XMM Optical Monitor

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DEM Thermal test plan

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CHANGE RECORD

ISSUE	DATE	PAGES CHANGED	COMMENTS
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1 Sandia Thermal Testing Facilities

Sandia National Laboratories maintains a thermal vacuum facility in the basement of Building 890 in Area I of the Albuquerque site. There are a total of seven vacuum systems in this facility:

Bell Jar	18 inch diameter
Bell Jar	24 inch diameter
Bell Jar	36 inch diameter
Bell Jar	42 inch diameter
Bell Jar	60 inch diameter
Horizontal Chamber	7 ft by 10 ft
Horizontal Chamber	8 ft by 12 ft

Each of these systems, except the 24 inch diameter bell jar, has the capability to heat and cool the unit under test (UUT). (The 24 inch diameter bell jar is used only for bakeout of conformal coating, epoxies, cables, and painted hardware.) The five largest systems are typically used to test entire payloads while the 18 inch diameter bell jar is typically used for tests of small boxes or other special tests. The two large chambers use rail systems to slide payloads into the chamber.

The five largest systems contain baseplates for mounting the UUT as well as shrouds which surround the UUT. The 24 inch bell jar has only a thermal blanket for heating; the 18 inch chamber contains only a baseplate. The baseplates and shrouds contain liquid nitrogen for cooling and electrical heaters for heating. The temperatures of the shrouds and baseplates are controlled by separate programmable controllers. Typically, payloads receive MIL STD 1540A type testing (minimum of 3 full thermal cycles as well as dwelling at the temperature extremes). Some payloads also receive on-orbit temperature cycle simulation. Temperature extremes of ± 100 degrees C can be obtained.

All systems, except the 18 inch and 24 inch bell jars, have fail-safe mechanisms which turn off power to the UUT if vacuum is lost. (This prevents electrical arcing if the pressure gets too high.)

All seven systems have thermal fail-safe mechanisms to prevent unacceptable temperature extremes.

All seven systems contain thermocouples which allow multipoint monitoring of temperatures on thermally controlled systems, and on external points on the payloads. Temperature readings of all thermocouples, except the 24 inch bell jar, are automatically recorded on strip chart recorders whenever a UUT is in the vacuum system. Payloads are typically tested from -40 to +120 degrees Fahrenheit.

Pumpdown to 50 millitorr typically requires 30 to 40 minutes; pumpdown to 1.0 E-6 torr requires about 8 hours. The ultimate vacuum pressures range from 5 E-6 to 5 E-8 Torr depending on UUT outgassing. High vacuum is achieved in the 24 inch and 18 inch bell jars by using hot oil diffusion pumps while cryo pumps are used on all other systems. (Cryo pumps prevent oil contamination of the flight systems.)

Payloads functions are controlled and monitored either from test racks that are located next to the chamber and are connected to the payload through connector portals, or from test racks located remotely that are connected to the payload through fiber optic cables.

2 Test Plan

The Unit Under Test (UUT) will consist of two identical XMM Optical Monitor DEM boxes which compose the Flight DEM System. One of the above mentioned Thermal Vacuum systems will be chosen for the test based on compatibility with the size of the DEM boxes and on the availability of the vacuum system.

The test will be conducted in a thermal vacuum test chamber with the UUT mounted on a thermally controlled heat sink. The controlling temperature sensor will be placed on the UUT baseplate. Electrical power will be turned off until desired vacuum has been reached. At that point, power will be applied and the testing will begin.

The test will consist of one special cycle followed by five normal cycles as specified in the X-ray Multi Mirror Mission Experiment Interface Document Part A (RS-PX-0016) Section 6.5.4.3.2. The special cycle is used to test the ability of the UUT to withstand non-operating temperature extremes and to test the

switch-on capability of the UUT at low temperatures.
Special Cycle (Performed once):

1. - Turn on UUT
2. - Perform Limited Performance Test (LPT) at ambient temperature
3. - Turn off UUT
4. - Increase temperature to T Maxi, dwell for TBD hours
5. - Decrease temperature to T1 Maxi, dwell for TBD hours
6. - Turn on UUT
7. - Perform LPT
8. - Turn off UUT
9. - Decrease temperature to T Mini, dwell for TBD hours
10. - Turn on UUT
11. - Perform LPT (this test may be omitted)
12. - Turn off UUT
13. - Increase temperature to T1 Mini, dwell for TBD hours
14. - Turn on UUT
15. - Perform LPT

Normal Cycle (Performed five times):

1. - Increase temperature to T1 Maxi, dwell for TBD hours
2. - Perform LPT
3. - Decrease temperature to T1 Mini, dwell for TBD hours
4. - Perform LPT

At the conclusion of the last normal cycle, an end procedure is performed:
End Procedure (Performed once):

1. - Increase temperature to slightly above ambient, dwell for TBD hours
2. - Perform LPT
3. - Turn off UUT
4. - Restore pressure to ambient
5. - Turn on UUT
6. - Perform LPT
7. - Turn off UUT
8. - Remove UUT from vacuum chamber

3 Test Levels and Duration

The pressure will be less than or equal to 1.0 E-6 torr.

The temperature limits for qualification, as specified in section 6.5.4.3.1 of the EID Part A, are as follows:

T1	Mini	-20 C
T1	Maxi	+50 C
T	Mini	-35 C
T	Maxi	+65 C

The temperature limits for acceptance, as specified in section 6.5.4.4 of the EID Part A, are as follows:

T1	Mini	-15 C
T1	Maxi	+45 C
T	Mini	-30 C
T	Maxi	+60 C

The speed of temperature variation is set at 20 degrees C per hour.