George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

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ORGANIZATIONAL WORK INSTRUCTION

EM50

OPERATION OF ATOMIC OXYGEN BEAM FACILITY

Revision E

APPROVING AUTHORITY	NAME	TITLE	ORG	DATE
Group Leader	DeWitt Burns	Environmental Effects Branch	EM50	4/27/2005

CHECK THE MASTER LIST—
VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE

DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		Aug. 7, 1997	Baseline version of OWI
Revision	A	June 3, 1999	Updated for reorganization, new titles, elimination of division authority
Revision	B	Feb. 22, 2000	Changed QMS documents to directives
Revision	C	July 6, 2000	Updated for records management
Revision	D	Sept. 1, 2004	Updated per HQ Rules Review Action
Revision	E	04-27-05	Changes made due to reorganization

OPERATION OF ATOMIC OXYGEN BEAM FACILITY

1. SCOPE

1.1 Scope.

This document establishes the organizational work instruction for the Atomic Oxygen Beam Facility (AOBF) located in Bldg. 4711, Room E179.

1.2 Purpose.

The purpose of this document is to outline the steps necessary for hyperthermal atomic oxygen exposure of material samples or other items in the AOBF. Exposure in the AOBF simulates the effect of the low Earth orbit environment.

1.3 Applicability.

This document only applies to the Atomic Oxygen Beam Facility in Bldg. 4711, Room E179. This work instruction is not a substitute for formal training in AOBF operation. Untrained personnel should not attempt to use this document to operate the AOBF in Bldg. 4711, Room E179 unless supervised by trained, experienced personnel.

2. APPLICABLE DOCUMENTS

MPD 1280.1	Marshall Management Manual
EM50-OWI-002	Document and Data Control
EM50-OWI-003	Control of Records
GMP 20 KEID	Operating Manual

3. DEFINITIONS

Warning - Warnings are used when failure to observe instructions or precautions could result in injury to personnel.

Caution - Cautions are used when failure to observe instructions could result in damage to equipment.

Note - Information to help clarify multi-person procedures or simultaneous multiple operations.

4. INSTRUCTIONS

Work performed and data generated within EM50 that affects the quality of products as specified in the scope of the Marshall

Quality Manual (MQM) shall be documented and controlled per EM50-OWI-002.

4.1 **Pre-Test Preparation**

4.1.1 Install samples in test chamber, check alignment, and measure distance from sample holder to neutralizer plate.

4.1.2 If required, connect thermocouples from samples to digital readout.

4.1.3 Replace access port covers. Ensure that system is airtight and ready for pump-down.

4.2 **Pump Down**

4.2.1 Turn on roughing pump and open roughing valve to AOBF. Run roughing pump until vacuum level reaches 10^{-3} torr.

Caution - Turning on the turbopumps before 10^{-3} torr vacuum level is reached could result in damage to equipment.

4.2.2 Turn on turbopumps, open foreline valve, open gate valves, and continue pumping. Use ion gauge to monitor vacuum level. Vacuum level shall reach 10^{-6} torr before beginning atomic oxygen exposure, and pumps shall remain on during exposure.

4.3 **Start-up of Atomic Oxygen Beam**

4.3.1 Turn off ion gauge.

4.3.2 Turn off Low Speed Switch on turbo pumps and let them speed up.

4.3.3 Plug in water solenoid to Magnetron.

4.3.4 Turn on power to microwave power supply.

4.3.5 Turn on power to pulse generators.

4.3.6 Turn on power to oscilloscopes.

4.3.7 Turn on power supply to neutralizer plate, set at -50 volts.

4.3.8 Turn on power to Magnet Control Panel including power supply next to Magnet Control Panel.

4.3.9 Turn on water to pin and neutralizer plate.

4.3.10 Turn on DI water circulating pump (P2); wait until all lights on the control box are green.

4.3.11 Turn on Power Cut-Off to Rectifier (in Shop behind the wall).

4.3.12 Turn on AC Power Breaker on front panel of rectifier; if this action trips the breaker (B3) in the bus, it must be reset in room W139. (The main door is outside, but W139 can be accessed through the autoclave lab.)

4.3.13 Turn on DC Power Breaker on front panel of rectifier.

4.3.14 Turn voltage Adjust knob on magnet control panel to 100%.

4.3.15 Raise current to 300 A.

4.3.16 Let chiller start and cool fluid to 50 °F.

4.3.17 Raise current to 450 A.

4.3.18 Turn on mercury lamp and shine into chamber.
4.3.19 Turn on Cold Cathode Gauge.
4.3.20 Turn on gas pulse and raise amplitude voltage to between 45 V and 50 V.
4.3.21 Start generating microwave into chamber; watch the reflected power pulse on oscilloscope. A discharge will be started when the reflected power goes to a minimum.

Caution: Do not let the pulse remain high for more than 5 seconds.

4.3.22 Adjust gas pulse amplitude to maximize current; amount 35 V to 36 V.
4.3.23 Once pulse current is maximized, adjust reflected power at the Triple-Stub Tuner.
4.3.24 Turn off mercury lamp.
4.3.25 Start timer.
4.3.26 Record current at start, middle, and end of pulse.
4.3.27 Decrease voltage to neutralizer plate to -3 V.
4.3.28 Observe for the next one to two hours while the system warms up. The gas pulse amplitude will need to be increased to maintain optimum levels.
4.4 **Monitoring during operation**
4.4.1 Set voltage to neutralizer plate to -50 V.
4.4.2 Record current at the start, middle and end of pulse.
4.4.3 Decrease voltage to neutralizer plate back to -3 V.
4.4.4 Record sample temperature, if available, at regular intervals.
4.4.5 Monitor the chiller and the temperature of coolant leaving magnets.

Caution: Temperature of the coolant leaving the magnets shall not exceed 170 °F. If the chiller fails to maintain coolant temperature, shut down the AOBF.

4.5 **Shutdown**
4.5.1 Turn off microwave generator.
4.5.2 Shut down power to pulse generators, oscilloscopes, and power supplies.
4.5.3 Shut down power to microwave power supply.
4.5.4 After allowing time to cool, turn off water to Magnetron by unplugging solenoid.
4.5.5 Lower current to magnets.
4.5.6 Turn off DC Power Breaker on front of rectifier (behind wall in shop area).
4.5.7 Turn off AC Power Breaker on front of rectifier.
4.5.8 Turn off Cut-off switch on main power panel.

Caution: Coolant must be allowed to circulate through the Magnetron and the magnets until they approach room temperature.

4.5.9 Turn off water to neutralizer plate and source pin.
4.5.10 After allowing time for the magnets to cool to room temperature, turn off circulating pump (P2).
4.5.11 Shut off power to magnet control panel.
4.5.12 Turn off cold cathode gauge and turn on ion gauge.
4.5.13 Turn on Low Speed Switch on turbo pumps.

5. NOTES

None.

6. SAFETY PRECAUTIONS AND WARNING NOTES

This work instruction is not a substitute for formal training in AOBF operation. Untrained personnel should not attempt to use this document to operate the AOBF in Bldg. 4711, Room E179 unless supervised by trained, experienced personnel.

7. APPENDICES, DATA, REPORTS, AND FORMS

All activities with the AOBF shall be noted in the appropriate lab notebook. This shall include location of samples in the sample holder, current readings, sample temperature, and time of exposure.

When qualifying a material for spacecraft use, a data sheet shall be filled out with significant properties (mass, solar absorptance, conductivity, etc.) as measured for each sample before and after atomic oxygen exposure. The atomic oxygen exposure shall be calculated based on average current, time of exposure, and location in the AOBF, and cross-checked with a calibration sample (usually Kapton) or catalytic probe. This data sheet shall be presented to quality personnel for stamping. MSFC Quality may choose whether or not to be present for the atomic oxygen exposure and sample characterization.

8. RECORDS

Records will be retained in accordance with EM50-OWI-003. Copies shall be maintained on file in EM50 for a period not less than five years.

9. TOOLS, EQUIPMENT, AND MATERIALS

As required.

10. PERSONNEL TRAINING AND CERTIFICATION

The leader of the Environmental Effects Group shall be responsible for ensuring that all personnel using the AOBF in Bldg. 4711, Rm. E179 are trained. Training is generally accomplished as on-the-job training by experienced personnel. Records of personnel training shall be kept in the group office.

11. FLOW DIAGRAM