36-01510.061

# ACIS Verification Summary Report

| | |
|---|---|
| **Specification:** | ACIS Contract End Item Specification |
| **Requirement Number/Title:** | 3.2.2.4 Mounting (VRSD 3.2.2.4-1) |

**Requirement Statement:** The detector assembly shall be capable of removal and subsequent remounting without loss of alignment.

| | |
|---|---|
| **Verification Method:** | Analysis |

**Procedure Number:** N/A

**Configuration:** Assembled Detector Assembly drawing analysis

**Cycle Time:** N/A

**Verification Discussion/Results:**

See attached spread sheet.

Peter C. Yoh 6-30-97

ACIS Cognizant Engineer Date

# Massachusetts Institute of Technology
# Center for Space Research
Cambridge, Massachusetts 02139

Room NE80-6043 617-253-7552


## Memorandum

To: File
From: W Mayer Bill Mayer
Date: July 2, 1997
Subject: ACIS Alignment

As part of the overall ACIS to Observatory alignment verification, the initial MIT plan was to measure the detector alignment before and after vibration testing to assure that the CCD location did not shift an amount which eceeded the limit imposed by the Static Alignment Specification (3.2.1.4.1.2) of the ICD.

Due to the severe schedule constraints on the ACIS instrument in order to calibrate with the HRMA, MIT performed a simple analysis to show that the maximum shift due to vibration was about a factor of two less than the specification. Hence, this measure-vibrate-remeasure activity was cancelled. The following table documents the simple analysis that was performed.

The CCDs are solidly (epoxy) attached to the focal plane. The focal plane is held in the detector housing via four Torlon round standoffs. These standoffs fit in four counter-bores in the bottom side of the focal plane. By analyzing the situation for the smallest standoffs and the largest counter-bores, one determines that the maximum shift of the focal plane can be .009 inch. During the assembly, the focal plane is centered on these posts. Thus the maximum shift that could ensue from vibration is ±.0045. One should note that any mis-positioning of the four standoffs or counter-bores reduces the amount of possible shift below this amount. The ICD specification is ±.009 inch.

| **Detector Housing to Focal Plane Lateral Alignment Stability** | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| Part | Feature | Function | Dimension | Least Materiial | Max. Diametrical |
| | | | inch | Condition | Clearance |
| | | | | inch | inch |
| | | | | | |
| Detector Housing | Standoff Holes | Size | .750+.002 | 0.752 | |
| | | | | | 0.0050 |
| Standoff | Upper Shoulder | Size | .748 +/- .001 | 0.747 | |
| Standoff | Lower Shoulder | Size | .748 +/- .001 | 0.747 | |
| | | | | | 0.0040 |
| Focal Plane | Standoff Hole | Size | .750 +/- .001 | 0.751 | |
| | | | | | ------ |
| Total | | | | | 0.0090 |
| | | | | | |
| Note: There are four (4) stand-offs, the tightest two (2) define location in Y, Z, and theta x. | | | | | |
| There is no clearance in the stand-off length so X, theta y and theta z can not shift. | | | | | |

3.2.1.4.1.2: FPSI Static Alignment and Orientation

The FPSIs shall provide the following static alignment and orientation of the detector focal plane and aim points to the HRMA optical axis (assuming a perfect Observatory):

| | ACIS | HRC |
|---|---|---|
| Focus (displacement along X)* | ± 0.003 inches | ± 0.0005 inches |
| Lateral displacement along Y | ± 0.009 inches | ± 0.009 inches |
| Lateral positioning along Z | ± 0.009 inches | ± 0.009 inches |
| Angular alignment about X | ± 10 arcmin | ± 10 arcmin |
| Angular alignment about Y | ± 83.2 arcsec | ± 56 arcsec |
| Angular alignment about Z | ± 83.2 arcsec | ± 56 arcsec |

* Nominal axial location behind the -X surface of the SIM Translation Table is -14.000 inches.

3.2.1.4.2: On-Orbit Alignment Stability

3.2.1.4.2.1: Observatory Alignment Stability

The observatory, except for occultation, shall provide the following stability for a 48 hour period:

| | Low Frequency (1) | High Frequency (2) |
|---|---|---|
| Lateral displacement along Y | ± 0.010 inches | ± 0.00010 inches |
| Lateral positioning along Z | ± 0.010 inches | ± 0.00010 inches |
| Angular alignment about X | ± 9.833 arcmin | ± 10 arcsec |
| Focus (displacement along X) | ± 0.003 inches (3) | |
| Angular alignment about Y | ± 18.7 arcsec (3) | |
| Angular alignment about Z | ± 18.7 arcsec (3) | |

Notes:
(1) Low Frequency applies to frequencies less than 0.05 Hz
(2) High Frequency Applies to frequencies greater than 0.05 Hz
(3) Requirement applies to all frequencies

This performance shall be maintained during operational phases for the above mentioned time period, accounting for the thermal environment including worst case slews, and/or changes in

| | Dim/Tol | LMC | Clearance |
|---|---|---|---|
| Stand off hole in Housing | $.750^{+.002}_{-.000}$ | .752 | |
| Stand off | $.748 \pm .001$ | .747 | |
| | | | .005 |
| Stand off | $.748 \pm .001$ | .747 | |
| Stand off hole in Paddle | $.750 \pm .001$ | .751 | |
| | | | .004 |
| Max diametrical clearance | | | .009 |
| Nominal diametrical clearance | | | .005 |

Note: There are four (4) stand offs, the tightest two (2) define location in Y, Z, and $\phi X$. There is no clearance in stand off length so X, $\phi Y$, and $\phi Z$ can not shift due to slippage.

LMC = Least Material Condition

Element: ACIS

Requirement Number: 3.2.2.4

Verification Item: 3.2.2.4-2-1

# AXAF-I Verification Requirement Compliance Data Submittal

Evaluators: CHE

Type of Review:
- ☐ Verification Item Closure
- ☒ Requirement Closure

Requirement Title: Mounting

Compliance Data/Location:
MA-56/ACIS-110-A-24/Bldg 4200 Rm 522
MA-184/36-01510.061/Rm 522 Bldg 4200 (MIT Closure Report)
MA-304/ACIS-600-I-05/Rm 522 Bldg 4200

Verification Method: Analysis

Comments:

Due to schedule constraints, test was replaced by an analysis.

A new Verification Summary Report (36-01510.061) was submitted on July 2, which shows that mechanical stability meets the ICD requirement.

William Mayes 7/16/97

Status: Open 5/15/97 due 6/13/97

Recommendation:
- ☐ Approve
- ☐ Disapprove
- ☐ Other (Explain)

Action Required for Closure:

| MSFC Evaluator: | Date: | Organzation: | Phone Number: |
|---|---|---|---|
| | | | |

Disposition:
- ☐ Approve
- ☒ Disapprove
- ☐ Other (Explain)

Action Required for Closure: The agreement documented in the VRSD calls for a repeatibility test of the DA alignment. There is no mention of this test. Provide the measurement data defined in the VRSD.

| Chief Engineer: | Date: |
|---|---|
| Anthony R. Lavoie | 6/25/97 |

# AXAF-I Verification Requirement Compliance Data Submittal

**Element:** ACIS

**Requirement Number:** 3.2.2.4

**Verification Item:** 3.2.2.4-2-2

**Evaluators:** CHE

**Type of Review:**
- ☐ Verification Item Closure
- ☒ Requirement Closure

**Requirement Title:** Mounting

**Compliance Data/Location:** MA-184/36-01510.061/Rm 522 Bldg 4200 (MIT Closure Report)

**Verification Method:** Test

**Comments:**

**Status:** Open 6/5/97 due 6/27/97

**Recommendation:**
- ☐ Approve
- ☐ Disapprove
- ☐ Other (Explain)

**Action Required for Closure:**

| MSFC Evaluator: | Date: | Organization: | Phone Number: |
|---|---|---|---|
| | | | |

**Disposition:**
- ☐ Approve
- ☒ Disapprove
- ☐ Other (Explain)

**Action Required for Closure:** The agreement documented in the VRSD calls for a repeatibility test of the DA alignment. There is no mention of this test. Provide the measurement data defined in the VRSD.

| Chief Engineer: | Date: |
|---|---|
| Anthony R. Lavoie | 6/25/97 |

# ACIS Verification Summary Report

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|---|---|
| **Specification:** | ACIS Contract End Item Specification |
| **Requirement Number/Title:** | 3.2.2.4 Mounting (VRSD 3.2.2.4-1) |

**Requirement Statement:** The detector assembly shall be capable of removal and subsequent remounting without loss of alignment.

| | |
|---|---|
| **Verification Method:** | **Analysis** |

**Procedure Number: ACIS Verif. Report ACIS-110-A-24VR**

**Configuration:**

**ACIS Instrument Mounted in ISIM**

**Cycle Time: N/A**

**Verification Discussion/Results:**

**The requirements of this paragraph have been verified in ACIS-110-A-24VR. All mechanical interfaces between the ACIS Detector and the ISIM use tight fitting shear pins to align the detector and shims into the proper position to meet the static alignment requirements specified in the ICD. Each detector shim is serilized and must be installed on the correct foot of detector assembly. Assuming proper installation of shims, all static alignment requirements can be met. Therefore, the ACIS can be removed and reinstalled without exceeding the required static alignment requirements. The requirements of paragraph 3.2.2.4 have been satisfied and no further discussion is required.**

Neil W. Tice 5/30/97

ACIS Cognizant Engineer Date