



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

EM50-OWI-033
Baseline
March 3, 2006

ORGANIZATIONAL WORK INSTRUCTION

EM50

Impact Testing Facility Large Ballistic Gun

THIS PROCEDURE DESCRIBES HAZARDOUS OPERATIONS

**APPROVING
AUTHORITY**

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DOCUMENT HISTORY LOG

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1. SCOPE

1.1 Scope

This document establishes the standard test procedure for the Large Ballistic Gun (LBG) located outside Bldg. 4571 on the outdoor test range.

1.2 Purpose

The purpose of this document is to outline the approach necessary for routine operation of the Large Ballistic Gun.

1.3 Applicability

This document only applies to the subject test system. This document is not a substitute for formal training.

2. APPLICABLE DOCUMENTS

- EM50-OWI-002 - Work Request Process
- EM50-OWI-003 - Control of Records
- EM50-OWI-004 - Control of Customer-Supplied Products
- ITF-SOP-001 - Impact Testing Facility, Standard Operating Procedure, Area Warning
- MPR 8730.5 - Control of Inspection, Measuring, and Test Equipment
- MWI 3410.1 - Personnel Certification Program
- MWI 8715.15 - Ground Operations Safety Assessment and Risk Mitigation Program

3. DEFINITIONS/ACRONYMS

Area Coordinator – Individual responsible for making area warning announcements and controlling warning lights and drop gates in the Test Area.

- HOR - Hand Operated Regulator
- HOV - Hand Operated Valve
- ITF - Impact Testing Facility
- LBG - Large Ballistic Gun

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- PG - Pressure Gauge
- SOP - Standard Operating Procedure
- SOW - Statement of Work
- SPTA - Solid Propulsion Test Area

4. INSTRUCTIONS

4.1 Hardware Submittal

Projectile and/or target hardware submitted for testing shall be provided with appropriate records and defined requirements for handling, testing, and environmental exposure. Hardware submittals shall include all appropriate work request forms and quality tracking records.

4.2 Test Facility Environment

The test facility is located in the East Test Area. The area and this test facility are deemed hazardous operations; therefore, only authorized personnel are allowed in the facility during test operations. All warning signs, lights, and sirens shall be obeyed at all times.

4.3 Hardware Testing

All hardware will be tested per requirements outlined in a detailed statement of work (SOW) from the customer. Specific operational procedures are in Section 11 of this document. Test operations are prohibited when Test Area is under a lightning warning.

4.4 Test Facility Calibration

Calibration shall be maintained on critical instrumentation as described in MPR 8730.5, Control of Inspection, Measuring, and Test Equipment. Test specific critical instrumentation will be defined in a SOW and addressed during the Test Readiness Review.

All instrumentation associated with the test system that requires calibration shall have current calibration stickers. If any instrument calibration is out of date, refer to MPR 8730.5 on how to address out of calibration equipment.

5. NOTES

Tolerances for projectile velocity and impact angles shall be defined in the SOW.

6. SAFETY PRECAUTIONS AND WARNING NOTES

Warning - Warnings are used when failure to observe instructions or precautions could result in serious injury or death to personnel or major equipment damage.

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Caution - Cautions are used when failure to observe instructions could result in minor injuries to personnel or some damage to equipment.

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

6.1 General Safety Concerns

Proper safety procedures shall be followed for all operations. Personnel safety provisions shall include as a minimum, safety glasses and hearing protection worn during test operations; safety glasses during cleaning operations with solvents or liquids which might splash into the users eyes; proper gloves and laboratory coats worn during cleaning operations; safety shoes required during facility build-up or modifications when system components are handled; all mechanical connections for compressed gas verified as leak free and properly anchored; and, system electrical cords inspected to insure all safety requirements, i.e. cord strain relief, frayed insulation, etc. are met. Any unacceptable conditions shall be corrected immediately. Operations shall be performed with a minimum of two trained operators.

6.2 Pre-Test Checkout

Prior to initiating any test all components shall be visually inspected for signs of stress, i.e. fraying, cracks. Components to be inspected include, but are not limited to, accumulator, flex hoses, tubing, wiring, etc. If any defects are noted the component shall be taken out of service immediately.

If component defects become apparent during a test the system shall be vented immediately and the component taken out of service.

7. APPENDICES, DATA, REPORTS, AND FORMS

7.1 Data

All test data shall be recorded in appropriate laboratory notebook, electronic media, or on test specific shot sheets.

7.2 Work Request Forms

An EM50 specific work request shall be generated, tracked, and documented per EM50-OWI-002 – Work Request Process. Sample information provided by the customer shall be included on a work request form.

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7.3 Reports

Reports documenting test results shall be written, provided, and maintained per EM50-OWI-003 - Control of Records. All forms shall be included with a memo to the requesting office.

The report of results from each test shall include the following:

- (1) Target setup configuration (with photos),
- (2) Projectile dimensions and mass, with and without sabot, if applicable,
- (3) Test temperature,
- (4) Instrumentation setup (diagrams and/or photos),
- (5) Accumulator pressures required for each shot,
- (6) Impact velocity for each shot,
- (7) Instrumentation data (spreadsheet, photos, video), as applicable,
- (8) Material or hardware performance,
- (9) Plans for further testing, if applicable, and
- (10) A statement of any other relevant items that might be deemed important.

Other data reporting may be required as defined in a SOW.

8. RECORDS

Records required to support testing per this OWI and records of test results shall be maintained in accordance with EM50-OWI-003 - Control of Records. Laboratory notebooks kept with the test facility, work request forms, shot sheets, and the test results / memos shall be considered records. All data and records that are classified shall be appropriately handled and secured and turned over to the customer with the final report.

9. EQUIPMENT, TOOLS AND MATERIALS

Specific test equipment and fixtures and those responsible for providing them shall be defined in the SOW. All test support equipment shall be in proper working order. Tools and materials used in cleaning, setup and testing shall not damage the facility or the hardware provided for testing. All samples and hardware shall be handled with proper care to prevent damage. Special handling requirements shall be defined in a SOW.

10. PERSONNEL TRAINING

Personnel conducting tests at ~~the ITF~~ shall attend required training for High Pressure, Explosives Handlers, Personal Protective Equipment and ~~Laser Safety~~ per MWI 3410.1 and shall be trained by a ~~qualified~~ user in all aspects of system use ~~and~~ operation. The user shall be approved by the Branch ~~Chief~~ before being allowed to conduct testing. Untrained personnel shall not attempt to use the ~~system~~ unless supervised by trained, experienced personnel.

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11. SYSTEM OPERATIONS

11.1 Initial Preparations

Prior to any testing, raise the red warning flag to alert area personnel that the range is active. Verify that the two downrange perimeter gates are closed and secure. Scan area for unauthorized personnel. Place roll around barricades in road to block traffic: one off the northwest corner of the 4572 annex, and the other off the southeast corner of 4571. Notify Area Coordinator (4-3080) that the test range is active, and request that Task 3 of Area Warning Standard Operating Procedure, ITF-SOP-001, be executed. Notify Protective Services dispatch (4-4753) that the range is active and patrols avoid the perimeter fence road.

11.2 Shot Setup

- 11.2.1 Open barrel breech, and slide barrel forward.
- 11.2.2 Insert projectile into breech, making sure it is seated firmly.
- 11.2.3 Open breech bleed plug, and visually verify that breech ball valve is closed.
- 11.2.4 Slide barrel back, and carefully engage threads of breech block until it is seated firmly.
- 11.2.5 Insert laser alignment tool assembly into muzzle to verify impact point.
- 11.2.6 Open rollup door and secure in the open position.
- 11.2.7 With target securely in place, turn on laser. Adjust target as required, and put a point on target with Sharpie where laser dot is.
- 11.2.8 Turn off laser and remove alignment tool.
- 11.2.9 Set up associated lights, cameras, other instrumentation and hardware, as required.
- 11.2.10 Verify that breech bleed plug is closed.
- 11.2.11 Verify that all firing circuit keys are in the safe position, removed and secure.
- 11.2.12 Request that all nonessential personnel leave the area and fall back to a safe distance.

11.3 Propellant Loading

WARNING: Eye and ear protection shall be worn during these steps.

- 11.3.1 Verify that all valves are closed, all regulators are backed all the way out and all flex hoses are securely fastened to anchors.
- 11.3.2 At helium trailer: connect supply flex hose and slowly open main valve until completely open. Do not stand directly in front of outlet. Note trailer pressure gauge.
- 11.3.3 In gun container: At main He panel, verify trailer pressure at PG-101. Slowly open HOV-103 to full open position.
- 11.3.4 Verify that the gun selector valve (HOV-108) is pointing to "Large Gun."
- 11.3.5 Prior to the first shot, verify proper operation of the firing circuit: Slowly turn HOR-104 clockwise until PG-106 reads about 200 psi.

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- 11.3.6 Open HOV-121 on Breech Valve Control panel.
- 11.3.7 Turn HOR-123 until PG-124 reads 100 psi. **CAUTION:** Do not exceed 110 psi.
- 11.3.8 Plug in the Safety Interface Module, insert keys and turn to "FIRE" position.
- 11.3.9 At the Fire Control Console, plug in power, insert fire key, and turn to "FIRE" position.
- 11.3.10 Press dual fire buttons and verify proper operation of breech ball valve.
- 11.3.11 Safe firing circuit by turning all keys to "SAFE" position and removing keys.
- 11.3.12 Close HOV-121 and vent system by opening HOV-122.
- 11.3.13 Back off HOR-123 and close HOV-122.
- 11.3.14 At LBG panel: back off HOR-104 and verify that HOV-114 is in proper position.
- 11.3.15 Turn on warning beacons, close perimeter gate, and verify that area is evacuated of nonessential personnel.
- 11.3.16 Open HOV-112.
- 11.3.17 At main panel: slowly turn HOR-104 in clockwise direction until PG-117 (or PG-116 if using low pressure range) indicates desired pressure.
CAUTION: If operating in low pressure range, DO NOT exceed 600 psi on PG-116.
- 11.3.18 Close HOV-112 and monitor pressure.
- 11.3.19 Check for leaks and adjust pressure, if necessary.

11.4 Firing Procedure

- 11.4.1 With accumulator charged, verify that at all doors in the container are open to prevent overpressure.
- 11.4.2 Verify warning beacons are flashing, gate is closed, and area free of unauthorized personnel.
- 11.4.3 Request Area Coordinator perform Task 4 of ITF-SOP-001.
- 11.4.4 At Breech Valve Control Panel, open HOV-121 and turn HOR-123 until PG-124 indicates 100 psi.
- 11.4.5 At Safety Interface Module, insert keys and turn to "FIRE" position.
- 11.4.6 Fall back to Firing Room and sound warning siren.
- 11.4.7 Turn key to "FIRE" position on Fire Control Console and give audible countdown.
- 11.4.8 Press "FIRE" buttons.
- 11.4.9 Turn key to "SAFE" position and remove and unplug power cord from fire control box.
- 11.4.10 Back in gun container, turn module keys to "SAFE" position and remove.
- 11.4.11 Close HOV-121, open HOV-122 and back off HOR-123.
- 11.4.12 Back off HOR-104 until it is all the way out.
- 11.4.13 Verify range is clear, open breech and slide barrel forward.
- 11.4.14 Notify essential personnel that they may enter, but that accumulator is still pressurized. They are to remain clear of the gun breech.

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11.5 Additional Shots

Repeat steps 11.2.2 through 11.3.4 then 11.3.15 through 11.4.14 for next shot.

11.6 System Safing

- 11.6.1 Verify that personnel are clear of Helium panel vents.
- 11.6.2 Close HOV-103 and open HOV-112.
- 11.6.3 With hearing protection on, open HOV-107 to vent panel lines.
- 11.6.4 When PG-106 reads near zero, close HOV-107, HOV-112 and HOV-122.
- 11.6.5 At Helium trailer: slowly close main valve completely.
- 11.6.6 Back in container, open HOV-102 to vent main tubing from trailer.
- 11.6.7 Close HOV-102 when PG-101 reads near zero.
- 11.6.8 Turn off container warning beacons.
- 11.6.9 Disconnect supply flex hose at trailer and cap openings.

11.7 Final Operations

Notify Area Coordinator (4-3080) that outdoor operations have ceased, and request Task 5 of ITF-SOP-001 be performed. Remove barricades, red warning flag, and secure area.

12. Emergency Procedures

In the event of an emergency, call 911 and request appropriate emergency personnel. Shut off main helium supply at trailer, vent system and disconnect supply flex hose.

12.1 Gun Misfire

During firing operations, if the gun doesn't fire or misfires perform the following:

- 12.1.1 At Firing Console: Turn key to "SAFE" position and remove from box.
- 12.1.2 Unplug console power.
- 12.1.3 Turn off helium supply at trailer.
- 12.1.4 At Interface Module, turn keys to "SAFE" position and remove.
- 12.1.5 Close HOV-103 and open HOV-102 to vent supply system.
- 12.1.6 Open HOV-112 and HOV-107 to vent accumulator and valve control.
- 12.1.7 Unplug power cord to Interface Module.
- 12.1.8 Remove breech bleed plug and open breech of gun.
- 12.1.9 Close all helium system valves and back off regulators.
- 12.1.10 Turn off warning beacons.
- 12.1.11 Troubleshoot malfunction and make corrections/repairs.