XMM Optical Monitor

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SPECIFICATION FOR FLIGHT IMAGE INTENSIFIERS

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1. SCOPE

This Specification is for a total of 6 image intensifiers, complete with mountings. Three of these will be used for Qualification testing, 2 for flight and there will be1 flight spare. Flight intensifiers will be subjected only to Acceptance Levels of vibration testing.
These intensifiers will be part of the Blue Module of the Optical Monitor which is an experiment to be fitted on the ESA X-Ray Multi-Mirror Mission (XMM).

2. TIME TABLE

The time table will be as agreed in the purchase order.

3. REQUIREMENTS

The intensifiers shall conform to the requirements detailed in the following paragraphs.

4. REFERENCE DOCUMENTS

The following document forms part of this RFQ, as specified within:
ESA Experiment Interface Document Part A (EID A), RS-PX-0016 issue 6, February 1996.

5. TECHNICAL SPECIFICATION

^{XMM}OM Intensifier	Quality Level	
Parameter	**Qualification Model**	**Flight Model**
Photo-cathode Type	S20	S20
Input Window Material	Hereaus Suprasil. Selected for minimum fluorescence. Concave window, radius of curvature -57.57mm, centre thickness 4mm	Hereaus Suprasil. Selected for minimum fluorescence. Concave window, radius of curvature -57.57mm, centre thickness 4mm
Proximity Focusing Gap	150µm ± 50µm	150µm ± 50µm
First MCP Characteristics (MSSL supplied)	8µm pores on 10µm centres ≥8° bias 40:1 aspect ratio Manufactured by Galileo	8µm pores on 10µm centres ≥8° bias 40:1 aspect ratio Manufactured by Galileo
Second MCP Characteristics (MSSL supplied)	10µm pores on 12µm centres ≥8° bias 80:1 aspect ratio Manufactured by Galileo	10µm pores on 12µm centres ≥8° bias 80:1 aspect ratio Manufactured by Galileo

Third MCP Characteristics (MSSL supplied)	10µm pores on 12µm centres ≤1° bias 80:1 aspect ratio Manufactured by Galileo	10µm pores on 12µm centres ≤1° bias 80:1 aspect ratio Manufactured by Galileo
MCP Configuration	Chevron in a Single Plane ±5°	Chevron in a Single Plane ±5°
MCP Orientation of bias angle	Reference mark on MCP to be aligned to ±2° w.r.t. CCD X axis (see Appendix)	Reference mark on MCP to be aligned to ±2° w.r.t. CCD X axis (see Appendix)
Electrical Resistance of Second & Third MCP's	Matched to within 10%	Matched to within 10%
Phosphor Type	P20 (fast)	P20 (fast)
Output Window	Fibre-Optic Taper (MSSL Supplied)	Fibre-Optic Taper (MSSL Supplied)
Operating Voltage Distribution	See Table 1	See Table 1
Photo-cathode RQE @20°C	>15% @ 300nm >3% @ 550nm	>20% @ 300nm >6% @ 550nm
Photo-cathode Emission Defects (Defect if ≥0.1 counts/sec)	None at V_{max}	None at V_{max}
Photo-cathode Non-Uniformity over 18x18mm area aligned with ±X CCD axis	<10% rms. of mean over any 50nm interval from 200nm to 550nm	<5% rms. of mean over any 50nm interval from 200nm to 550nm
MCP Switched ON Channels (Def^{n} - switched on if dark current >0.05 counts/sec at nominal operating voltages)	< 10 within 18mm x 18mm central area orientated along the ±X CCD axis	none within 18mm x 18mm central area orientated along the ±X CCD axis
Dark Defects Measured at Phosphor (Def^{n} - local areas <70% gain)	<10 between 20um & 80µm; ≤1 between 80µm and 500µm none larger than 500µm	<3 between 20um & 80µm; none larger than 80µm
MCPs Gain Non-Uniformity over 18 x 18mm area, aligned with ±X CCD axis (see Note 1)	<10% rms of mean	<10% rms of mean

Dark Counts @ 20°C	<100 counts/cm^2/sec excluding switched on channels	<50 counts/cm^2/sec excluding switched on channels
Photon Gain (See Note 2)	>5x10^6 photons/photoelectron at peak of the pulse height distribution, tube operated at nominal voltages	>5x 10^6 photons/photoelectron at peak of the pulse height distribution, tube operated at nominal voltages
Pulse Height Distribution	1. <90% ΔG/G FWHM valley height <30% of peak. Test area 2.25 x 2.25mm 2. spatial variation of the peak over the whole area of the detector <15% peak to peak (See Note 3) N.B. tube operated at nominal voltages	1. <90% ΔG/G FWHM valley height <30% of peak Test area 2.25 x 2.25mm 2. spatial variation of the peak over the whole area of the detector <15% peak to peak (See Note 3) N.B. tube operated at nominal voltages
Maximum Survival Voltage (See Note 4)	PC to MCP1 : 400V Across MCP1 : 900V Across MCP2 & MCP3: 3200V Across anode gap : 6000V	PC to MCP1 : 400V Across MCP1 : 900V Across MCP2 & MCP3: 3200V Across anode gap : 6000V
Output Event Width Distribution on phosphor screen	70µm ±20µm FWHM	70µm ±20µm FWHM
Signal Induced Background	≤0.3 per primary event for events of energy between 5% and 15% of the primary event ≤0.03 per primary event for events with energy >15% of the primary event	≤0.3 per primary event for events of energy between 5% and 15% of the primary event ≤0.03 per primary event for events with energy >15% of the primary event

Note 1. The 18x 18mm area is illuminated with a brightness of >100,000counts per second and is acquired by a CCD camera; integrate for >300 sec(or equivalent) to achieve sufficient S/N.
Note 2. Precise Photon Gain is given by the cross-calibration between MSSL OGSE and Supplier’s optical tester.
Note 3. The 18 x 18mm area is divided into 2.25 x 2.25mm sections and thePHDs are measured separately in each section.
Note 4. Maximum voltage of each point is tested individually with the remaining points kept at nominal voltage. Maximum voltage must be applied for at least 30 minutes.

Blue Detector Image Intensifier - Electro-Optical Additional Goals

Parameter	Qualification Model	Flight Model
Lifetime (Flat field)	≤5% degradation in DQE @350nm after flat field exposure of $2x10^{12}$ detected events/cm^2	≤5% degradation in DQE @350nm after flat field exposure of $2x10^{12}$ detected events/cm^2
Lifetime (Point Image)	≤5% degradation in DQE @350nm after 1000 second exposure of 10^5 detected events in an image of diameter 50µm	≤5% degradation in DQE @350nm after 1000 second exposure of 10^5 detected events in an image of diameter 50µm

TABLE 1
Operating Voltage Distribution (Qualification & Flight)

	Photo-cathode Gap	Voltage across 1st MCP	Voltage across 2nd & 3rd MCP's	Anode Gap Voltage
Nominal	350V	670-800V	2400-2900V	4500-5000V

6. MECHANICAL DESIGN

The mechanical design shall be in accordance with the EID A issue 6, par 5.5. Particular attention is drawn to paragraphs 5.5.3 Materials' Requirements, 5.5.4 Stiffness Requirements and 5.5.5 Strength Requirements. The mass shall not exceed 236g.

7. THERMAL DESIGN

The intensifiers must be capable of withstanding the following temperature conditions:-

Space Environment

Operating		Minimum switch-on	Non-Operating	
Min	Max		Min	Max
+16°C	+40°C(TBC)	-35°C	-35°C	+55°C

Laboratory Environment

Operating		Minimum switch-on	Non-Operating	
Min	Max		Min	Max
0°C	+40°C(TBC)	-35°C	-35°C	+55°C

8. PROCESS

The intensifiers shall be made to the Manufacturer's flight process and QA system. These procedures will be assessed and will subsequently form a part of the purchase agreement.

9. TESTING

9.1 Performance Testing

Methods for testing the parameters detailed in par 5 shall be identified in the quotation.

9.2 Vibration Testing

The Intensifiers shall meet the requirements for vibration testing, as specified in the EID A issue 6.
Sine vibration test levels for the Instrument are given in par 6.5.3.2.1 for electronic units.
Random vibration test levels for the Instrument are give in par 6.5.3.2 for units on the Mirror Support Platform.
N.B. These vibration levels are for the Instrument. They do not take into account amplification that will occur because of the disposition of the Intensifiers with respect to the vibration attachment points.

9.3. Thermal Vacuum Testing

The Intensifiers shall meet the thermal vacuum requirements specified in par 6.5.4 in the EID A issue 6.

9.4 Corona

The Intensifiers shall meet the requirements specified in par 6.5.5 in the EID A issue 6.

10. MATERIALS

Materials shall be used that are consistent with the objectives of this specification They must have low outgassing (≤0.1% total material loss and ≤0.01% collected vaporised condensable material), high reliability and survive the vibration testing detailed in par 9. All materials used in the devices must be capable of being identified and traced to their source documentation.

11. PHYSICAL SIZE

The intensifiers shall conform to the physical envelope detailed in drawing A3 5255 701-17, a copy of which is included as the Appendix.

12. HIGH VOLTAGE CABLE ASSEMBLIES

These shall be free issued by MSSL and shall be fitted as shown in the Appendix, drawing A3 5255 701-17.

13. CLEANLINESS

On delivery, the contamination levels of the external surfaces of all the intensifier assemblies shall be not greater than 1.5×10^{-8} g/cm^2(molecular) and not greater than 45 ppm (particulate).

14. IN-PROCESS WITNESSING BY MSSL

MSSL reserves the right to witness key process steps and key tests for any of these devices. These key points shall be identified and agreed with MSSL before manufacture begins and the supplier shall provide MSSL with a minimum of 3 working days notice of their occurrence.

15. MARKING

Each tube shall be marked with the MSSL serial number on the inner surface of the outer housing. Numbers will be sequential from 1 to n, where n is the number of housed tubes produced to satisfy contractual requirements.

16. PACKING AND TRANSPORTATION

Each intensifier shall be individually packaged to maintain its cleanliness in material that is suitable for long term storage. Protection for transportation shall be provided.

17. DOCUMENTATION

The following documentation shall be provided with each delivery and for each intensifier:-

Details of materials used, including batch numbers, serial numbers etc., as appropriate.
A copy of all test results.
An overall Certificate of Conformance to this Specification.