# HIRDLS

**TR-MMS-458**
(3164-SA031-TRF)
Issue 2

**HIGH RESOLUTION DYNAMICS LIMB SOUNDER**

Originator: R Coupe Date 11 January, 2000

Subject/Title **SSH FM Thermal Vacuum and Functional Test Report**

Description/Summary/Contents.


The following HIRDLS Sunshield Subsystem Flight Model (SSH FM), Serial Number FM001, tests have been performed :

Thermal Vacuum testing at RAL
Functional and Vibration testing at MMS-P

The objective of the test programme was to subject the SSH to workmanship level tests as defined in the Sunshield Subsystem Specification and Test Procedure, and to correlate the results with the EM test performance



Keywords FM, SSH Assembly, Thermal Vacuum Test, Functional Test


Purpose of this Document. Test Report for SSH Assembly WorkmanshipTests

| | | | |
|---|---|---|---|
| Reviewed/Approved by: | | | |
| Date (yy-mm-dd): | 00 – 01 – 11 | | |


**Rutherford Appleton Laboratory**
**Chilton**
**Didcot**
**Oxfordshire**
**OX11 0QX**
**United Kingdom**

**Matra Marconi Space UK**
**Anchorage Road**
**Portsmouth**
**Hants PO3 5PU**
**United Kingdom**


**EOS**

# SSH FM THERMAL VACUUM AND FUNCTIONAL TEST REPORT

## TR-MMS-458

*Prepared by* ..... *Date* 11-1-2000

*R T.S COUPE*

*Checked by* N Greenstand ..... *Date* 11th Jan 2000

*Authorised by.* ..... *Date.* 11/Jan/00

*I K STEWART*

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**P.O. Box 16, Filton, Bristol, BS34 7YB, England**

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## 1. INTRODUCTION

The HIRDLS Sunshield Subsystem (SSH) Flight Model (FM), Serial Number FM001, has been subjected to Workmanship tests. Thermal Vacuum testing was carried out at RAL, Vibration and functional testing at MMS Portsmouth

The objective of the test programme was to subject the SSH to :-
Workmanship level tests defined in the Sunshield Subsystem Specification (AD1) and Test Procedure (AD3), and to correlate the results with the EM test performance.

This report summarises the test results and, where applicable, deviations from the procedure

## 2. EXECUTIVE SUMMARY

The test results confirm the HIRDLS SSH FM has successfully survived the Workmanship test programme without any significant change in operating performance The major performance parameters are summarised below

### 2.1 SSH Door Opening Operation Torque Margins

**Measured**

| | | |
|---|---|---|
| Hinge bearings and potentiometer | - | 0 09 Nm |
| Anti-backlash torsion spring (max. Torque) | - | 0.70 Nm. |
| **Minimum overall torque margin** | - | **2.8** |

(Torque margin determined by reducing motor current with resistors in series with motor windings)

**Required (GSFC 424-11-13-01 para 3.4.5.3 )**

**Minimum test verified torque ratio - 2.25**
This is the appropriate margin as 88% of resistive torque is the spring load.

### 2.2 SSH Latch Opening Operation Torque Margins

**Measured**

| | | |
|---|---|---|
| Maximum latch operating torque | - | 0 4 Nm. |
| Maximum torsion spring torque | - | 1.4 Nm. |
| Minimum HOP actuator output torque | - | 4.0 Nm. |
| **Minimum overall torque margin** | - | **2.86** |

**Required (GSFC 424-11-13-01 para 3.4.5.3 )**

**Minimum test verified torque ratio is - 2.25**
This is the appropriate margin as 78% of resistive torque is the spring load.

Note that the HOP Actuator minimum output torque is based on the lowest force output at the start of operation when the torsion spring torque is at a minimum of 1 Nm The force increases towards the end of the stroke. Note also HOP actuator nominal output force is a 1/3 of maximum

## 3. APPLICABLE DOCUMENTS

| | | |
|---|---|---|
| AD 1 | SP-HIR-50 Issue D | Sunshield Subsystem Specification |
| AD 2 | HRIL100 Issue 4 | Sunshield / HDA Assembly BOM |
| AD 3 | TP-MMS-452 Issue 2 | Sunshield Subsystem Test Procedure |
| AD 4 | TC-MMS-400 Issue 1 | Manual for SSH and SVA Test Equipment |
| AD 5 | TR-MMS-459 Issue 1 | FM SSH Vibration Test Report |
| AD 6 | AIV-99-092-STC | HIRDLS SSH Thermal Vacuum Test Report |
| AD 7 | TR-MMS-461 Issue 1 | FM STH Vibration Test Report |

## 4. TEST SPECIMEN

The test item was the SSH Flight Model, Serial No. FM001 as defined in AD 2.

## 5. TEST SEQUENCE

### 5.1 Preliminary Characterisation Test Results

#### 5.1.1 HDRM Latch Operating Torques

| | |
|---|---|
| Resistive torque on latch compress seal | 0.25 Nm |
| Resistive torque on fully lock door | 0.3 Nm |
| Latch torsion spring, Fully open | 0.7 Nm |
| Latch torsion spring, Fully closed | 0.5 Nm |
| Latch operates acceptably with 1 torsion spring | |

- HDRM Operating torque

| | |
|---|---|
| Open position | 1.4 Nm |
| Closed position | 1.0 Nm |

- Deflection due to latch preload of 30N (HDRM position shimmed to provide this preload) — 0 004"
- Force to compress seal at latch — 20 N

### 5.1.2 Door Hinge Friction Torque

- Resistive torque of both hinges, and potentiometer 0 09 Nm
- Detent torque of motor gearhead 0 16 Nm
- Drive anti-backlash torsion spring 0.47 Nm (Max)

### 5.1.3 Electrical Tests

Refer to Appendix 1 for results of SSH Pin Survey.

### 5.1.4 Grounding

Grounding resistance measurements between:-

- Door and aperture plate grounding terminal 0.5Ω
- Hinge clevis plates to aperture plate grounding terminal 0.4 & 19Ω
- Latch plate to aperture plate grounding terminal 0.5Ω

## 5.2 Baseline Function Test

### 5.2.1 HDRM

The HDRM HWA was operated Deployment / retract times, microswitch operations and thermistor temperatures were recorded. Some fundamental operating parameters are summarised below.

- HWA starts to open latch after 2 min power up, when temperature of HWA housing reaches 68°C
- HWA fully open latch after 3 min power up, when temperature of HWA housing reaches 95°C

It can be concluded that the HDRM operates within specification.

### 5.2.2 Hinge Drive

- Brake torque required to overcome powered motor detent 2 92 Nm
- Hinge potentiometer resistive torque 0 09 Nm

Torque margin = $\frac{2.92}{.09}$ => 5

Operation of door under 1g ( hinge axis centreline horizontal ) is satisfactory.

Stepper motor count / potentiometer output voltage results were plotted to calibrate the potentiometer errors (using data regression) The results are presented in Appendix 2.

Note that from the latched position, a step count of approximately 20 (≡ 2°) is required for the door to clear the latch lever arm roller.

#### 5.2.2.1 Torque Margin

3 variable resistors were connected in series with the motor windings to reduce the available current to the windings.

The door was operated initially with the resistors set to 90 Ω The resistance was then increased in 5 Ω steps until the motor stalled. A motor stepping rate of 20 Hz was used throughout.

The door was found to be fully operational with an additional resistance of 100 Ω on both windings ( 105Ω causes motor to stall just before door contacts the door fully open microswitch)

The line to line motor winding resistance was measured at 111 Ω

Hence, based on the resistance change, it is possible to calculate the torque margin as follows -

Nominal winding resistance terminal to terminal = 111Ω

Resistance with additional resistors (2 x 100Ω) = 311Ω

Torque ∝ current ∝ resistance

Therefore, **Torque margin as measured = 311/111 = 2.8**

### 5.3 SSH Vibration Test (6-8 September 1999)

For full details of stand-alone SSH FM vibration testing refer to AD 5.

## 5.4 Post Vibration Function Test

### 5.4.1 HDRM

HDRM operated satisfactorily

### 5.4.2 Hinge Drive

Hinge drive and microswitches all operated satisfactorily.

The motor step count / potentiometer output voltage was calibrated. The test results are detailed in Appendix 2.

### 5.4.3 Test Results Summary

The HDRM and hinge drive test results compare favourably with baseline test and show no significant change in operating characteristics.

## 5.5 Thermal Vacuum Test (27 September- 2 October 1999)

The EM unit has been tested in vacuum ($<10^{-5}$ torr) at its upper and lower workmanship temperature limits and operated by representative electronics (EGSE Ref. AD4).

The SSH was mounted in the test chamber with the hinge axis vertical and functional tests were performed at the following stages :-

- Prior to closing chamber (to verify operating clearances and harness)
- at -25°C
- at +25°C
- at ambient temperature (After 4 thermal cycles)

Refer to RAL test chamber report (AD6, see Appendix 3) for thermal vacuum temperature cycling details.

### 5.5.1 HDRM

The HDRM was only fully operated at -25°C to demonstrate full operation of its retention latch and microswitch.

Operation of the actuator's heaters were performed after the hot cycle and at the end of the 4 thermal cycles.

### 5.5.2 Hinge Drive Operations at 28V

**Test Results**

| @ -25°C | Potentiometer Voltage | | | | | |
|---|---|---|---|---|---|---|
| | **Initial Test** | **90Ω** | **95Ω** | **100Ω** | **105Ω** | **Status Switch** |
| Door closed (initial) | 3 854 | | | | | ≤ |
| Door open (Prime winding) | 7 923 | 7 902 | | 7.900 | ***7.198*** | ≤ |
| Door closed (Prime winding | 3 857 | 3.864 | | 3 866 | 3.866 | ≤ |
| Door open (Redundant ) | 7.926 | 7 900 | | 7.893 | ***6.824*** | ≤ |
| Door closed (Redundant) | 3.860 | 3 865 | | 3 865 | 3 866 | ≤ |

| @ 25°C | Potentiometer Voltage | | | | | |
|---|---|---|---|---|---|---|
| | **Initial Test** | **90Ω** | **95Ω** | **100Ω** | **105Ω** | **110Ω** |
| Door closed (initial) | 3 863 | | | | | |
| Door open (Prime winding) | 7 922 | 7.899 | 7 897 | 7 896 | 7 889 | ***7.594*** |
| Door closed (Prime winding | 3 860 | 3 863 | 3 864 | 3 864 | 3 865 | ***3.865*** |
| Door open (Redundant ) | 7 914 | 7 896 | 7 897 | 7 896 | 7.881 | ***7.147*** |
| Door closed (Redundant) | 3 860 | 3 864 | 3.865 | 3.865 | 3.881 | ***3.866*** |

| @ 25°C | Potentiometer Voltage | | | | | |
|---|---|---|---|---|---|---|
| **Post 4 Thermal cycles** | **Initial Test** | **90Ω** | **95Ω** | **100Ω** | **105Ω** | **Status Switch** |
| Door closed (initial) | 3 861 | | | | | ≤ |
| Door open (Prime winding) | 7 914 | 7.898 | | 7.897 | 7.987 | ≤ |
| Door closed (Prime winding | 3 861 | 3.864 | | 3.865 | 3.865 | ≤ |
| Door open (Redundant ) | 7.914 | 7.898 | | 7.987 | 7.987 | ≤ |
| Door closed (Redundant) | 3.861 | 3.864 | | 3 865 | 3.860 | ≤ |

In the above tables the high-lighted figures are where drive motor stalled before making the open or closed status switch. Status switches operated satisfactorily throughout

All AD590 thermistors operated satisfactorily

**Potentiometer voltage / step count calibration tests**
Potentiometer ouput voltage readings were logged at each motor step (0 1°door rotation) for opening and closing the door. Tests were performed at temperature extremes Refer to Appendix 2 for details

The SSH was inspected and no obvious degradation or damage was noted All operations were nominal at temperature extremes and after thermal cycling.

### 5.6 Vibration Test (SSH fitted to STH Structure, October 1999)

For full details of vibration testing at STH level refer to AD 7.

### 5.7 Post Vibration Function Test

#### 5.7.1 HDRM

HDRM operated satisfactorily and the test results compare favourably with baseline tests and show no significant changes in operating characteristics

#### 5.7.2 Hinge Drive

Hinge drive and microswitch all operated satisfactorily.

The hinge drive results show that the torque margin has reduced to **2.08.** This reduction is due to the drive having to overcome the additional torque induced by the gravity vector of the STH configuration, (i e. this is purely a ground test condition)

The potentiometer calibration test could not be performed as the 30°inclination of the hinge axis caused the drive to mis-step

#### 5.7.3 Test Results

| Post vibration Test SSH fitted to STH | Potentiometer Voltage | | | | | |
|---|---|---|---|---|---|---|
| **Ambient conditions** | **Initial Test** | **60Ω** | **65Ω** | **70Ω** | | **Status Switch** |
| Door closed (initial) | 3 849 | ≤ | | | | ≤ |
| Door open (Prime winding) | 7 930 | ≤ | ≤ | X | | ≤ |
| Door closed (Prime winding | 3.854 | ≤ | ≤ | X | | ≤ |
| Door open (Redundant ) | 7 914 | ≤ | X | X | | ≤ |
| Door closed (Redundant) | 3 861 | ≤ | X | X | | ≤ |

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## CHANGE RECORD

| CHANGE NUMBER | CLASS | CHANGE DETAILS | ISSUE |
|---|---|---|---|
| 3164- 00344 | - | First Issue | 1 |
| 3164-00355 | II | UPDATE | 2 |

## APPENDICES

**APPENDIX 1 SSH Electrical Pin Survey**

**APPENDIX 2 Hinge drive stepper motor / potentiometer error calibration results**

**APPENDIX 3 RAL Thermal Vacuum Test Chamber Report AIV-99-092-STC**

# APPENDIX 1 SSH Electrical Pin Survey

# SSH PIN SURVEY

## SOCKET P212S

| P211S | Function | Destn | Wire Groups | Wire Type | Comments |
|---|---|---|---|---|---|
| 3 | SSH HWA Shield | | Common to HWA A,B | 2TS22 | |
| 1 | SSH HWA Heater A Drive | | Grouped with 1, 11, 3 | 2TS22 | 81.8Ω |
| 11 | SSH HWA Heater A Return | | Grouped with 1, 11, 3 | 2TS22 | |
| 2 | SSH HWA Heater B Drive | | Grouped with 2, 6, 3 | 2TS22 | 79.4Ω |
| 6 | SSH HWA Heater B Return | | Grouped with 2, 6, 3 | 2TS22 | |
| 8 | SSH Drive Motor A Shield | | Grouped with 7, 12, 13, 8 | 3TS24 | |
| 7 | SSH Motor A Phase 1 Drive | | Grouped with 7, 12, 13, 8 | 3TS24 | **SEE NOTE 1** |
| 12 | SSH Motor A Phase 2 Drive | | Grouped with 7, 12, 13, 8 | 3TS24 | **SEE NOTE 1** |
| 13 | SSH Motor A Phase 3 Drive | | Grouped with 7, 12, 13, 8 | 3TS24 | **SEE NOTE 1** |
| 9 | SSH Motor B Phase 1 Drive | | Grouped with 9, 10, 14, 15 | 3TS24 | **SEE NOTE 2** |
| 10 | SSH Drive Motor B Shield | | Grouped with 9, 10, 14, 15 | 3TS24 | |
| 14 | SSH Motor B Phase 2 Drive | | Grouped with 9, 10, 14, 15 | 3TS24 | **SEE NOTE 2** |
| 15 | SSH Motor B Phase 3 Drive | | Grouped with 9, 10, 14, 15 | 3TS24 | **SEE NOTE 2** |
| 4 | Spare | | | | |
| 5 | Spare | | | | |

**Note 1.** PIN 7→12 = 111.8Ω
PIN 7→13 = 111.6Ω
PIN 12→13 = 111.7Ω

**Note 2.** PIN 9→14 = 111.7Ω
PIN 9→15 = 111 4Ω
PIN 14→15 = 111.3Ω

# SSH PIN SURVEY

## SOCKET P212S

| P212S | Function | Destn | Wire Groups | Wire Type | Comments |
|---|---|---|---|---|---|
| 1 | SSH Sun Sensor B Cable Shield | | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | |
| 2 | SSH Sun Sensor B Cathode 2 | 2.58 KΩ | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | TO PIN 31 |
| 17 | SSH Sun Sensor B Cathode 1 | 2.58 KΩ | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | TO PIN 31 |
| 18 | SSH Sun Sensor B Cathode 4 | O/C | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | TO PIN 31 |
| 31 | SSH Sun Sensor B Anodes | | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | |
| 32 | SSH Sun Sensor B Cathode 3 | 2.58KΩ | Grouped with 1, 2, 17, 18, 31, 32 | 5TS26 | TO PIN 31 |
| 11 | SSH Latch Fully Disengaged uSW N.C. | O/C | Grouped with 11, 27, 41 | 3TS26 | TO PIN 27 (DISENGAGED) |
| 27 | SSH Latch Fully Disengaged uSW Com | | Grouped with 11, 27, 41 | 3TS26 | |
| 41 | SSH Latch Fully Disengaged uSW N.O. | S/C | Grouped with 11, 27, 41 | 3TS26 | TO PIN 27 (DISENGAGED) |
| 12 | SSH Door Fully Closed uSW N.C. | O/C | Grouped with 12, 28, 42 | 3TS26 | TO PIN 28 (CLOSED) |
| 28 | SSH Door Fully Closed uSW Com | | Grouped with 12, 28, 42 | 3TS26 | |
| 42 | SSH Door Fully Closed uSW N.O. | S/C | Grouped with 12, 28, 42 | 3TS26 | TO PIN 28 (CLOSED) |
| 13 | SSH Latch Fully engaged uSW N.C. | O/C | Grouped with 13, 29, 43 | 3TS26 | TO PIN 29 (ENGAGED) |
| 29 | SSH Latch Fully engaged uSW Com | | Grouped with 13, 29, 43 | 3TS26 | |
| 43 | SSH Latch Fully engaged uSW N.O. | S/C | Grouped with 13, 29, 43 | 3TS26 | TO PIN 29 (ENGAGED) |
| 14 | SSH Door Fully Open uSW N.C. | O/C | Grouped with 14, 30, 44 | 3TS26 | TO PIN 30 (OPEN) |
| 30 | SSH Door Fully Open uSW Com | | Grouped with 14, 30, 44 | 3TS26 | |
| 44 | SSH Door Fully Open uSW N.O. | S/C | Grouped with 14, 30, 44 | 3TS26 | TO PIN 30 (OPEN) |
| 21 | SSH Motor Temperature B Drive | 115 KΩ | Grouped with 21,22 | 2TS26 | OK |
| 22 | SSH Motor Temperature B Sense | OVL`D | Grouped with 21,22 | 2TS26 | OK |
| 3 | SSH Sun Sensor A Cable Shield | | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | |
| 4 | SSH Sun Sensor A Cathode 2 | 2.64 KΩ | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | TO PIN 33 |
| 19 | SSH Sun Sensor A Cathode 1 | 2.6 0 KΩ | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | TO PIN 33 |
| 20 | SSH Sun Sensor A Cathode 4 | O/C | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | TO PIN 33 |
| 33 | SSH Sun Sensor A Anodes | | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | |

# SOCKET P212S CONT'D

| P212S | Funtion | Destn | Wire Groups | Wire Ttpe | Comments |
|---|---|---|---|---|---|
| 34 | SSH Sun Sensor A Cathode 3 | 2.64 KΩ | Grouped with 3, 4, 19, 20, 33, 34 | 5TS26 | TO PIN 33 |
| 35 | SSH Motor Temperature A Drive | 1.9 mΩ | Grouped with 35, 36 | 2TS26 | OK |
| 36 | SSH Motor Temperature A Sense | OVL`D | Grouped with 35, 36 | 2TS26 | OK |
| 5 | SSH HWA Temperature A Drive | 1.9 mΩ | Grouped with 5, 6 | 2TS26 | OK |
| 6 | SSH HWA Temperature A Sense | OVL`D | Grouped with 5, 6 | 2TS26 | OK |
| 7 | SSH HWA Temperature B Drive | | Grouped with 7, 8 | 2TS26 | OK |
| 8 | SSH HWA Temperature B Sense | | Grouped with 7, 8 | 2TS26 | OK |
| 9 | SSH Door Position Sensor Cable Shield | | Grouped with 9, 24, 25, 39 | 3TS26 | |
| 24 | SSH Door Position Sensor Drive | | Grouped with 9, 24, 25, 39 | 3TS26 | SEE NOTE 3 |
| 25 | SSH Door Position Sensor Return | | Grouped with 9, 24, 25, 39 | 3TS26 | SEE NOTE 3 |
| 39 | SSH Door Position Sensor Wiper | | Grouped with 9, 24, 25, 39 | 3TS26 | SEE NOTE 3 |
| 10 | Spare | | | | |
| 15 | Spare | | | | |
| 16 | Spare | | | | |
| 23 | Spare | | | | |
| 26 | Spare | | | | |
| 37 | Spare | | | | |
| 38 | Spare | | | | |
| 40 | Spare | | | | |

**NOTE 3.** PIN 24→25 = 47.8 KΩ

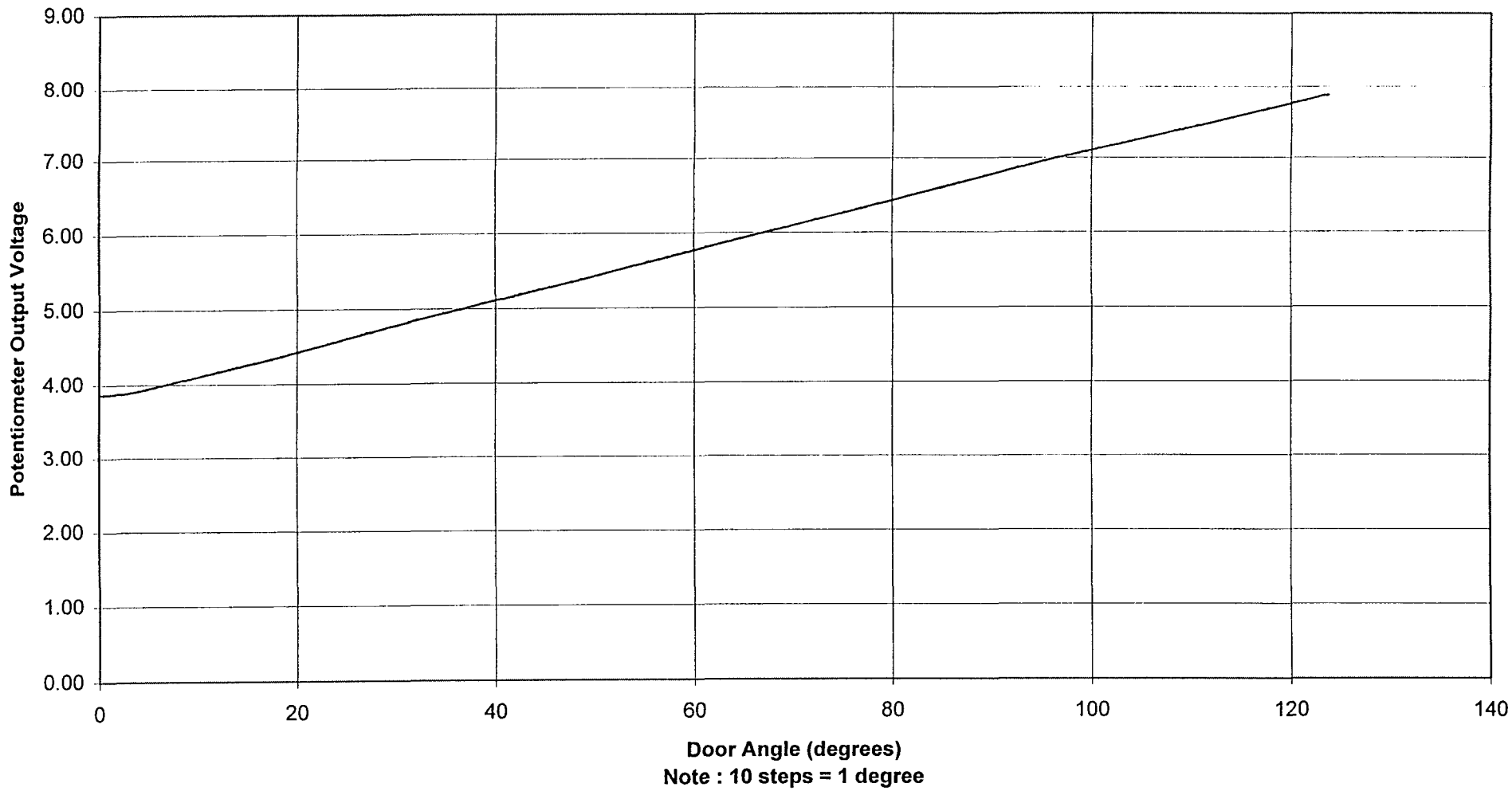
PIN 24→39 = 29.7 KΩ RESULTS RECORDED AT 0°
PIN 25→39 = 18.8 KΩ

PIN 24→39 = 10.4 KΩ RESULTS RECORDED AT 123°
PIN 25→39 = 38.5 KΩ

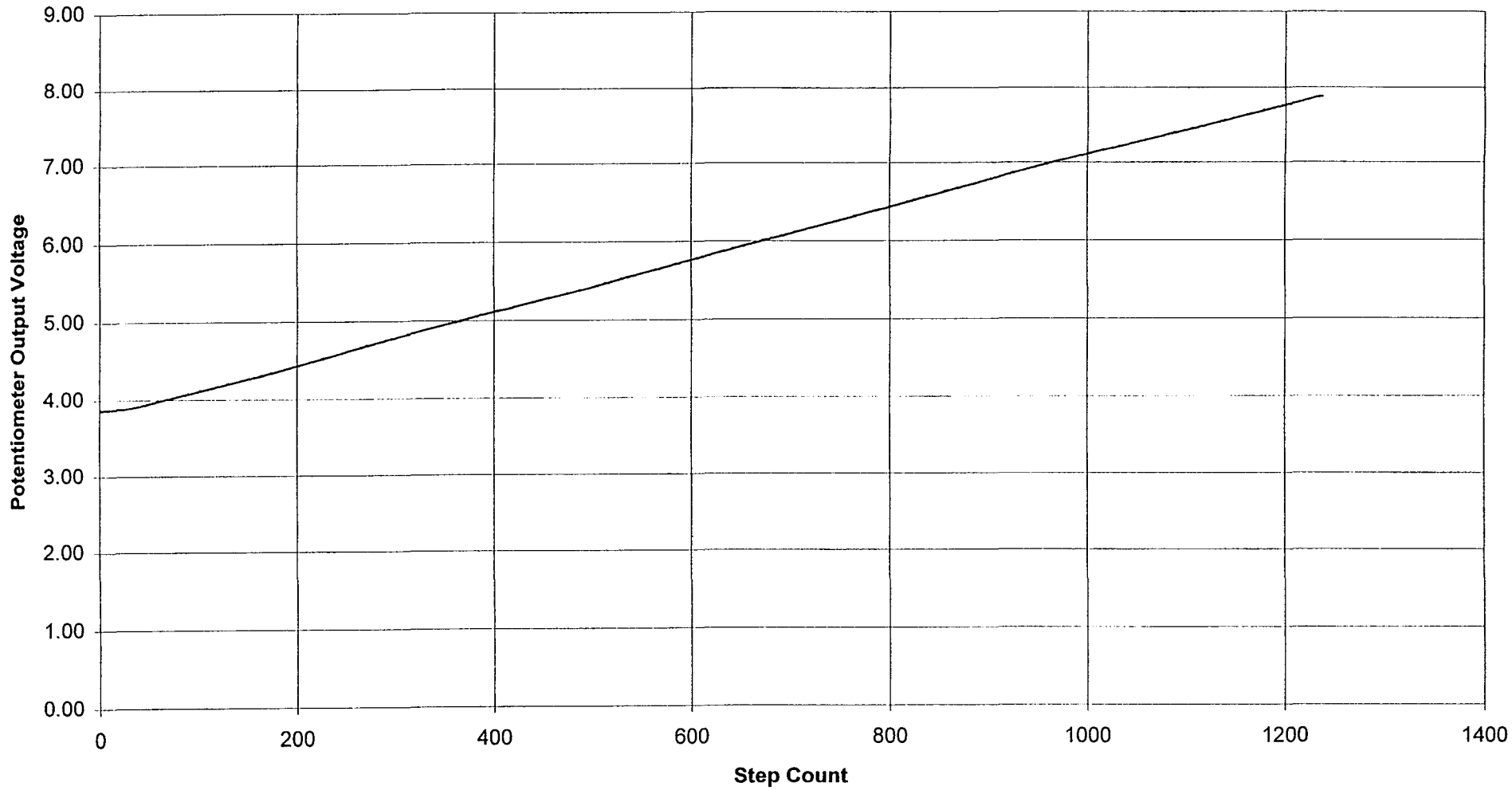
RESULTS SHOW THAT THE SPAN OF THE DOOR IS CLEAR OF THE POTENTIOMETER DEADBAND

# APPENDIX 2 Hinge drive stepper motor / potentiometer error calibration results

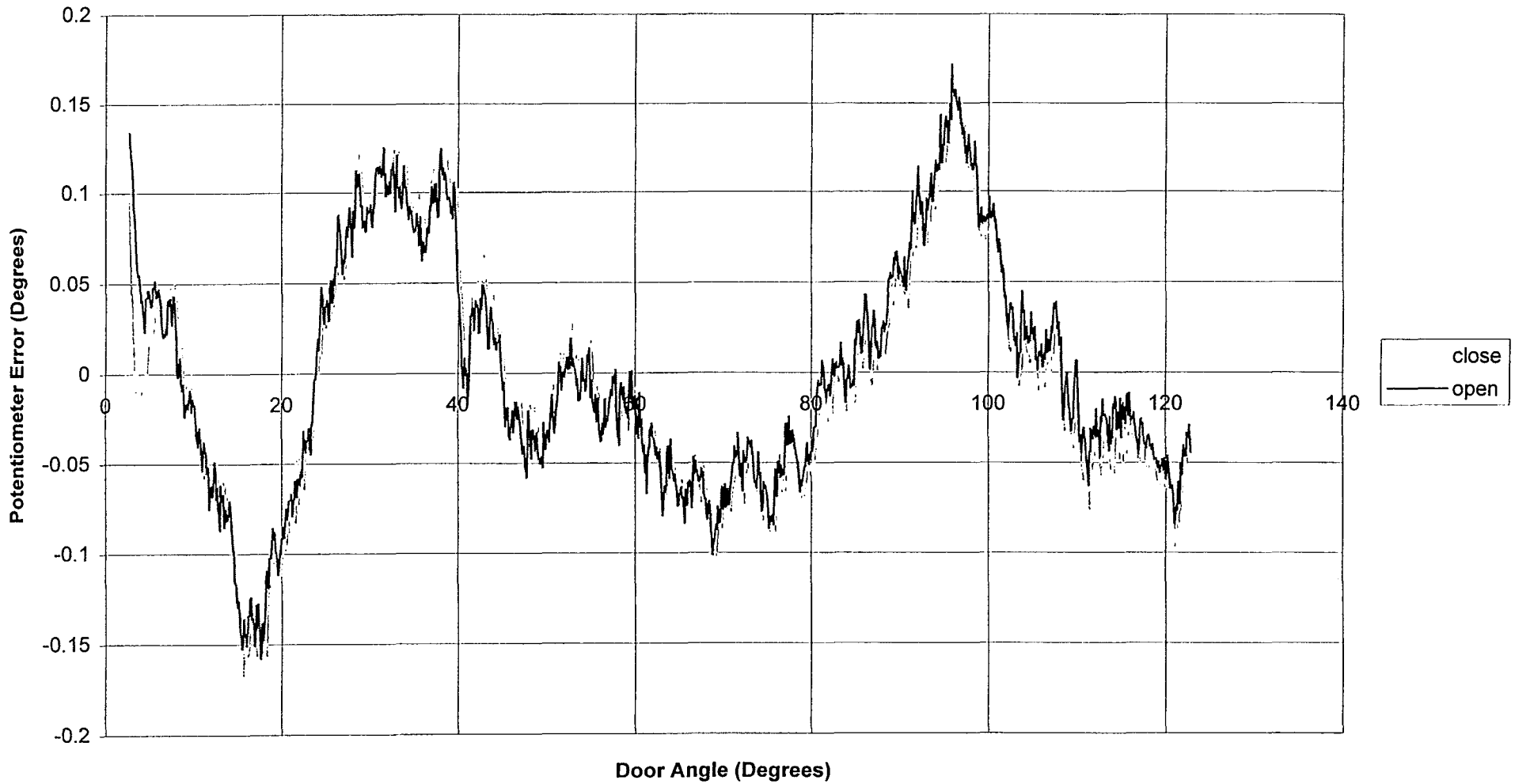
**Potentiometer Output Voltage versus Door Angle Position**



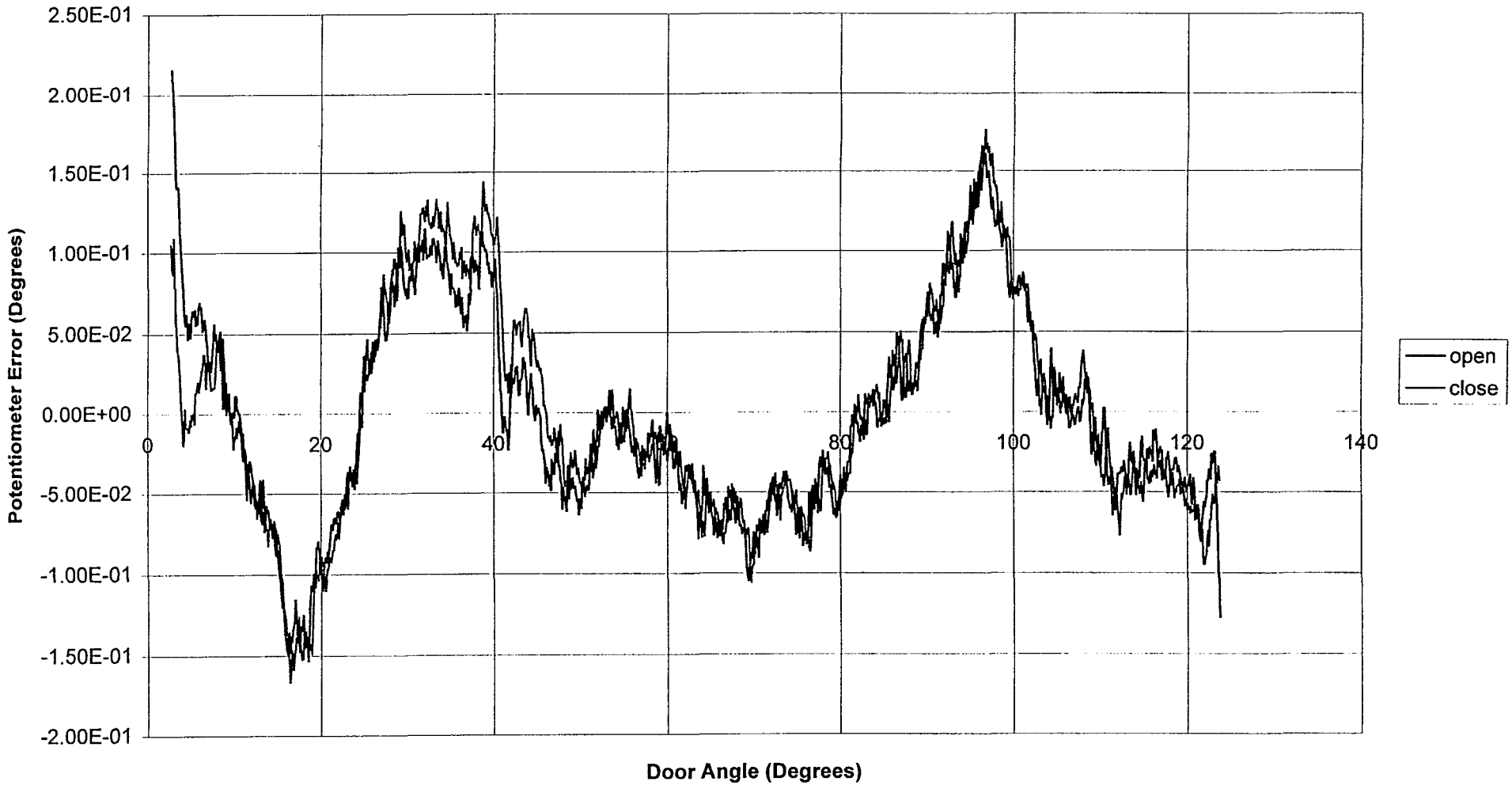
**Potentiometer Output Voltage versus Hinge Drive Step Count**



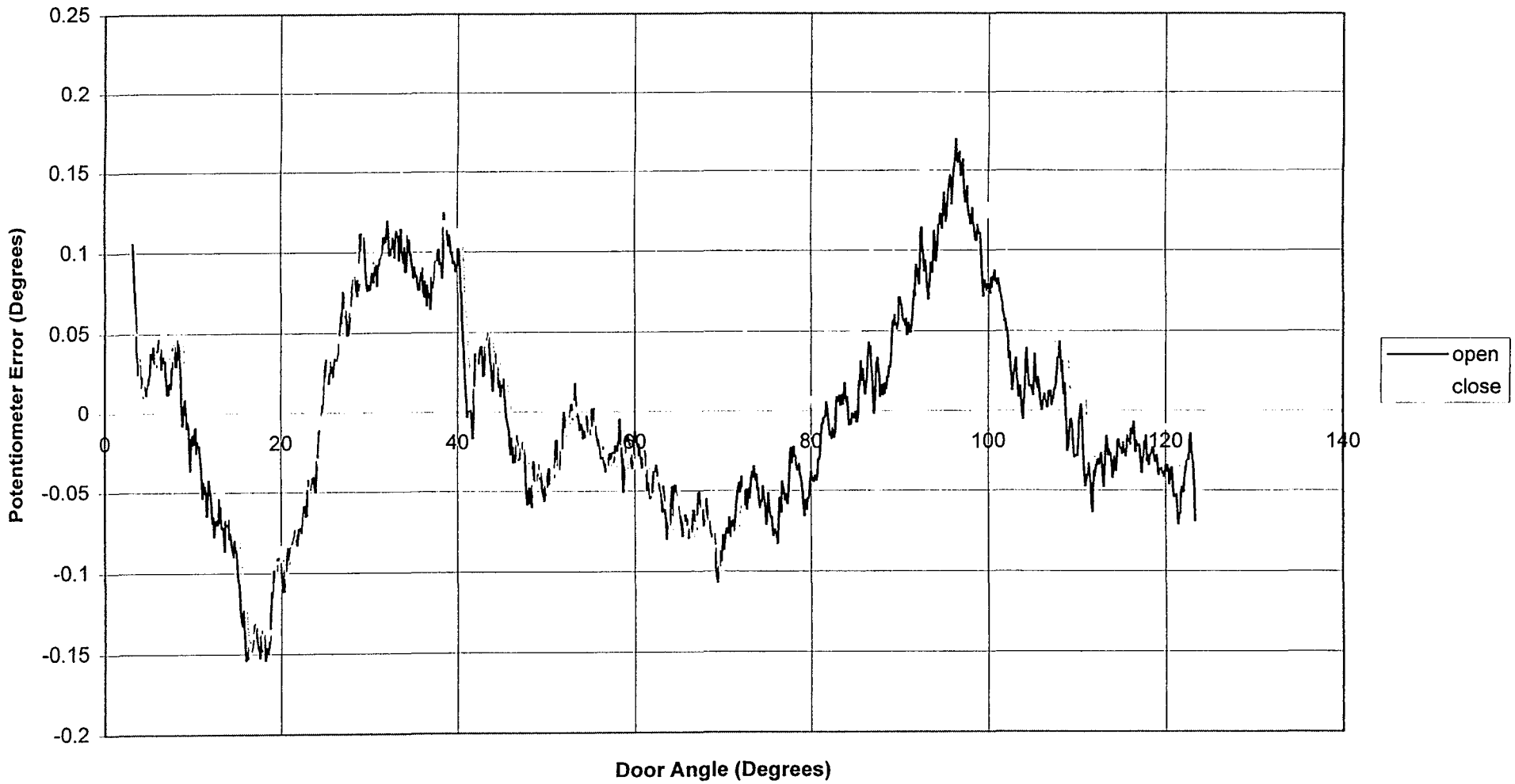
**FM HIRDLS SSH: Calibration Error plot - Baseline Test - 3/9/99**



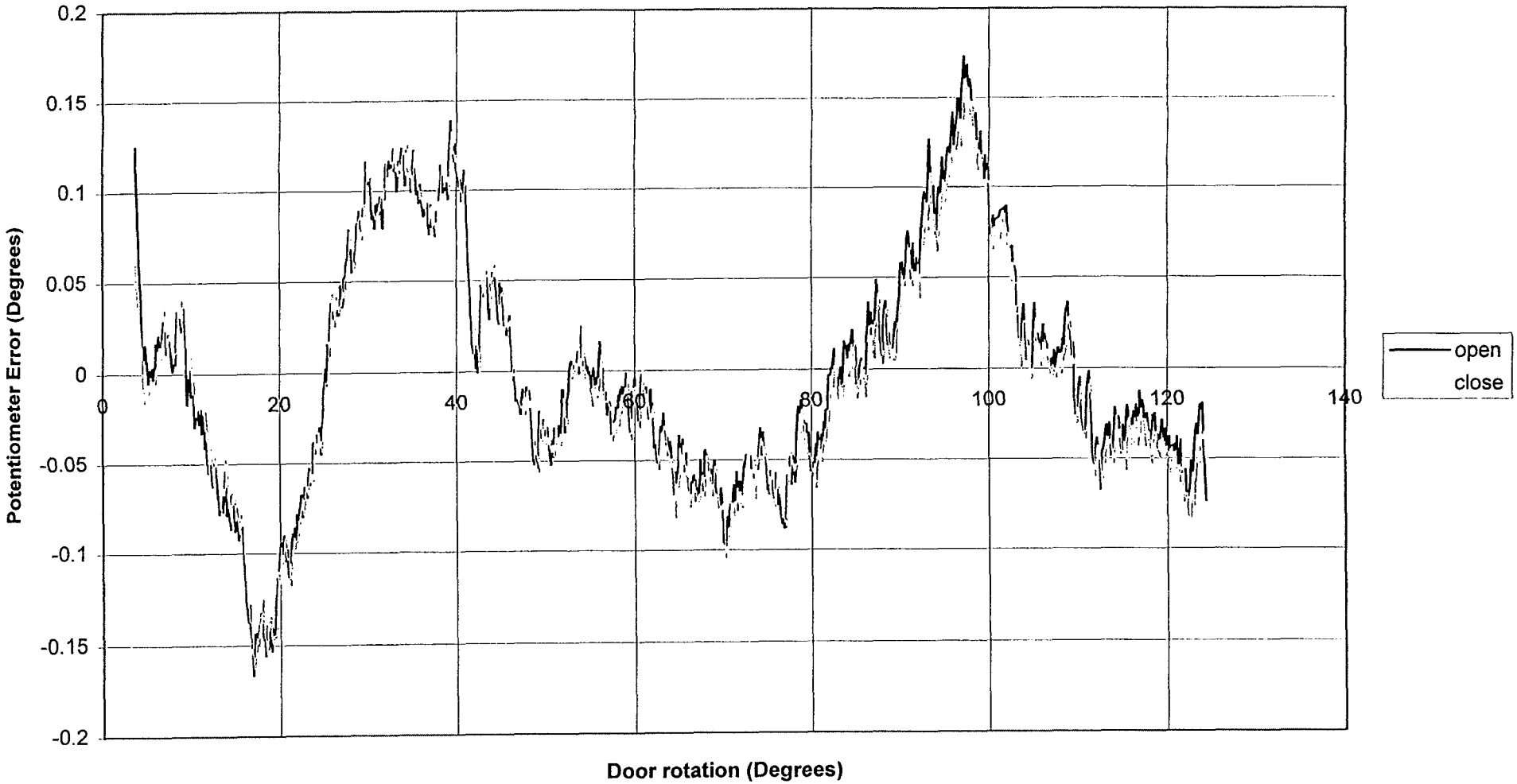
**FM HIRDLS SSH: Calibration Error Plot - Post Vibration test - 9/9/99**



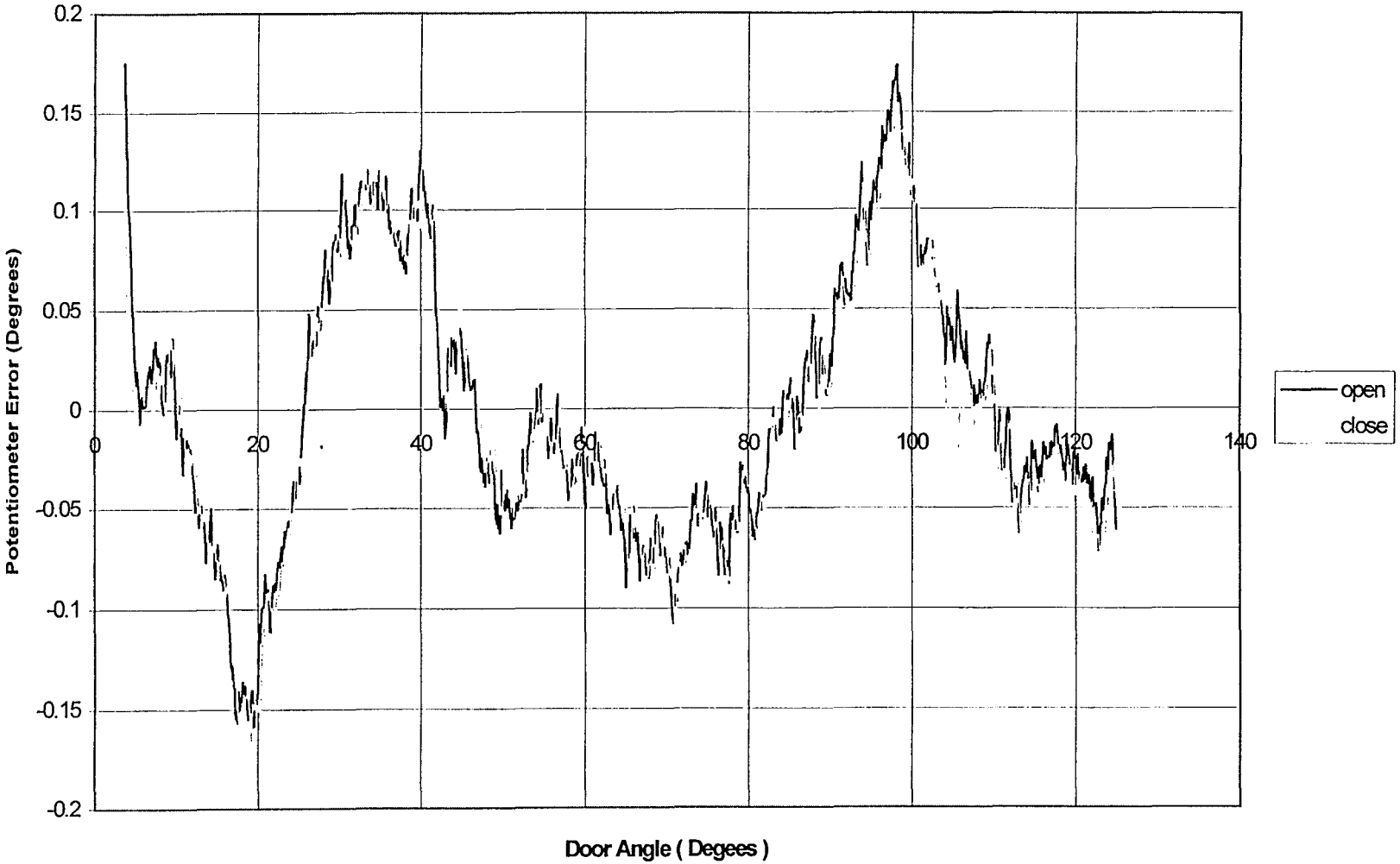
**FM HIRDLS SSH : Pre Thermal Vacuum Calibration Error-27/9/99**



**FM HIRDLS SSH : Calibration Error Plot @ 25 Degrees C -29/9/99 18:11**



**FM HIRDLS SSH :Calibration Error Plot @-25 Degees C -29/9/99 12:45**



**APPENDIX 3 RAL Thermal Vacuum Test Chamber Report AIV-99-092-STC**

Note Figures are not included – refer to original RAL document for details

# SSD ENVIRONMENTAL TESTING

## HIRDLS FM DOOR

## Thermal Vacuum Test

**REPORT No: AIV-99-092-STC**

**Contents:**

1) Test Specification.

2) Sensor Locations

3) Test Objectives

4) Test Results.

5) Cleanliness

6) Conclusion

Figs: 1 to 8) Thermal Cycling Mass Spectrometer Plots. (Not included herein)

Figs: 9 to 11) Temperature Vs Time Test Plots. (Not included herein)

Photograph

Annex: A) Equipment Used.

Date: 6/10/99

Reporting Officer: Pat O'Brien Ext.: 5741

Customer Organisation: Matra Maconi Space

Project: HIRDLS

Test Item: Sun Shield Assembly

Description:

Demanding Officer: Ian Stewart

Observers: Rob Coupe Steve Yardly

## 1) Test Specification

| REQUIREMENT | TEMPERATURE |
|---|---|
| Maximum Operational | 25°C |
| Minimum Operational | -25°C |
| Maximum Non Operational | 25°C |
| Minimum Non Operational | -25°C |
| Maximum Rate of Change | 5°C/min |
| Tolerances | +3°C 0°C<br>0°C -3°C |
| Temperature Vs Time Plot | Figs 9 to 11 |

| REQUIREMENT | DURATION |
|---|---|
| Soak Time | 4Hrs |

| REQUIREMENT | PRESSURE |
|---|---|
| Maximum Pressure | 1E-5mBar |

## 2) Sensor Locations

| TC | POSITION | FUNCTION |
|---|---|---|
| PL16 | Stepper Motor | Monitor |
| PL17 | Potentiometer | Monitor |
| PL19 | Far Centre of Base Plate | Monitor |
| PL20 | Support Frame Trop Centre | Monitor |
| PL22 | Actuator | Monitor |
| PL23 | Near Centre Base Plate | Monitor |
| PL24 | Potentiometer Frame | Monitor |
| PL25 | Front Thermal Plate | Monitor |
| PL26 | Rear Thermal Plate | Monitor |
| PL29 | Lower Hinge | Monitor |

## 3) Test Objectives

The objective of the test was to thermally cycle SSH FM between 25°C and -25°C and perform functional tests at three predetermined points

## 4) Test Results:

| Parameter | Date | Time | Temperature | Pressure |
|---|---|---|---|---|
| Pumpdown Initiated | 27/09/99 | 16 20 | | |
| Start Thermal Cycling | 29/09/99 | 07 40 | 19 0°C | 2 3 E-6 |
| Finish Thermal Cycling | 02/10/99 | 19 00 | 30°C | 3 5 E-7 |
| Letup Initiated | 03/10/99 | 07 45 | 20°C | 6 6 E-7 |
| Maximum Pressure At | 29/09/99 | 07.40 | 19°C | 2 3 E-6 |
| Minimum Pressure At | 02/10/99 | 13 00 | -21°C | 9 9 E-8 |

## 5) Cleanliness:

| Test Type | Cleanliness | Status | Peaks | Figures |
|---|---|---|---|---|
| Pre Test Calibration | Satisfactory | Normal | | |
| Thermal Testing | Satisfactory | Normal | 18 & 28 | |

Comments:

| |
|---|
| The SSH was mounted on a thermal plate which in turn was installed in the Space Test Chamber. Both the tank shroud and the thermal plate were cycled through the test profile together. |

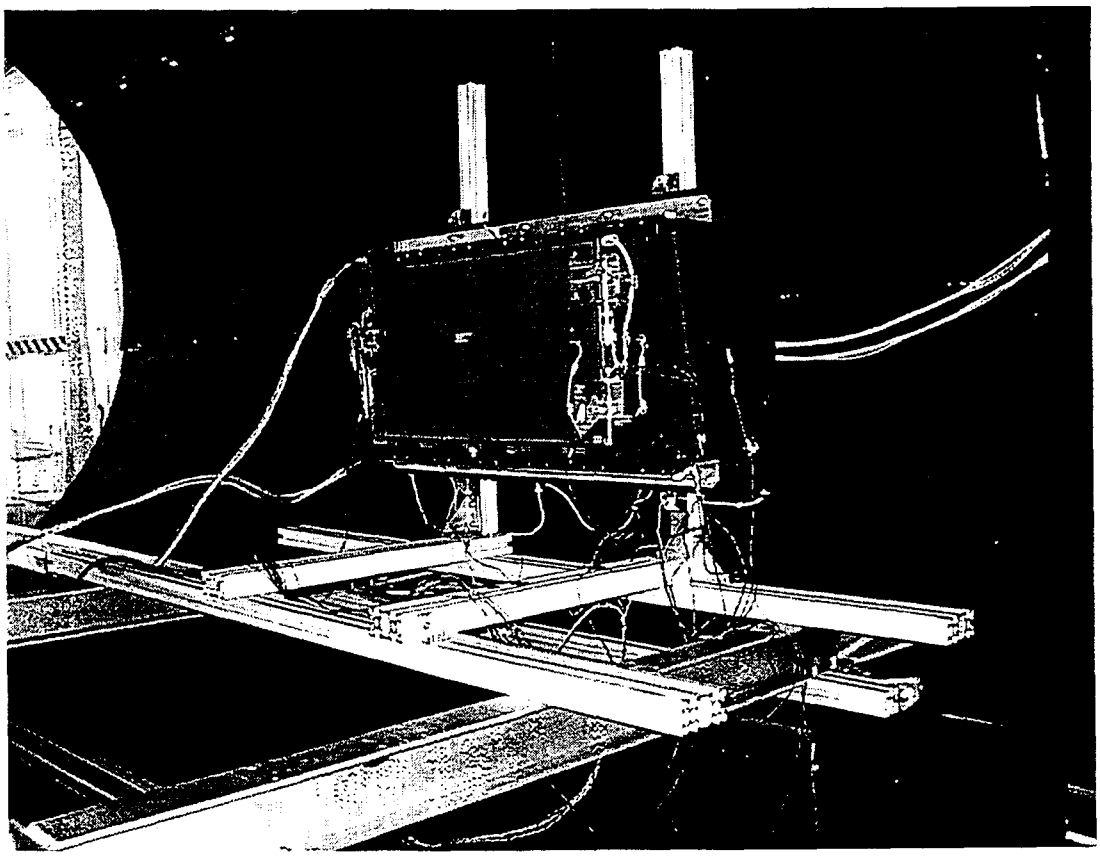
## 6) Conclusion

| |
|---|
| A thermal vacuum test was performed on HIRDLS SSH successfully |

**Thermal Vacuum Operations Manager.**

**Date:**

SSH in Space Test Chamber



Annex A

## EQUIPMENT USED

| Equipment | Manufacturer | Type | Calibration Date | Certificate No | Comments |
|---|---|---|---|---|---|
| Mass Spectrometer 0-200 AMU | Spectra Metrics | Multi Quad Head 1 | 18/09/98 | NA | Calibrated by Original Equipment Manufacturer |
| Vacuum gauges | Balzers | TPG300 Pirani/Penning | NA | NA | |
| Monitoring PRT's | TC LTD | PT100 Class A | Jan 99 | NA | In house Calibration |
| Temperature Controller | Eurotherm | PC 3000 | JAN 99 | NA | In house Calibration |
| Data acquisition system | Measurement Systems | Datascan Modules | JAN 99 | NA | In house Calibration |
| Calibrator | Beamax | TC 303 | 25/07/99 | 0081517 | Absolute Calibration Ltd |