, it shall be handled per MIL-STD-1686 Class 1, as implemented by SPS 120211. (Note: Some hardware on Deep Impact may be sensitive to less than 50 volts. Reference SPS 3096.) The test specimen, the test operator (using wrist straps), and related electrical test equipment shall be connected to a common ground before any electrical connecting or disconnecting operations, and during the use of any electrical test equipment probes. The following requirements are important:

a. All personnel within 1 meter of the Instrument or Electronics, and all related test equipment shall be connected to a common ground at all times.

b. An ionizing blower shall be in place and operating whenever static generators such as nylon sheeting or paper are within one meter of exposed electrical interfaces.

c. Under no circumstances shall connections be made to the unit under test while power is applied.

d. Test cables and equipment shall have all pins shorted to equal potential (or ground) prior to being connected to ESDS hardware. This requirement shall be met by using shorting devices on applicable connectors prior to mating.

3.1.2 Proof Load Certification (as applicable). All equipment to be used for flight hardware lifts shall have current proof load certification. If certification paperwork does not exist, or is out of date, proof load testing must be performed, using a technique appropriate for the device in question. Immediately prior to use, each such device shall be visually inspected for damage.

Any hardware exhibiting cracks, or any cable having parted strands, or any similar defects, shall be disposed of and replaced or documented on an MDR, regardless of its state of certification.

3.1.3 General Precautions for Connectors:

a. Use connector savers on all flight hardware electrical connectors that require them per the Deep Impact Connector Guidelines.

b. Flight hardware electrical connectors shall be capped with ESD approved covers when they are not in use, to minimize contamination, and to prevent damage from electrostatic discharge.

c. Before mating any connector, examine the connector to assure that there is no interference or visible contaminants at the pin or socket interface. Notify QA if connectors exhibit any problems.

d. Extreme care shall be exercised should connectors need to be probed at any time, and the following precautions taken:
   - The probing pin shall be a mating pin or socket that is insulated to prevent shorting.
   - The probing pin shall be gold plated, or of a non-marring smooth surface.

3.2 Safety Requirements

In accordance with the Reliability, Parts and System Safety Handbook SP0031A-014, the System Safety Engineer or his delegate has final authority over safety provisions contained in this procedure, and in controlling any hazardous conditions which may arise during any operations performed in accordance with this procedure.

3.2.1 Responsibility for Safety. All personnel are responsible for maintaining a safe work environment. The Test Conductor or cognizant operator shall assure that appropriate safe practices are implemented during these operations, and that operations are performed in a proper order.

3.2.2 Test Readiness reviews. Prior to the commencement of any activities detailed in this document, and again at each shift change, the Test Conductor or cognizant operator shall conduct a pre-test briefing. Also, immediately prior to each hazardous sequence of operations, the Test Conductor or cognizant operator shall conduct a pre-task briefing. Both the pre-test and pre-task briefings shall include a discussion of:

a. Test sequence, objectives, and equipment

b. Nature and location of the specific hazards to be encountered

c. Hazard controls, including protective equipment, safety boundaries, personnel access, etc.

d. Limitations on concurrent activity

e. Emergency instructions and response, and, when the situation warrants, the availability of emergency shutdown procedures.

3.2.3 Caution and Warning Notations. In this procedure follow these definitions:

- Caution: Operational step, etc., which if not adhered to or observed could result in damage to the equipment
- Warning: Operational step, etc., which if not adhered to or observed could result in loss of life, or personal injury, or exposure

3.2.4 Mechanically Assisted Lift Hazard. Severe damage to personnel and flight hardware may result if lifting fixtures are excessively loaded. Lifting hardware shall never be used in a configuration that may apply loads greater than the working load that is clearly marked on each piece of lifting hardware. Never use lifting hardware that is not marked with a working load and proof test date. A properly certified crane operator shall control the lift.

3.3 Cleanliness and Environment

Hardware cleanliness requirements at the different assembly levels are delineated in the assembly certification log. If required by that cert log these operations shall be conducted in a class 10,000 clean area as defined in FED-STD-209B, and as implemented by BATC process standard BPS 21.04. Cleanliness of the test units shall be established and maintained per BATC specification SPS 2756.

Standard laboratory conditions of atmospheric temperature (18 to 28°C), pressure (520 to 810 torr), and relative humidity (25 to 70 percent) are acceptable for the operations defined herein.

3.4 Controlled Redline Procedures

BATC DEEP IMPACT test procedure change control shall be implemented in compliance with DEEP IMPACT QWI.

a. Any testing of flight hardware shall be required to be done in accordance with a test procedure that has been formally released prior to the start of the applicable test. This means that test procedures must be released through BATC Engineering Document Control prior to use.

b. Once the test procedure is released, it may be changed in compliance with WI Test.4.3.005 Controlled Redline Test Procedure. Such changes may also be made during the test.

c. Applicable personnel as prescribed in program plan QSP 1.4 Program Management must approve such changes.

d. The Test Engineer controls the “AS-RUN COPY” of the test procedure containing such changes.

e. Subsequent to completion of the applicable test, but before final buyoff of that test in the applicable Certification Log, the redline changes to the "AS- RUN COPY" test procedure shall be incorporated in a formal revision of the test procedure.

3.5 Software Configuration

Prior to beginning any DEEP IMPACT test, the revision of any and all flight software and test software shall be recorded. The listing will include the software version numbers, tables, and

database version numbers. If any software is revised during the testing, record the revision information required identifying the software configuration used during each test operation.

4.0 QUALITY ASSURANCE (QA) PROVISIONS

QA provisions operative during activities defined in this procedure are derived from the DEEP IMPACT Product Assurance (PA) Plan and the DEEP IMPACT Quality Work Instructions (QWI) document. These provisions, summarized below, identify the interfaces between QA and test personnel.

a. The PEQA shall be notified, in advance, of performance of any activities described in this procedure. A QA Inspector shall be assigned to monitor those activities as is deemed necessary or appropriate, in accordance with the QWI. When required, QA shall notify the customer and/or government representatives, who may, at their option, monitor or witness the activity. The PEQA shall attend the "Ready-to-Test" meeting with assigned QA personnel, to assure QA support during the test, and to address and resolve outstanding QA items.

b. The PEQA shall assure that the proper "as-run copy" of this procedure document has been prepared, and that the required Cert Log is in proper order. When all pre-test conditions have been met, the PEQA shall complete the "Ready-to-Test" entry in the applicable Cert log.

c During testing, the PEQA shall approve, prior to its implementation, any major changes to the test procedure involving actual testing deviation, test set-up, measurement methodology, or tolerance changes, along with the cognizant design engineer and the Test Conductor.

d. Test Support provided by the QA Inspector shall be as follows:

- Verify that calibration is current for test and measuring equipment in accordance with QSP 11.1 " Selection, Maintenance, and Control of Inspection, Measuring, and Test Equipment".
- Verify that applicable project-specific electrical ground support equipment (GSE) has been properly certified and tagged in accordance with QSP 11.2 "Development, Certification, and Control of Ground Support Equipment".
- Verify that applicable lifting and handling GSE has been properly proof tested and tagged.
- Assure that the proper change control practices are applied as described in section 3.4, which implements the applicable provisions of QSP 4.4 Design Changes.
- Assist in assuring that the precautionary and safety requirements stated in sections 3.1 and 3.2 are met.
- Assist in the inspection of test setups prior to application of power to a test specimen, and prior to any mechanism-assisted lifts or moves.
- Witness all flight article movements, and stamp data as being approved where such data meets the requirements specified in the procedure.
- Monitor all automated tests, and stamp data collected per procedure requirements.

- Approve, along with the Test Conductor, any minor changes to the procedure document (such as misspellings, grammar, administrative-type errors, and non-functional operational changes).
- Prepare quality assurance test documents as applicable. In the Action Item List of the Certification Log, document any discrepancies or non-conformances noted during or after testing, and immediately notify the PEQA.

e. At completion of the test, the PEQA/Inspector shall perform the following:

- Review all test data for completeness, and to verify that all measurements are within tolerances.
- Assure that the resulting test data fulfills the test requirements of the end item.
- Verify completion of any related action items and disposition of any related MDR's in the test Cert Log.

f. Upon the occurrence of a test anomaly (any event that deviates from the planned procedures, exceeds normal variations, or generates unexpected data), operation of the test article shall be stopped immediately, All other test conditions and parameters shall be maintained (except as those conditions that may pose an immediate hazard). The Inspector and the Test Conductor shall review the anomaly. Minor, non-destructive, investigative troubleshooting that will not change the failure mode of the article under test, may be conducted by the Test Conductor, with PEQA concurrence. All troubleshooting shall be performed in accordance with QSP 13.1 Control of Nonconforming Product and WI PA.13.1.004 Test Anomaly Work Sheet (TAWS). At no time will anything other than minor troubleshooting be allowed without Material Review Board (MRB) approval. If the anomaly is found to result from human error or test equipment problems that have not affected the test article, corrective action shall be taken and testing may continue. The PEQA checks the "continue test" box, the "approval" box, and signs the TAWS along with the Responsible Engineer.

g. If a test anomaly cannot be resolved as described above, the PEQA shall be notified, and an appropriate entry shall be made in the Action Item List (AIL) portion of the Certification Log. The PEQA shall prepare a Material Discrepancy Report (MDR) and convene the Material Review Board (MRB) for action as specified in WI PA.13.1.002 "Completion of Material Discrepancy Report". The MRB convened to resolve an anomaly that occurred during testing shall include a representative of the project test group. Testing of the failed item shall then not continue without prior authorization from the MRB.

5.0 CONFIGURATION AND TEST DESCRIPTION

5.1 Test Item Configuration

The Instrument Platform Assembly (559700) with its flight thermal blankets will be mounted on the IP Thermal Vac Fixture (T131406) with the flight flexures and flight-like fasteners. The T131406 fixture will be attached to the T131503 Roll Fixture, Instrument Platform. The setup will include the 2 Instrument Electronics and the CCD Preamp Boxes.

5.2 Test Description

a. The IP on the roll fixture will be placed in front of Optical Test Station 2.

b. The MRI optical to CCD boresight and focus will be checked and set using the 568641 ITOC to read the CCD.

c. The HRI will then be aligned to the MRI using the optical cubes on each instrument. The HRI will be moved using shims on the flexure to platform attach points to match it to the MRI.

d. The HRI optical to CCD boresight and focus will be checked and set using the 568641 ITOC to read the CCD.

e. Images will then be taken in the upright and inverted positions to determine boresight of each instrument and boresight co-alignment.

6.0 REQUIRED EQUIPMENT

This list of equipment is necessary but not sufficient to perform all procedures incorporated by reference. Each referenced procedure will contain a list of specific hardware required to perform that procedure. The engineer responsible for the referenced procedure shall assemble the specific hardware and software and report readiness to the test conductor.

6.1 IP Flight Hardware

- 559700 Instrument Platform Assembly ✓
- 564303 Instrument Electronics Assembly, HRI ✓
- 564304 Instrument Electronics Assembly, MRI ✓
- 564307 CCD Preamp Assembly (2 ea.) ✓

6.2 GSE, Tooling, and Other Test Equipment

- T131406 IP Thermal Vac Fixture Assembly
- T131503 Roll Fixture, Instrument Platform — FLOTRON
- T131459 ~~Assembly Thermal Control Surrogate Panel~~ 1 Flight panel 1
- 568641 ITOC SN00 for MRI SN02 for HRI
- G102451 Data Analysis Computer (hammer) ✓
- Ionizing air blower (2ea) ✓
- Optical Test Station 2 ✓
- Breakout Box and appropriate cables } see 574503 & 574502 as-Run for equipment.
- Wavetek Handheld DVM

DLH 6/4/03

7.0 TEST SETUP

Prior to executing the test procedure contained in section 8 the Test Engineer and Test Conductor(s) shall confirm that the following operations to set up the hardware and test equipment are complete.

a. Verify that the Test Readiness Review and test prerequisites have been satisfied. Review the Cert Log and confirm that the hardware is ready to proceed. ✓

b. Verify that all GSE and other equipment required and listed in section 6.0 is available, correctly configured for the test procedure, and have current calibration stickers or certification. ✓

7.1 Mechanical Setup

a. Install the Instrument Platform Assembly (559700) on the T131406 IP Thermal Vac Fixture and ~~T131503 Roll~~ FLOTRON Fixture with the flight flexures and flight like fasteners.

b. Set the IP setup in front of Optical Test Station 2. ✓

c. Connect a GN_2 purge line to the IP to allow operation of the mechanisms after 48 hours of purge. ✓

7.2 Electrical Setup, MRI

CAUTION

Do not connect the CCD to the CCD Preamp Assembly at this time. Exposed focal plane interfaces are to be in the flow of ionized air at all times.

a. Electrically connect the Instrument Electronics Assembly, MRI (564304) to the 568641 ITOC. Connect Mechanism Cable and the TLM Cable to the MECH/TLM Board in the IE and MRI Instrument. Connect the cables from the IE to the Preamp Assembly. ✓

b. Perform a Shorts/Open test on the CCD detector as per FUNCTIONAL TEST PROCEDURE, CCD (574503). ✓ see C023382 OP 691-31R

c. Perform a CCD Safe-to-Mate test as per FUNCTIONAL TEST PROCEDURE, CCD (574503). C023382 OP 691-31R

d. Ensure that the IE is powered off before proceeding to the next step. ✓

e. Connect the CCD to the IE. ✓

f. Turn on power and warm clock the CCD per CSTOL: MRI VIS Detector Single Mode Dark Imaging (564435). – see results of ~~5664~~ functional 576694 ✓

7.3 Electrical Setup, HRI C023382 OP 691-35R

CAUTION

Do not connect the IR Detector or the CCD to the Instrument Electronics or Preamp at this time. Exposed focal plane interfaces are to be in the flow of ionized air at all times.

DLH 6/4/03

CAUTION

Connection of the IR Detector and CCD to the Instrument Electronics is to be done by Detector Engineering per 574502 for the IR Detector and 574503 for the CCD. Failure of any procedure incorporated by reference in this document is grounds for halting operations as per Section 4 item F. Pass/fail criteria are defined in the procedures incorporated by reference.

a. Electrically connect the Instrument Electronics Assembly, HRI (564303) to the 568641 ITOC. Connect Mechanism Cable and the TLM Cable to the MECH/TLM Board in the IE and HRI Instrument. Connect the cables from the IE to the Preamp Assembly. ✓

b. Perform a Shorts/Open test on the IR Detector at the IR Thermal Isolation Connector per FUNCTIONAL TEST PROCEDURE, IR SENSOR ASSEMBLY (574502). ✓ See C023382OP 691.29R

c. Perform a Shorts/Open test on the CCD detector as per FUNCTIONAL TEST PROCEDURE, CCD SENSOR ASSEMBLY (574503). ✓ See C023382OP 691.29R

d. Perform an IR Safe-to-Mate test at the IE-SIM cable connectors INSTR_P7, INSTR_P6, and INSTR_P8 as per FUNCTIONAL TEST PROCEDURE, IR SENSOR ASSEMBLY (574502). ✓ See C023382 OP 691.27R

e. Perform a CCD Safe-to-Mate test as per FUNCTIONAL TEST PROCEDURE, CCD SENSOR ASSEMBLY (574503). ✓ See C023382OP 691.27R

f. Ensure that the IE is powered off before proceeding to the next step. ✓

g. Connect the IR Detector to the Instrument Electronics per FUNCTIONAL TEST PROCEDURE, IR SENSOR ASSEMBLY (574502). ✓

h. Connect the CCD to the Instrument Electronics per FUNCTIONAL TEST PROCEDURE, CCD SENSOR ASSEMBLY (574503). ✓

i. Turn on power and warm clock the CCD per CSTOL: HRI VIS Detector Single Mode Dark Imaging (574506). See HRI functional 576692 C023382 OP

j. Warm-clock the IR Detector per CSTOL: HRI IR Detector Single Mode Calibration (575086). ✓ see 574502 C023382 OP 691.27R

✓ +X ~~A~~ –X STET DLH 6/4/03

8.0 TEST PROCEDURE

8.1 MRI CCD Boresight Measurement with respect to Reference Cube

a. Align Test Station 2 per SER DI-INST-OPT-050. ✓

DLH 6/4/03

Ball Aerospace & Technologies Corp.	SIZE	CAGE CODE	DWG. NO.	REV
P.O. Box 1062 Boulder, CO 80306	A	13993	564422	–
	SCALE NONE			SHEET 11

b. Autocollimate the 20" mirror to 30" collimator.

c. Perform through focus measurement of return from 20" mirror. Zero the readout for the Z-axis stage under the PhaseCam.

d. Rotate the 20" mirror so that the beam covers, and is normal to, the MRI entrance aperture. Assure that the alignment cube and aperture can be found at the same time.

e. Address the instrument reference cube by adjusting the angle of the 20" mirror so that the interferogram of the cube is nulled.

f. Mount the "hockey puck" sphere at the PhaseCam source point and adjust its position for zero power. Remove the sphere. <0.03

g. Insert pinhole and center on the PhaseCam source point.

h. Insert the diffuser. Start the strobe at 8 Hz.

i. Record 10-image sequence, 100-msec exposure, per CSTOL: MRI VIS Detector Single Mode Light Imaging (564436).

j. Stop the strobe.

k. Select those images that contain a spot. Disregard those that have no spots, and those that have a spot farther up the column than the others. Such a spot will have been recorded during CCD frame transfer. If no valid images are found, adjust the strobe system and recording operations and record a new set of images.

l. Analyze the valid images for MRI boresight by finding the image centroid, and then averaging the coordinates. Record the results.

m. Rotate the Roll Fixture to invert the MRI.

n. Remove the diffuser and knife-edge from the beam.

o. Repeat steps f through m.

p. Compare to expected offset.

q. If the offset exceeds the allowance, calculate the required modifications to the CCD positioning shims.

r. Replace the shims as required and remeasure the boresight by repeating Steps f through p.

8.2 MRI Image Quality Measurement N/A – use "MRI Through-Focus with Pinhole Target" in "Addition to 564422" DLH 6/4/03

a. Calculate predicted ambient focus offset on the MRI Focus Data Sheet.

b. Perform through focus measurement of return from 20" mirror. Zero the readout for the Z-axis stage under the PhaseCam.

c. Insert 5" reference mirror ahead of the MRI.

d. Perform through focus measurement of return from 5" mirror. Record the optimum PhaseCam source position on MRI Focus Data Sheet.

e. Place the theodolite fold mirror on its stand. Autocollimate theodolite to 20" mirror.

f. Address the instrument reference cube by adjusting the angle of the 20" mirror so that the interferogram of the cube is nulled.

g. Set "hockey puck" sphere for zero power.

h. Target instrument axis by adjusting 20" mirror to offset from MRI Boresight Data Sheet if required. If necessary, remove the theodolite fold mirror from its kinematic mount and place it on the optical table as close as possible to the base on which it was sitting.

i. Set PhaseCam stage to calculated best-focus offset position.

j. Insert pinhole and center.

k. Insert diffuser, start strobe at 8 Hz.

l. Obtain test image, and Stop strobe.

m. Evaluate for offset from desired target location on the detector array. Images should be less than 50 pixels from the center of the array. The image should not lie within 5 pixels of a boundary between quadrants.

n. Adjust 20" mirror, using theodolite as reference, to minimize image offset from desired target position if necessary.

o. Set PhaseCam stage to nominal offset position calculated at the top of the MRI Focus Data Sheet.

p. Insert knife-edge and center.

q. Insert diffuser, start strobe at 8 Hz.

r. Record 10-image sequence, 100-msec exposure, per CSTOL: MRI VIS Detector Single Mode Light Imaging (564436).

s. Stop strobe.

t. Check images for acceptability.

u. Obtain knife-edge width from DIVe.

v. Derive average PSF from images. Record the result on the MRI Focus Data sheet and compare it to the requirement.

w. Adjust pointing to top center, bottom center, right center, and left center of FOV in turn, using the theodolite for targeting. Knife-edge image should be within 100 rows or columns of the edge of the FOV, but not lie on a seam between quadrants.

x. Repeat steps q through u for each position.

y. Return the 20" mirror to its initial position using the theodolite. NA

z. Move PhaseCam stage to first offset position and repeat steps q through u. MRI focus offset steps are 2.0 mm.

aa. Repeat for all focus offset locations. The range of focus offset positions is nominally ±10mm, but may be increased or decreased on either end by the test conductor.

bb. Analyze images for best on axis focus position. Record the results on the MRI Focus Data Sheet.

cc. Compare to offset prediction.

8.3 HRI to MRI Initial Boresight Offset Measurement and Adjustment

a. Calculate predicted boresight offset on Work Sheet C.

b. Point the IP into a open area away from Test Station 2. Do not float the IP Roll-over fixture on its pneumatic suspension.

c. Set up Theodolite #1 facing the MRI alignment cube. Autocollimate from the –Z surface of the cube. Zero the azimuth reading and record the elevation reading on Data Sheet D.

d. Set up Theodolite #2 facing the HRI alignment cube. Autocollimate from the –Z surface of the cube. Zero the azimuth reading and record the elevation reading on Data Sheet D.

e. Face the Theodolites at each other and record the readings on Data Sheet D

f. Calculate the pointing offset of the HRI cube with respect to the MRI cube

g. If the offset exceeds the allowance, calculate new shim thickness values.

h. Replace HRIT pointing shims and remeasure the offset.

✓ +X ~~Δ=X~~ SIET DLH 6/4/03

8.4 HRI CCD Boresight Measurement with respect to Reference Cube

a. Align Test Station 2 per SER DI-INST-OPT-050. ✓

b. Autocollimate the 20" mirror to 30" collimator. ✓

c. Perform through focus measurement of return from 20" mirror. Zero the readout for the Z-axis stage under the PhaseCam. ✓

d. Rotate the 20" mirror so that the beam covers, and is normal to, the HRI entrance aperture. Assure that the alignment cube and aperture can be found at the same time. ✓

e. Address the instrument reference cube by adjusting the angle of the 20" mirror so that the interferogram of the cube is nulled.

f. Mount the "hockey puck" sphere at the PhaseCam source point and adjust its position for zero power. Remove the sphere.

g. Insert pinhole and center on the PhaseCam source point.

h. Insert the diffuser. Start the strobe at 8 Hz.

i. Record 10-image sequence, 100-msec exposure, per CSTOL: HRI VIS Detector Single Mode Light Imaging (564507).

j. Stop the strobe.

k. Select those images that contain a spot. Disregard those that have no spots, and those that have a spot farther up the column than the others. Such a spot will have been recorded during CCD frame transfer. If no valid images are found, adjust the strobe system and recording operations and record a new set of images.

l. Analyze the valid images for HRI boresight by finding the image centroid, and then averaging the coordinates. Record the results.

m. Rotate the Roll Fixture to invert the HRI.

n. Remove the diffuser and knife-edge (pinhole) from the beam.

o. Repeat steps f through m.

p. Compare to expected offset.

q. If the offset exceeds the allowance, calculate the required modifications to the CCD positioning shims.

r. Replace the shims as required and remeasure the boresight by repeating Steps f through p.

8.5 HRI Image Quality Measurement

N/A use "HRI Through-Focus with Pinhole Target" in "Addendum to 564422"

a. Calculate predicted ambient focus offset on the HRI Focus Data Sheet.

b. Perform through focus measurement of return from 20" mirror. Zero the readout for the Z-axis stage under the PhaseCam.

DLH 6/4/03

c. Insert 5" reference mirror ahead of the HRI.

d. Perform through focus measurement of return from 5" mirror. Record the optimum PhaseCam source position on HRI Focus Data Sheet.

e. Place the Theodolite fold mirror on its stand. Autocollimate Theodolite to 20" mirror.

f. Address the instrument reference cube by adjusting the angle of the 20" mirror so that the interferogram of the cube is nulled.

g. Set "hockey puck" sphere for zero power.

h. Target instrument axis by adjusting 20" mirror to offset from HRI Boresight Data Sheet if required. If necessary, remove the Theodolite fold mirror from its kinematic mount and place it on the optical table as close as possible to the base on which it was sitting.

i. Set PhaseCam stage to calculated best-focus offset position.

NA

j. Insert pinhole and center.

k. Insert diffuser, start strobe at 8 Hz.

l. Obtain test image, and Stop strobe.

m. Evaluate for offset from desired target location on the detector array. Images should be less than 50 pixels from the center of the array. The image should not lie within 5 pixels of a boundary between quadrants.

n. Adjust 20" mirror, using Theodolite as reference, to minimize image offset from desired target position if necessary.

o. Set PhaseCam stage to nominal offset position calculated at the top of the HRI Focus Data Sheet.

p. Insert knife-edge and center.

q. Insert diffuser, start strobe at 8 Hz.

r. Record 10-image sequence, 100-msec exposure, per CSTOL: HRI VIS Detector Single Mode Light Imaging (564507).

s. Stop strobe.

t. Check images for acceptability.

u. Obtain knife-edge width from DIVe.

v. Derive average PSF from images. Record the result on the HRI Focus Data sheet and compare it to the requirement.

w. Adjust pointing to top center, bottom center, right center, and left center of FOV in turn, using the Theodolite for targeting. Knife-edge image should be within 100 rows or columns of the edge of the FOV, but not lie on a seam between quadrants.

x. Repeat steps q through u for each position.

y. Return the 20" mirror to its initial position using the Theodolite.

z. Move PhaseCam stage to first offset position and repeat steps q through u. HRI focus offset steps are 2.0 mm.

aa. Repeat for all focus offset locations. The range of focus offset positions is nominally ±10mm, but may be increased or decreased on either end by the test conductor.

bb. Analyze images for best on axis focus position. Record the results on the HRI Focus Data Sheet. NA

Compare to offset prediction ✓ +X △ −X ↑ inverted FLOTRON

8.5 HRI to MRI Combined Boresight Offset Measurement

a. Calculate predicted boresight offset on Co-alignment Work Sheet if the data is available.

b. Move IP or 20" mirror so that both telescopes face the 20" mirror and the beam partially covers both apertures. ✓ △

c. Align Test Station 2 per SER DI-INST-OPT-050. ✓

d. Autocollimate 20" mirror to 30" collimator. ✓

e. Perform through focus measurement of return from 20" mirror. Zero the readout for the Z-axis stage under the PhaseCam. −0.129mm

f. Insert 5" reference mirror N/A DLH not needed for Boresight 6/4/03

g. Perform through focus measurement of return from 5 mirror. Record the PhaseCam optimum source position on Data Sheet F.

h. Address the MRI reference cube by adjusting the angle of the 20" mirror so that the interferogram of the cube is nulled. ✓ △

i. Mount the "hockey puck" sphere at the PhaseCam source point and adjust its position for zero power. Remove the sphere. ✓

j. Insert and center on the PhaseCam source point. ✓ △ pinhole

k. Insert diffuser, start strobe at 8 Hz ✓ △

l. Record 10 image sequence, 100-msec exposure, for each Instrument per CSTOL:HRI VIS Detector Single Mode Imaging (574507) and CSTOL:MRI VIS Detector Single Mode Imaging (564436). took 24 mode 2 images ✓ △

m. Stop strobe. ✓ △

n. Select those images for both instruments that contain a spot. Disregard those that have not spots, and those that have a spot farther up the column than the others. Such a spot will have been recorded during CCD frame transfer. If no valid images are found, adjust the strobe system and recording operations and record a new set of images. ✓

o. Analyze images for MRI or HRI boresight by finding the image centroid, and then averaging the coordinates. Record the results on Co-alignment Work Sheet. ✓

p. Compare to expected value on Co-alignment Work Sheet. ✓

q. Calculate new shims and replace shims at HRI attach points N/A 6/10/03 DLH

r. Torque to spec

s. Repeat measurements. NA DLH 6/10/03

MRI Boresight Data Sheet

Post-Vibe 2 offset for +X up orientation		+5.8	-17.6	arc-seconds
equals	Quadrant D	2.8	8.5	pixelsfrom center
CCD Measured Centroid	Quadrant ____	_____	_____	pixels
CCD offset (difference)		_____	_____	pixels
Post-Vibe 2 offset for -X up orientation		-1.1	-14.0	arc-seconds
equals	Quadrant B	0.5	6.8	pixelsfrom center
CCD Measured Centroid	Quadrant ____	_____	_____	pixels
CCD offset (difference)		_____	_____	pixels
CCD offset (average difference)		_____	_____	pixels
		_____	_____	Mils

See attached sheet pA1

TEST 6/10/03

QA 6-10-03

Ball Aerospace & Technologies Corp.	SIZE A	CAGE CODE 13993	DWG. NO. 564422	REV –
P.O. Box 1062 Boulder, CO 80306	SCALE NONE		SHEET 19	

MRI Focus Data Sheet

Source position for Optimum focus for 20" mirror			_____ mm
Temperature and Moisture offset from last test source offset position _____ mm			-0.338 mm (towards source)Nominal
Power error for sphere			_____ waves RMS (<0.03)
PSF for near axis image	_____	_____	_____ pixels (Rqmt <1.25 pixels FWHM)
PSF for +X image	_____	_____	_____ pixels (Rqmt <1.25 pixels FWHM)
PSF for -X image	_____	_____	_____ pixels (Rqmt <1.25 pixels FWHM)
PSF for +Y image	_____	_____	_____ pixels (Rqmt <1.25 pixels FWHM)
PSF for -Y image	_____	_____	_____ pixels (Rqmt <1.25 pixels FWHM)

Focus shift for on axis source	+1.190 mm (away from source)
Nominal position for best focus	+0.851 mm (away from source)
Focus shift for on edge of field source	-0.819 mm (away from source)
Nominal position for best focus	-1.157 mm (away from source)

Images taken at nominal position	_____ mm	time =	_____	_____ pixels
Position for 1st focus offset images	_____ mm	time =	_____	_____ pixels
Position for next focus offset images	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels
	_____ mm	time =	_____	_____ pixels

Position for optimum focus offset	_____	mm
Calculated position for optimum focus offset (9/12 data)	-0.766	mm
Difference from calculated optimum position	_____	mm
Equals	_____	waves RMS

PSF (Requirement B-spec 3.5.3 is <1.25 pixels FWHM) _____ pixels

TEST [signature] 6/10/03

QA 101 6/10/03

see attached sheet A2&A3 compared to previous (A4&A5)

Ball Aerospace & Technologies Corp.	SIZE A	CAGE CODE 13993	DWG. NO. 564422	REV –
P.O. Box 1062 Boulder, CO 80306	SCALE NONE		SHEET 20	

HRI Boresight Data Sheet

Post-Vibe 2 offset for +X up orientation		+5.8	-17.6	arc-seconds
equals	Quadrant D	2.8	8.5	pixelsfrom center
CCD Measured Centroid	Quadrant ____	_____	_____	pixels
CCD offset (difference)		_____	_____	pixels
Post-Vibe 2 offset for -X up orientation		-1.1	-14.0	arc-seconds
equals	Quadrant B	0.5	6.8	pixelsfrom center
CCD Measured Centroid	Quadrant ____	_____	_____	pixels
CCD offset (difference)		_____	_____	pixels
CCD offset (average difference)		_____	_____	pixels
		_____	_____	Mils

See attached sheet A 1

TEST 6/10/03

QA 6/10/03

Ball Aerospace & Technologies Corp.	SIZE	CAGE CODE	DWG. NO.	REV
P.O. Box 1062 Boulder, CO 80306	A	13993	564422	–
	SCALE NONE		SHEET 21	

HRI Focus Data Sheet

Source position for Optimum focus for 20" mirror			_____	mm
Temperature and Moisture offset from last test source offset position _____ mm			-0.338	mm (towards source)Nominal
Power error for sphere			_____	waves RMS (<0.03)
PSF for near axis image	_____	_____	_____	pixels (Rqmt <1.25 pixels FWHM)
PSF for +X image	_____	_____	_____	pixels (Rqmt <1.25 pixels FWHM)
PSF for -X image	_____	_____	_____	pixels (Rqmt <1.25 pixels FWHM)
PSF for +Y image	_____	_____	_____	pixels (Rqmt <1.25 pixels FWHM)
PSF for -Y image	_____	_____	_____	pixels (Rqmt <1.25 pixels FWHM)

Focus shift for on axis source	+1.190	mm (away from source)
Nominal position for best focus	+0.851	mm (away from source)
Focus shift for on edge of field source	-0.819	mm (away from source)
Nominal position for best focus	-1.157	mm (away from source)

Images taken at nominal position	_____	mm	time = _____	_____ pixels
Position for 1st focus offset images	_____	mm	time = _____	_____ pixels
Position for next focus offset images	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels
	_____	mm	time = _____	_____ pixels

see attached sheets A83A9

Compared to previous A6§A7

Position for optimum focus offset	_____	mm
Calculated position for optimum focus offset (9/12 data)	-0.766	mm
Difference from calculated optimum position	_____	mm
Equals	_____	waves RMS

PSF (Requirement B-spec 3.5.3 is <1.25 pixels FWHM) _____ pixels

TEST _____ 6/10/03 QA _____ 6/10/03

Ball Aerospace & Technologies Corp. P.O. Box 1062 Boulder, CO 80306	SIZE A	CAGE CODE 13993	DWG. NO. 564422	REV –
	SCALE NONE			SHEET 22

Co-alignment (body pointing) Work Sheet

Environmental Test Condition: _____

Section: Worksheet C Date: _____

T 1 Theodolite Readings (MRI alignment cube): Operator: _____

Azimuth: _____

Elevation: _____

Section: 8.1.2.14

T 2 Theodolite Readings (HRI alignment cube):

Azimuth: _____

Elevation: _____

Section: 8.1.2.15

T 1 Theodolite Readings (viewing Theodolite T2):

Azimuth: _____

Elevation: _____

T 2 Theodolite Readings (viewing Theodolite T1):

Azimuth: _____

Elevation: _____

Pointing offset of HRI cube with respect to MRI cube:
Azimuth: _____
Elevation: _____

New Shim thickness values:

Azimuth: _____
Elevation: _____

Sheet: _____

See attached sheet A1 DLH 6/10/03

Ball Aerospace & Technologies Corp. P.O. Box 1062 Boulder, CO 80306	SIZE A	CAGE CODE 13993	DWG. NO. 564422	REV –
	SCALE NONE		SHEET 23	

HRI / MRI boresight co-alignment

MRI CCD Measured Centroid Quadrant ____ _____ _____ pixels

HRI CCD Measured Centroid Quadrant ____ _____ _____ pixels

CCD offset (difference) _____ _____ pixels

Boresight offset (difference) _____ _____ arc-seconds

Axial magnification:

HRI = 61.2
MRI = 22.5

_____ _____ Mils

See attached sheet A1 DLH 6/10/03

Ball Aerospace & Technologies Corp. P.O. Box 1062 Boulder, CO 80306	SIZE A	CAGE CODE 13993	DWG. NO. 564422	REV –
	SCALE NONE		SHEET 24	

EQUIPMENT LIST

List all test equipment used in these tests including items used to take engineering data that may not be called out in this procedure. Verify all Calibration Due Dates.

Equipment	Make	Model	Metrology No.	Cal Due Date
ITOC		SN-00	[for MRI]	10-30-03
ITOC computer	SON (Sioux)		P129956	N/A
ITOC		SN-01	[for HRI]	1-3-04
ITOC computer	SON	(mohawk)	P129957	NA

see AS-RN 574503 & 574502 for ionizer or blowers, BOB, cables, DVM & oscilloscope for mate.

TEST [signature] 6/10/03

QA [signature] 6/10/03

Ball Aerospace & Technologies Corp.	SIZE	CAGE CODE	DWG. NO.	REV
P.O. Box 1062 Boulder, CO 80306	A	13993	564422	–
	SCALE NONE		SHEET 25	

Addition to 564422	Date 6/4/03

Additional Steps to 564422 (Instrument Platform Alignment)

MRI Tests

MRI Through-Focus with Pinhole Target

a) If not already done for the day, autocollimate the 20" fold mirror, and perform a through focus test on the 20" fold mirror ✓ offset 0.128 mm

b) Turn the 20" fold mirror to address the MRI aperture and MRI alignment cube. Adjust until the alignment cube is nulled. ✓

c) Install "hocky puck" mirror and adjust interferometer power to < 0.03 ✓

d) Place pinhole at focus of interferometer and adjust to get sufficient light from interferometer beam ✓

e) Place diffuser in beam ✓

f) Take background images with CSTOL script TP564436 (2 images are sufficient) with 100 msec exposure time mode 2 ✓

g) Turn on strobe lamp at 8 Hz repetition rate ✓

h) Take 5 to 10 pinhole images with CSTOL script TP564436 with 100 msec exposure time ✓

i) Turn off strobe lamp ✓

j) Examine images (background subtracted) for signal level, and adjust setup as necessary to produce a pinhole image with at least 100 DN of peak signal. Calculate center position and spot radius using DIVe ✓

k) Move PhaseCam stage to first focus offset position and repeat steps f) through j) ✓

l) Repeat for all focus offset positions. The range of focus offset positions is nominally +/- 10 mm from best focus, but may be adjusted by test conductor -5 to +8 ✓

MRI Plate Scale

N/A DLH 6/4/03

Perform the following steps to determine the MRI plate scale and IFOV

Test DLH 6/4/03 Page 1 of 10 QA 6/10/03

a) If not already done for the day, autocollimate the 20" fold mirror, and perform a through focus test on the 20" fold mirror

b) Turn the 20" fold mirror to address the MRI aperture and MRI alignment cube. Adjust until the alignment cube is nulled.

c) Install "hocky puck" mirror and adjust interferometer power to < 0.03 N/A DLH 6/4/03

d) Place pinhole at focus of interferometer and adjust to get sufficient light from interferometer beam

e) Place diffuser in beam

f) Take background images with CSTOL script TP564436 (2 images are sufficient) with 100 msec exposure time

g) Turn on strobe lamp at 8 Hz repetition rate

h) Take 5 to 10 pinhole images with CSTOL script TP564436 with 100 msec exposure time

i) Turn off strobe lamp

j) Examine images (background subtracted) for signal level, and adjust setup as necessary to produce a pinhole image with at least 100 DN of peak signal.

k) Adjust 20" mirror alignment to place pinhole within 50 pixels of the center of CCD image

l) Install 2" mirror in front of the 20" fold mirror and autocollimate theodolite to 20" mirror. Zero the azimuth reading to the current position

m) For the twelve additional positions listed in Plate Scale worksheet, adjust the theodolite to the new position and adjust the 20" fold mirror to autocollimate the theodolite. Repeat steps f) through i) after each theodolite adjustment.

n) Return 20" collimator mirror to center position and repeat steps f) through j)

MRI Test Targets

a) Remove pinhole from interferometer focus ✓

b) Insert Air Force Test Target at interferometer focus ✓

Test DLH 6/6/03 Page 2 of 10 QA 101 QA 6/10/03

c) Insert 600 to 700 nm bandpass filter between strobe lamp fiber-optic and diffuser ✓

d) Replace diffuser in beam ✓

e) Take background images using CSTOL script TP564436 (2 is sufficient) with 100 msec exposure ✓

f) Turn on strobe lamp at 8 Hz ✓

g) Take 4 to 10 images using CSTOL script TP564436 with 100 msec exposure ✓

h) Turn off strobe lamp ✓

i) Check signal level in clear areas of the test target and ensure that signals are above 4000 DN and not saturated (>14,000 DN). Adjust setup to achieve 4000 to 6000 DN if necessary ✓

j) Move 20" fold mirror to positions 2, 3, 7 and 8 in plate scale table and repeat background and strobe images

N/A only looking for orientation DLH 6/4/03

k) Return 20" fold mirror to center positions

l) Remove Air Force Test Target

m) Install Sine Wave Target

n) Take background images using CSTOL script TP564436 (2 is sufficient) with 100 msec exposure

o) Turn on strobe lamp at 8 Hz

p) Take 5 to 10 images using CSTOL script TP564436 with 100 msec exposure

q) Turn off strobe lamp

r) Check signal level in clear areas of the test target and ensure that signals are above 4000 DN and not saturated (>14,000 DN). Adjust setup to achieve 4000 to 6000 DN if necessary.

Test DLH 6/6/03 Page 3 of 10 QA 6/10/03

Addition to 564422	Date _____

MRI Plate Scale Worksheet

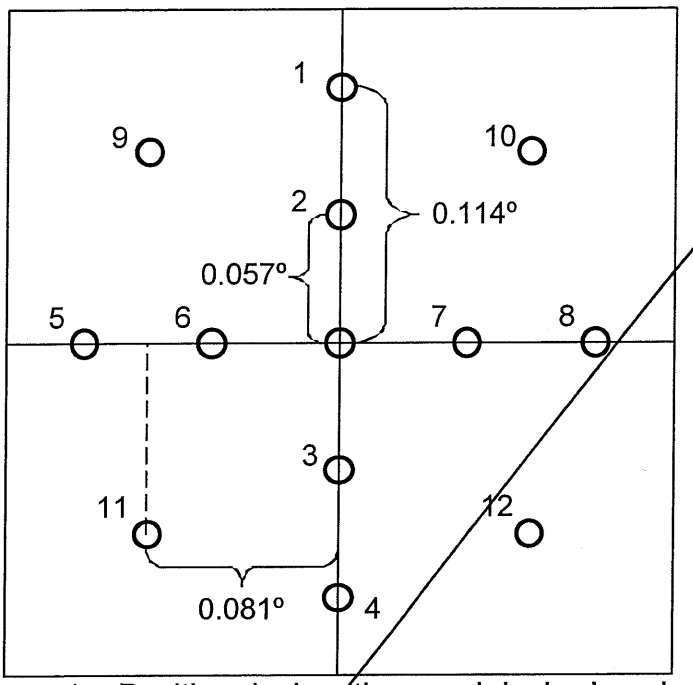


Figure 1 – Position designations and desired angles.

N/A
DLH
6/4/03

Pos'n #	Desired Theodolite Reading (°)		Measured Theodolite Reading (°)		First File
	Azimuth	Elevation	Azimuth	Elevation	
0	-------	-------			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
0					

Test

6/10/03

Addition to 564422 Date _____

Plate Scale Worksheet (Air Force Test Target)

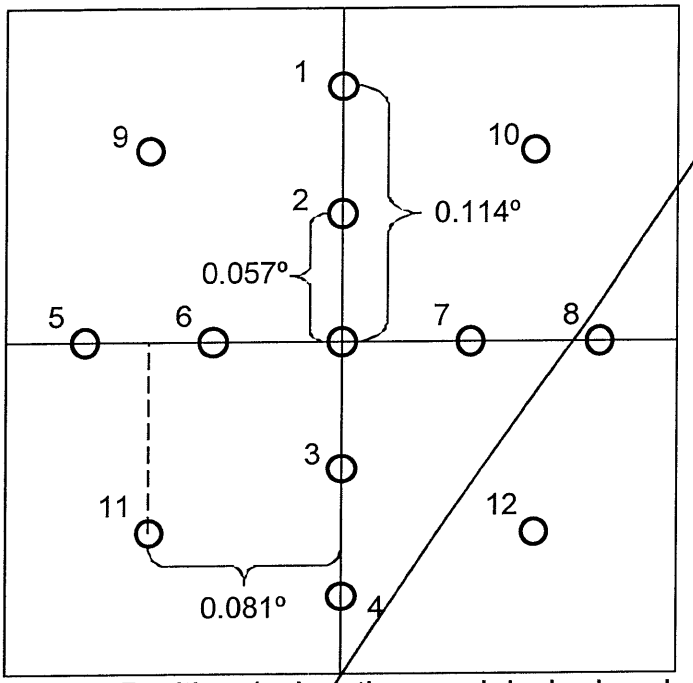


Figure 1 – Position designations and desired angles.

N/A
DLH
6/4/03

Pos'n #	Desired Theodolite Reading (°)		Measured Theodolite Reading (°)		First File
	Azimuth	Elevation	Azimuth	Elevation	
0	-------	-------			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

HRI Tests

HRI Through-Focus with Pinhole Target

a) If not already done for the day, autocollimate the 20" fold mirror, and perform a through focus test on the 20" fold mirror ✓

b) Turn the 20" fold mirror to address the HRI aperture and HRI alignment cube. Adjust until the alignment cube is nulled. ✓

c) Install "hocky puck" mirror and adjust interferometer power to < 0.03 ✓

d) Place pinhole at focus of interferometer and adjust to get sufficient light from interferometer beam ✓

e) Place diffuser in beam ✓

f) Take background images with CSTOL script TP574507 (2 images are sufficient) with 100 msec exposure time ✓ mod1 2 4ea

g) Turn on strobe lamp at 8 Hz repetition rate ✓

h) Take ~~5 to~~ 10 pinhole images with CSTOL script TP574507 with 100 msec exposure time ✓

i) Turn off strobe lamp ✓

j) Examine images (background subtracted) for signal level, and adjust setup as necessary to produce a pinhole image with at least 100 DN of peak signal. Calculate center position and spot radius using DIVe ✓

k) Move PhaseCam stage to first focus offset position and repeat steps f) through j) ✓

l) Repeat for all focus offset positions. The range of focus offset positions is nominally +/- 10 mm from best focus, but may be adjusted by test conductor ✓ 0.5 to 2.9mm DLH 6/4/03

HRI Plate Scale

N/A DLH 6/4/03

Perform the following steps to determine the HRI plate scale and IFOV

a) If not already done for the day, autocollimate the 20" fold mirror, and perform a through focus test on the 20" fold mirror

Test DLH 6/4/03 QA 6/6/03

b) Turn the 20" fold mirror to address the HRI aperture and HRI alignment cube. Adjust until the alignment cube is nulled.

NA DLH 6/4/03

c) Install "hocky puck" mirror and adjust interferometer power to < 0.03

d) Place pinhole at focus of interferometer and adjust to get sufficient light from interferometer beam

e) Place diffuser in beam

f) Take background images with CSTOL script TP574507 (2 images are sufficient) with 100 msec exposure time

g) Turn on strobe lamp at 8 Hz repetition rate

h) Take 5 to 10 pinhole images with CSTOL script TP574507 with 100 msec exposure time

i) Turn off strobe lamp

j) Examine images (background subtracted) for signal level, and adjust setup as necessary to produce a pinhole image with at least 100 DN of peak signal.

k) Adjust 20" mirror alignment to place pinhole within 50 pixels of the center of CCD image

l) Install 2" mirror in front of the 20" fold mirror and autocollimate theodolite to 20" mirror. Zero the azimuth reading to the current position

m) For the twelve additional positions listed in Plate Scale worksheet, adjust the theodolite to the new position and adjust the 20" fold mirror to autocollimate the theodolite. Repeat steps f) through i) after each theodolite adjustment.

n) Return 20" collimator mirror to center position and repeat steps f) through j)

HRI Test Targets

N/A MRI test targets only
DLH 6/4/03

a) Remove pinhole from interferometer focus

b) Insert Air Force Test Target at interferometer focus

c) Insert 600 to 700 nm bandpass filter between strobe lamp fiber-optic and diffuser

d) Replace diffuser in beam

e) Take background images using CSTOL script TP564436 (2 is sufficient) with 100 msec exposure

f) Turn on strobe lamp at 8 Hz

g) Take 5 to 10 images using CSTOL script TP564436 with 100 msec exposure

h) Turn off strobe lamp

NA DLH 6/4/03

i) Check signal level in clear areas of the test target and ensure that signals are above 4000 DN and not saturated (>14,000 DN). Adjust setup to achieve 4000 to 6000 DN if necessary

j) Move 20" fold mirror to positions 2, 3, 7 and 8 in plate scale table and repeat background and strobe images

k) Return 20" fold mirror to center positions

l) Remove Air Force Test Target

m) Install Sine Wave Target

n) Take background images using CSTOL script TP564436 (2 is sufficient) with 100 msec exposure

o) Turn on strobe lamp at 8 Hz

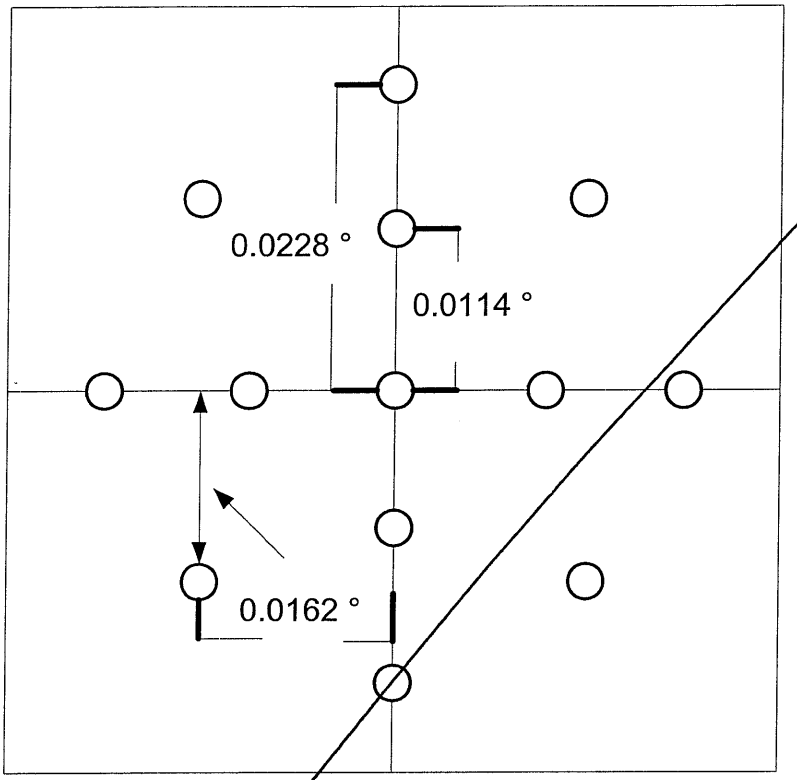
p) Take 5 to 10 images using CSTOL script TP564436 with 100 msec exposure

q) Turn off strobe lamp

r) Check signal level in clear areas of the test target and ensure that signals are above 4000 DN and not saturated (>14,000 DN). Adjust setup to achieve 4000 to 6000 DN if necessary.

Addition to 564422	Date _____

HRI Plate Scale Worksheet



N/A
DLH 6/4/03

Figure 1 – Position designations and desired angles.

Pos'n #	Desired Theodolite Reading (°)		Measured Theodolite Reading (°)		First File
	Azimuth	Elevation	Azimuth	Elevation	
0	-------	-------			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
0					

Addition to 564422 Date _____

Plate Scale Worksheet (Air Force Test Target)

N/A
DLH 6/14/63

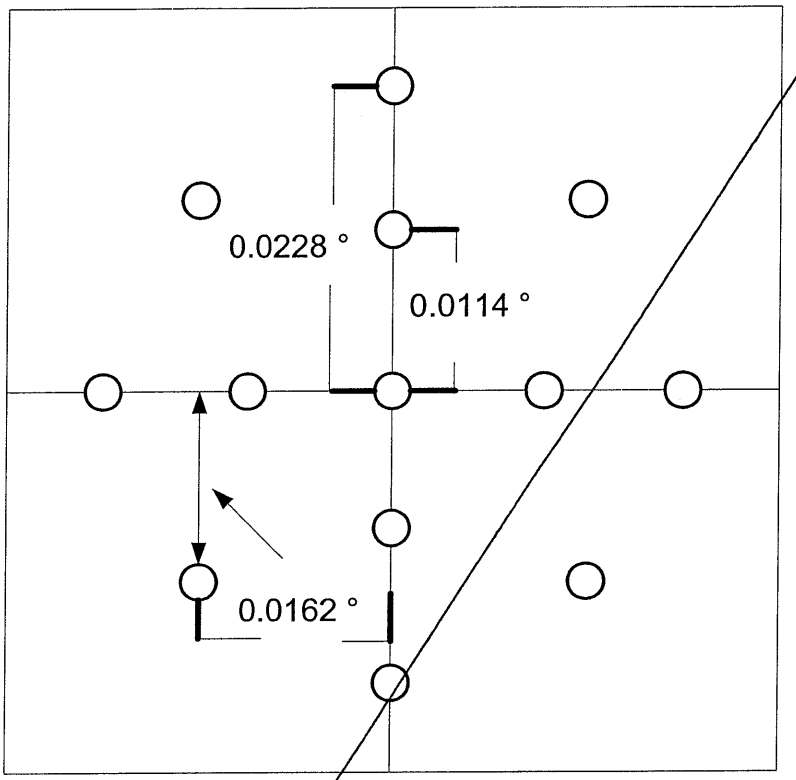
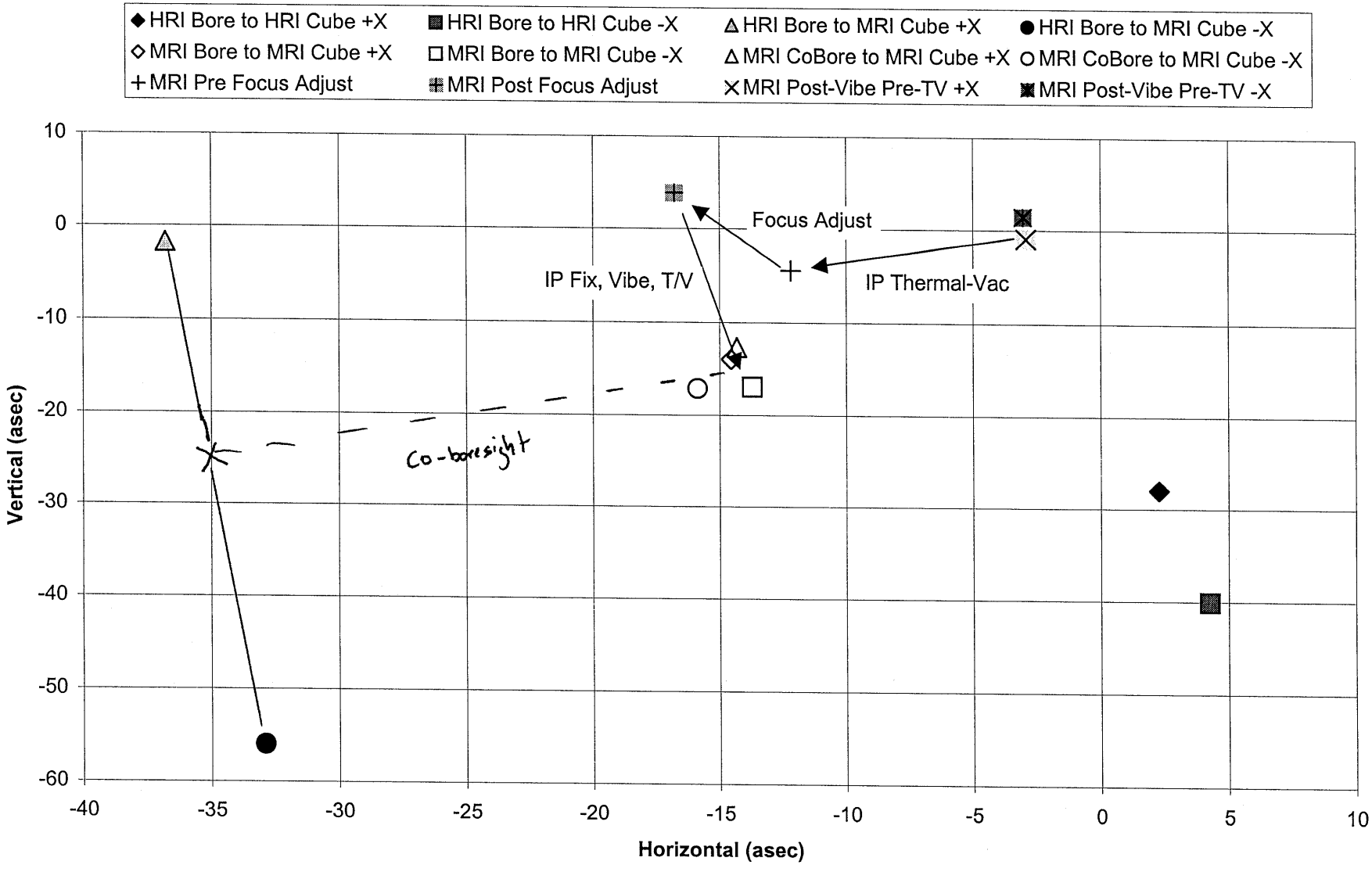


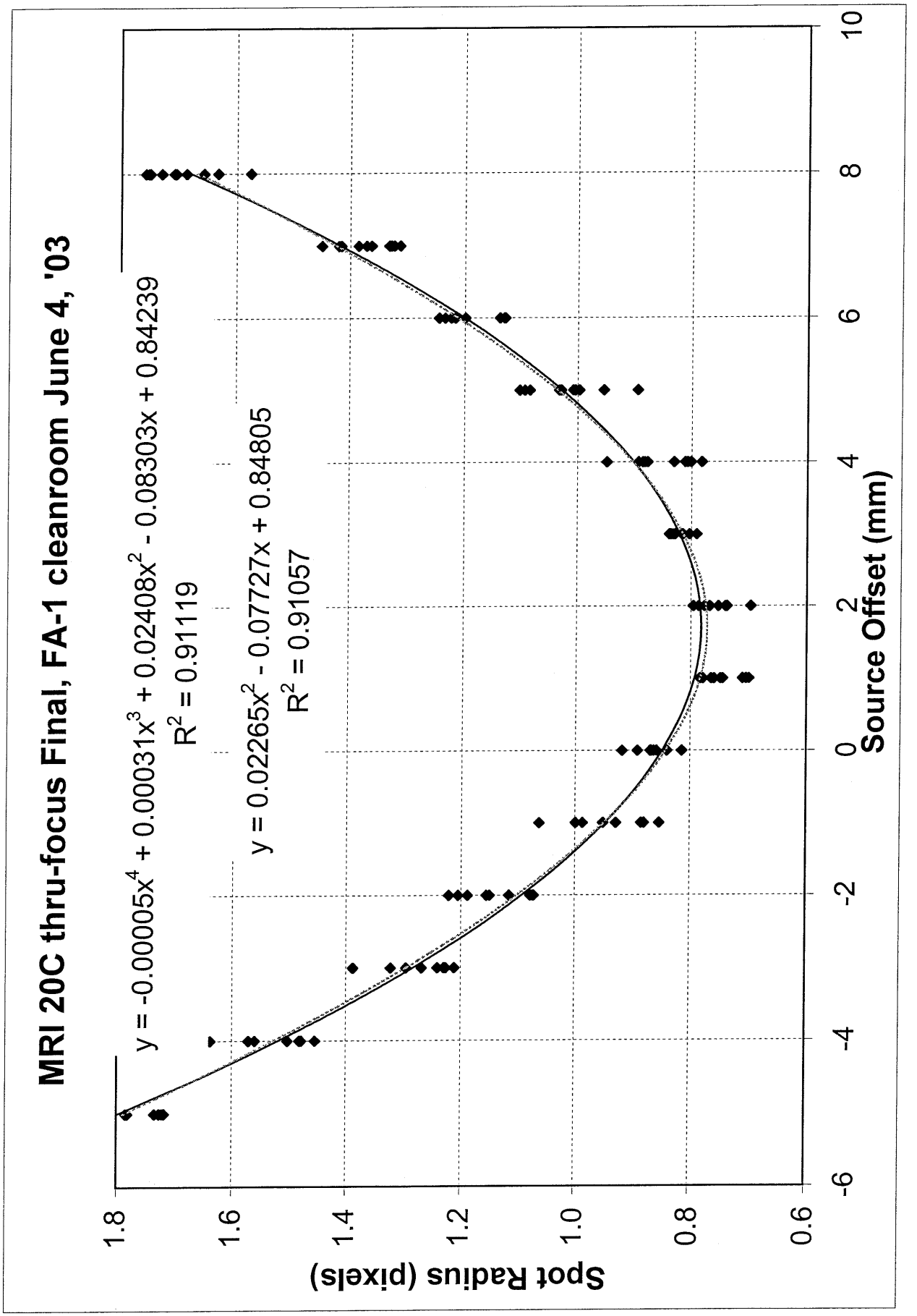
Figure 1 – Position designations and desired angles.

Pos'n #	Desired Theodolite Reading (°)		Measured Theodolite Reading (°)		First File
	Azimuth	Elevation	Azimuth	Elevation	
0	-------	-------			
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Final Co-Align June 4, 2003



Requirement co-boresight <206.19 asec



DLH 6/16/03

A2

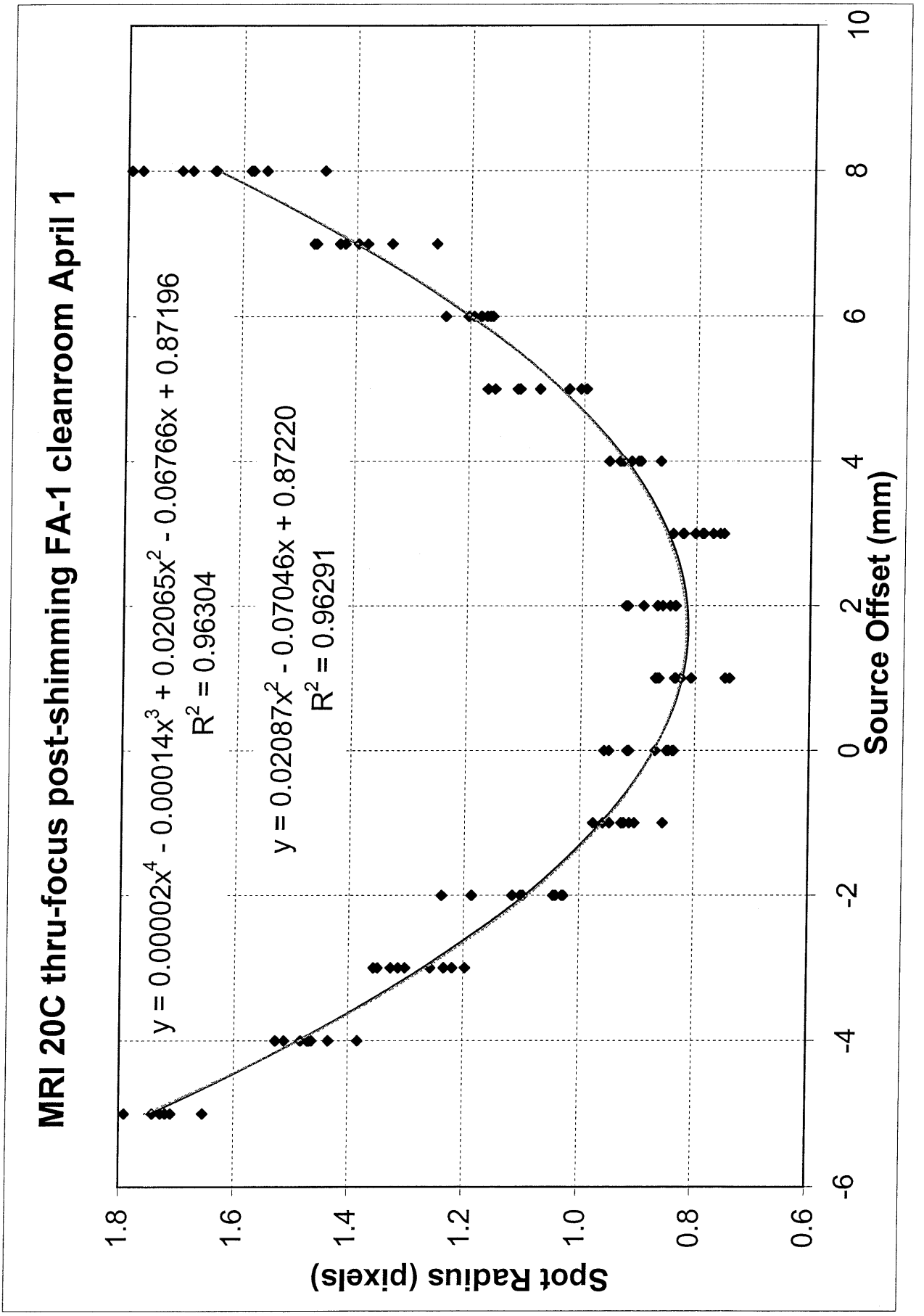
	A	B	C	D	E	X	X'	R(min)	FWHM
Quartic	-5.10E-05	3.07E-04	0.024077	-0.0830267	0.8423922	1.676	-0.000679	0.77	1.82
Quadratic			2.26E-02	-7.73E-02	8.48E-01	1.706	0.00000	0.78	1.84
Minimum radius								0.70	1.64
									pixels
							Average	0.78	1.83

	Quadratic		Quartic
5' Cryoflat Zero Position	0.000	mm	0.000
On-axis Offset	-1.223	mm	-1.223
Quadratic best focus	1.706	mm	1.676
Best Focus Source Offset	0.483	mm	0.453
Best Focus CCD Offset	0.126	mm	0.118
	0.0050	in	0.0046
Wavefront Offset	0.015	Waves RMS	0.014
Secondary Offset	0.006	mm	0.005
	0.0002	in	0.0002

EFL (m)	2.1
pinhole (um)	10
after removing pinhole	FWHM
4th power fit	1.80
parabolic fit	1.83
minimum	1.62
	pixels

8/10/03

A3



DL#6/10/03

A4

	A	B	C	D	E	X	X'	R(min)	FWHM
Quartic	1.56E-05	-1.42E-04	0.020651	-0.067661	0.8719622	1.660	0.000000	0.82	1.92
Quadratic			2.09E-02	-7.05E-02	8.72E-01	1.688	0.00000	0.81	1.91
Minimum radius								0.74	1.74
									pixels
							Average	0.81	1.92

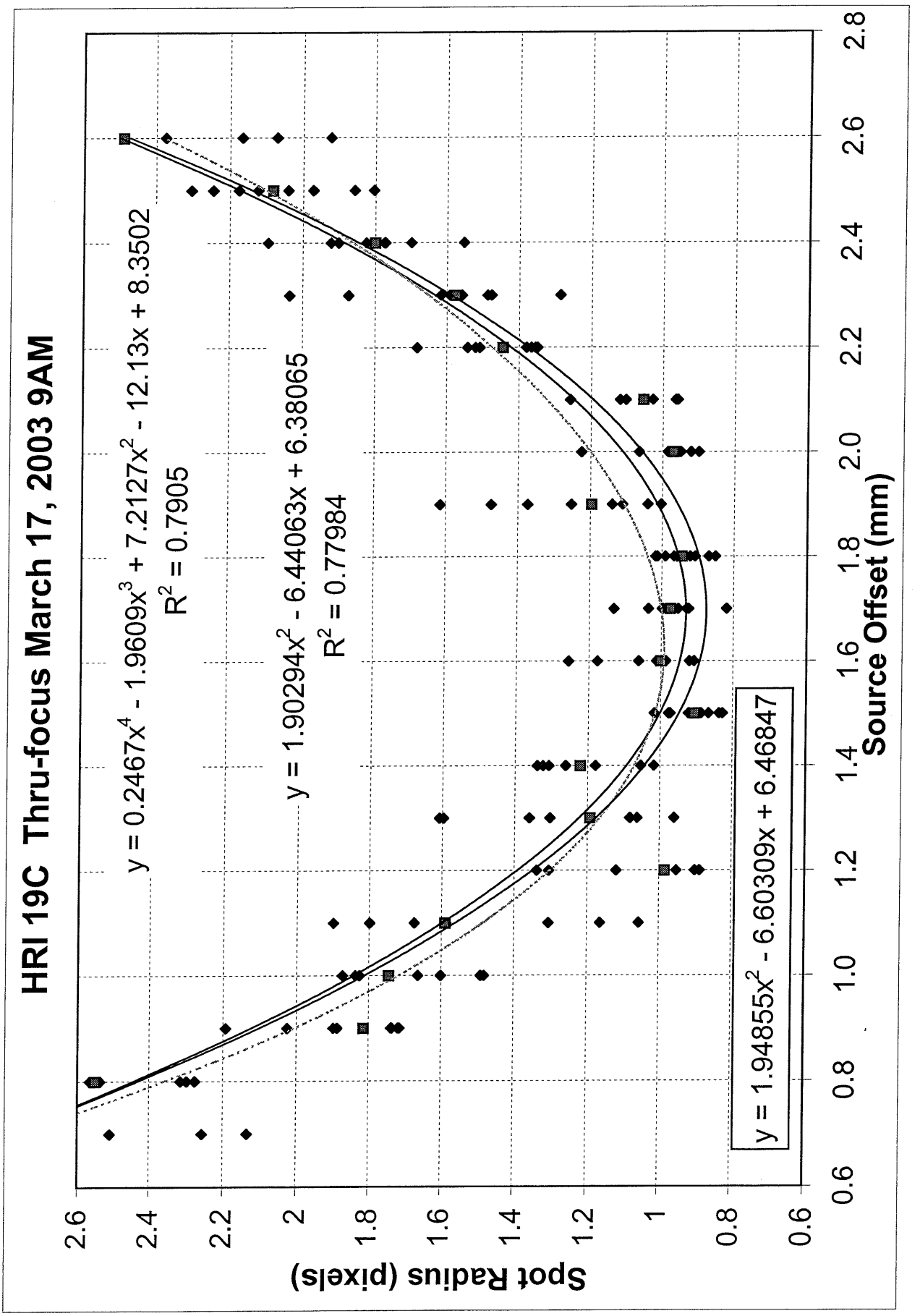
	Quadratic		Quartic
5' Cryoflat Zero Position	0.000	mm	0.000
On-axis Offset	-1.223	mm	-1.223
Quadratic best focus	1.688	mm	1.660
Best Focus Source Offset	0.465	mm	0.437
Best Focus CCD Offset	0.121	mm	0.114
	0.0048	in	0.0045
Wavefront Offset	0.014	Waves RMS	0.013
Secondary Offset	0.005	mm	0.005
	0.0002	in	0.0002

	EFL (m)	2.1
	pinhole (um)	10
after removing pinhole		FWHM
	4th power fit	1.91
	parabolic fit	1.90
	minimum	1.72
		pixels

	At zero power	FWHM
4th power fit	0.872	2.05
parabolic fit	0.872	2.05
		pixels

after removing pinhole	FWHM
	2.04
	2.04
	pixels

Verified 6/10/03 JS



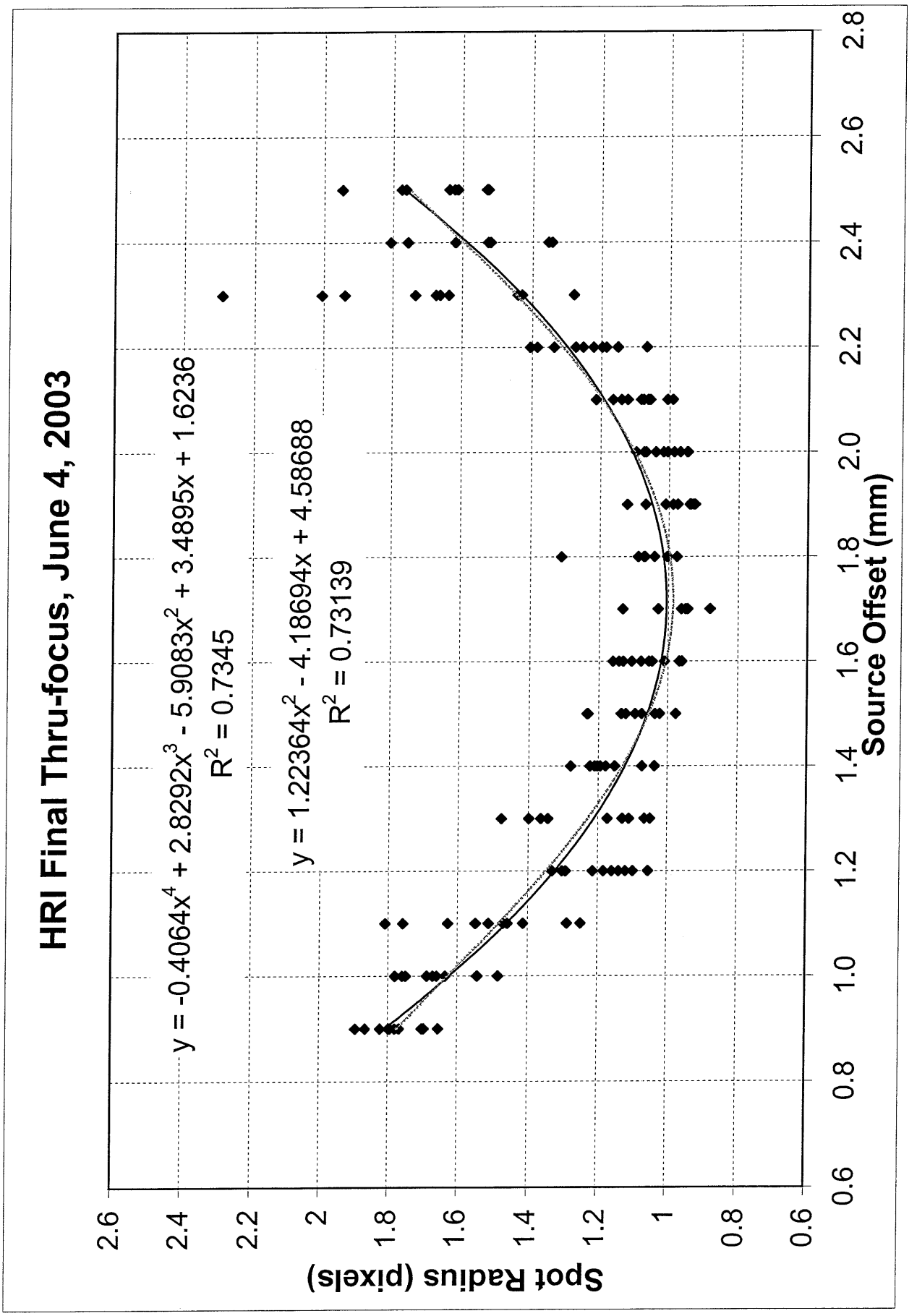
+1.1 to +2.3	A	B	C	D	E	X	X'	R(min)	FWHM
Quartic	-0.21771	0.737601	1.471423	-6.750426	6.4373531	1.583	0.000001	1.00	2.35
Quadratic			1.381106	-4.5123986	4.7023569	1.634	0.00000	1.02	2.39
Median quadratic			1.94855	-6.60309	6.46847	1.694	0.00000	0.87	2.06
Minimum radius								0.48	1.13
									pixels
							average	1.01	2.37

	Quadratic		Quartic	Median
5' Cryoflat Zero Position	0.002	mm	0.002	0.002
On-axis Offset	-0.027	mm	-0.027	-0.027
Quadratic best focus	1.634	mm	1.583	1.694
Best Focus Source Offset	1.605	mm	1.555	1.666
Best Focus CCD Offset	10.449	mm	10.122	10.844
Wavefront Offset	0.380	Waves RMS	0.368	0.395
Secondary Offset	0.171	mm	0.165	0.177
	0.0067	in	0.0065	0.0070
	0.4114	in		

EFL (m)	10.5
pinhole (um)	6
after removing pinhole	FWHM
4th power fit	2.23
parabolic fit	2.28
median parabolic	1.93
minimum	0.86
	pixels

At zero power	FWHM
6.425	15.13
4.694	11.05
6.457	15.20
0.838	1.97
	pixels

after removing pinhole	FWHM
	15.11
	11.03
	15.18
	1.83
	pixels



SLH 6/4/03

A8

+1.1 to +2.3	A	B	C	D	E	X	X'	R(min)	FWHM
Quartic	-0.40638	2.829237	-5.90832	3.48952204	1.6235646	1.719	-0.000051	0.99	2.32
Quadratic			1.223643	-4.1869409	4.58688	1.711	0.00000	1.01	2.37
								0.00	0.00
Minimum radius								0.88	2.07
									pixels
							average	1.00	2.34

	Quadratic		Quartic
5' Cryoflat Zero Position	0.000	mm	0.000
On-axis Offset	-0.027	mm	-0.027
Quadratic best focus	1.711	mm	1.719
Best Focus Source Offset	1.684	mm	1.692
Best Focus CCD Offset	10.963	mm	11.015
Wavefront Offset	0.399	Waves RMS	0.401
Secondary Offset	0.179	mm	0.180
	0.0071	in	0.0071
	0.4316	in	

At zero power	FWHM
1.624	3.82
4.587	10.80
0.000	0.00
1.050	2.47
	pixels

EFL (m)	10.5
pinhole (um)	6
after removing pinhole	FWHM
4th power fit	2.20
parabolic fit	2.25
median parabolic	#NUM!
minimum	1.94
	pixels

after removing pinhole	FWHM
	3.75
	10.77
	#NUM!
	2.36
	pixels