

# SPIRE

**SUBJECT: Cold workmanship vibration test procedure  
PFM**

**PREPARED BY: E Sawyer**

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**SPIRE**

**Project Document**

Cold vibration test procedure

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**Distribution**

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## Change Record

| ISSUE | DATE    |  |
|-------|---------|--|
| 1     | 5/4/06  | New issue  |
| 2     | 17/8/06 | Section 3, new sensor allocations for SOB/BSM following the change of SMEC |

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## Glossary

SPIRE      Spectral and Photometric Imaging REceiver

## References

### Applicable Documents

| No  | Document                           | Ref                  |
|-----|------------------------------------|----------------------|
| AD1 | SPIRE PFM cold vibration test plan | SPIRE-RAL-PRC-002524 |
|     |                                    |                      |
|     |                                    |                      |
|     |                                    |                      |
|     |                                    |                      |
|     |                                    |                      |
|     |                                    |                      |

### Reference Documents

## 1. SCOPE

This document describes the detailed procedure to be followed during the cold vibration testing on the FPU to be carried out at CSL, Liege.

It should be used in conjunction with AD1

## 2. ACCELEROMETER ALLOCATION

| Channel No | Location                          | Type | Serial no | Code | Axis | Feed thro' |
|------------|-----------------------------------|------|-----------|------|------|------------|
|            |                                   |      |           |      |      |            |
|            | FPU top of optics bench over cone | 7724 |           | FPUX | X    | 4          |
|            | FPU top                           | 7724 |           | FPUY | Y    | 5          |
|            | FPU top                           | 7724 |           | FPUZ | Z    | 6          |
|            |                                   |      |           |      |      |            |
|            |                                   |      |           |      |      |            |
|            |                                   |      |           |      |      |            |
|            |                                   |      |           |      |      |            |

## 3. TEMPERATURE SENSOR LOCATIONS

| Sensor No | Location          | CODE | Calibration Curve Prime | Calibration curve Redundant |
|-----------|-------------------|------|-------------------------|-----------------------------|
|           |                   |      |                         |                             |
| 1         | RF filter         | RF   | X30977                  | <b>X31056</b>               |
| 2         | Spectrometer 2K   | SPEC | X29606                  | <b>X29592</b>               |
| 3         | Photometer 2K     | PHOT | X29601                  | <b>X29603</b>               |
| 4         | Optical sub bench | OPSB | X30981                  | <b>X29602</b>               |
| 5         | Input baffle      | BAF  | X29604                  | <b>X31033</b>               |
| 6         | BSM/SOB interface | BSM  | X31032                  | <b>X31047</b>               |

NB the redundant set will be used for this test

#### 4. STEP BY STEP TEST SEQUENCE RECORD

| No  | Activity   | Time              | Date | Run number | Comments             | Resp. |
|-----|--|-------------------|------|------------|----------------------|-------|
| 1   | <b>Test preparation</b>  |                   |      |            |                      |       |
| 1.1 | Unpacking from container:<br>As per AD1<br><br>Store container until the end of the test   | 3 hrs             |      |            |                      |       |
| 1.2 | Visual inspection of the FPU<br><br>Cover with cover provided while awaiting integration<br><br>Fit the three accelerometers to the FPU. | 2 hrs<br><br>1 hr |      |            | Record any anomalies |       |



|     |  |  |  |  |  |  |
|-----|--|--|--|--|--|--|
|     |  |  |  |  |  |  |
| 2   | <b>Vibration Test in X axis</b>  |  |  |  |  |  |
| 2.1 | <p><b>Test preparation</b></p> <p>Assuming test adaptor is fitted to the shaker</p> <p>Fit FPU to test adaptor in accordance with AD1</p> <p>Check torque of mounting feet</p> <p>8.1 Nm plus running torque for M6<br/>8.25 plus running torque or M8 Kaylock nut.<br/>2.1 Nm for the JFET bolts.</p> <p>Remove MGSE</p> <p>Fit temporary thermal straps between FPU and fixture, 4 straps at each end of the SOB.</p> <p>Cover detector harness connectors with copper tape to</p> | <p>3 hrs</p> <p>½ hrs</p> <p>½ hrs</p> |  |  |  |  |



|   |   |        |  |  |  |  |
|---|---|--------|--|--|--|--|
|   | <p>Connect temperature sensors</p> <p>Note<br/>These sensors do not record accurate temperatures at room temperature.<br/>Accurate only below 40K.</p> <p>Individual calibration curves will be supplied by SPIRE</p>   |        |  |  |  |  |
| 3 | <b>TRR</b>  | 4 hrs  |  |  |  |  |
| 4 | Shrouds installation, connection of pumps and fluid lines   | 2 days |  |  |  |  |
| 5 | <p><b>Evacuation</b></p> <p>Monitor pressure during evacuation and check for consistence with evacuation rate requirement in AD1<br/>Evacuation and re-pressurisation to be in accordance with AD1, max rate 50mb/min</p> <p>Note pressure values or attach</p> |        |  |  |  |  |

|   |   |  |  |  |  |  |
|---|---|--|--|--|--|--|
|   | record  |  |  |  |  |  |
| 6 | <p><b>Cool down</b></p> <p>Monitor temperature sensors during cool down and check for consistence with cool down requirements in AD1</p> <p><b>Max rate of change of BSM sensor is:-</b><br/> <b>Ambient to 200K -- 5K/hour</b><br/> <b>200K to 100K -- 10K/hour</b><br/> <b>Below 100K -- 50K/hour</b></p> <p><b>Maximum delta T between BSM and LTA is:-</b><br/> <b>Ambient to 200K -- 35K</b><br/> <b>200K to 100K -- 40K.</b><br/> <b>Below 100K, No restriction</b></p> <p>Note Temperature or attach temperature record of temperature sensors</p> |  |  |  |  |  |

|                       |   |                                    |  |  |   |                       |                      |  |
|-----------------------|---|------------------------------------|--|--|---|-----------------------|----------------------|--|
|                       |   |                                    |  |  |   |                       |                      |  |
| 20.1                  | <p><b>Resonance search</b></p> <p>Check results against those expected.</p> <p>Confirm levels for next test</p> | <p>1/2hr</p> <p>1hr</p> <p>1hr</p> |  |  | 0.25g 5 to 2000Hz   |                       |                      |  |
| 20.5                  | <b>Low level Random test</b>  | 1/2hr                              |  |  | <p><b>-12dB</b></p> <p><b>Full level is</b></p> <table border="1"> <tr> <td>Frequency Range<br/>Hz</td> <td>Acceptance<br/>levels</td> </tr> </table> | Frequency Range<br>Hz | Acceptance<br>levels |  |
| Frequency Range<br>Hz | Acceptance<br>levels  |                                    |  |  |   |                       |                      |  |

|                    | test to AD1 at -12dB<br><br>Check results   | 1/2hr  |  |  |              | <table border="1"> <tr><td>20-100</td><td>+3dB/Oct</td></tr> <tr><td>100-150</td><td>0.032 g<sup>2</sup>/Hz</td></tr> <tr><td>150-300</td><td>0.0128 g<sup>2</sup>/Hz</td></tr> <tr><td>300-2000</td><td>-12 dB/Oct</td></tr> <tr><td>Global</td><td>2.77 g RMS</td></tr> </table>  | 20-100             | +3dB/Oct          | 100-150 | 0.032 g <sup>2</sup> /Hz | 150-300 | 0.0128 g <sup>2</sup> /Hz | 300-2000 | -12 dB/Oct                | Global   | 2.77 g RMS |        |            |  |
|--------------------|---|--|--|--|--------------|---|--------------------|-------------------|---------|--------------------------|---------|---------------------------|----------|---------------------------|----------|------------|--------|------------|--|
| 20-100             | +3dB/Oct  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 100-150            | 0.032 g <sup>2</sup> /Hz  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 150-300            | 0.0128 g <sup>2</sup> /Hz   |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 300-2000           | -12 dB/Oct  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| Global             | 2.77 g RMS  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 20.6               | <b>Intermediate level Random test</b><br><br>test to AD1 at -6dB<br><br>Check results | 1/2hr<br><br><br><br><br><br><br><br><br><br>1/2hr |  |  | <b>-6 dB</b> | <b>Full level is</b> <table border="1"> <thead> <tr> <th>Frequency Range Hz</th> <th>Acceptance levels</th> </tr> </thead> <tbody> <tr><td>20-100</td><td>+3dB/Oct</td></tr> <tr><td>100-150</td><td>0.032 g<sup>2</sup>/Hz</td></tr> <tr><td>150-300</td><td>0.0128 g<sup>2</sup>/Hz</td></tr> <tr><td>300-2000</td><td>-12 dB/Oct</td></tr> <tr><td>Global</td><td>2.77 g RMS</td></tr> </tbody> </table> | Frequency Range Hz | Acceptance levels | 20-100  | +3dB/Oct                 | 100-150 | 0.032 g <sup>2</sup> /Hz  | 150-300  | 0.0128 g <sup>2</sup> /Hz | 300-2000 | -12 dB/Oct | Global | 2.77 g RMS |  |
| Frequency Range Hz | Acceptance levels   |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 20-100             | +3dB/Oct  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 100-150            | 0.032 g <sup>2</sup> /Hz  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 150-300            | 0.0128 g <sup>2</sup> /Hz   |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| 300-2000           | -12 dB/Oct  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |
| Global             | 2.77 g RMS  |  |  |  |              |   |                    |                   |         |                          |         |                           |          |                           |          |            |        |            |  |



|      |                               |       |  |  |  |  |
|------|-------------------------------|-------|--|--|--|--|
|      | Compare with previous results | 1/2hr |  |  |  |  |
| 20.9 | <b>Post test analysis</b>     |       |  |  |  |  |
|      | Check completeness of data    | 1/2hr |  |  |  |  |
|      | Carry out initial assessment  | 2hrs  |  |  |  |  |
| 21   | <b>TRR</b>                    |       |  |  |  |  |
| 22   | <b>Post Test Activities</b>   |       |  |  |  |  |



- check completeness of test data

- **Warm up**

Monitor temperature sensor during warm up and check for consistence with cool down requirements in AD1 Note Temperature or attach temperature record of temperature sensors

**Max rate of change of BSM sensor is:-**

**Ambient to 200K -- 5K/hour  
200K to 100K -- 10K/hour  
Below 100K -- 50K/hour**

**Maximum delta T between BSM and LTA is:-**

**Ambient to 200K -- 35K  
200K to 100K -- 40K.  
Below 100K, No restriction**

|    |   |                                   |  |  |  |  |
|----|---|-----------------------------------|--|--|--|--|
|    | <p><b>Venting</b><br/>         Monitor pressure during venting and check for consistence with evacuation rate requirement in AD1<br/>         Note pressure values or attach record</p> <p><b>Max rate 50mb/min</b></p> | 4hrs                              |  |  |  |  |
| 23 | <p><b>Dismount</b><br/>         dismounting of shrouds</p> <ul style="list-style-type: none"> <li>• Visual inspection of test specimen</li> <li>• Removal of instrument (TBC) and</li> </ul>                            | <p>4hrs</p> <p>1hr</p> <p>2hr</p> |  |  |  |  |

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|    |  |     |  |  |  |  |
|----|--|-----|--|--|--|--|
|    | cleanliness inspection with UV light   |     |  |  |  |  |
|    | <ul style="list-style-type: none"><li>• Installation of the instrument inside its own container in accordance with AD1</li></ul> | 2hr |  |  |  |  |
| 24 | <b>Transport</b>   |     |  |  |  |  |

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Annex 1 PFM build standard