



National Aeronautics and  
Space Administration

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

**UNATTENDED OPERATION  
OF  
THE ENVIRONMENTAL TEST FACILITY**

**ENVIRONMENTAL TEST FACILITY BRANCH  
STRUCTURAL AND ENVIRONMENTAL TEST DIVISION  
TEST LABORATORY  
ENGINEERING DIRECTORATE**

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

**UNATTENDED OPERATION  
OF  
THE ENVIRONMENTAL TEST FACILITY**

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## 1.0 GENERAL INFORMATION

### 1.1 PURPOSE

The purpose of this procedure is to outline responsibilities and duties of test personnel when leaving a test in an unattended mode of operation at the Environmental Test Facility (ETF) Buildings 4612, 4619 or 4620.

### 1.2 SCOPE

This procedure is applicable to all personnel working in the ETF. The ETF includes the west high bay (room 155), adjoining labs (rooms 166 to 168), and adjoining office space (rooms 100 to 113) of MSFC Building 4619, at Building 4612 South Wing, Room 4 and Building 4620.

This procedure is applicable to all tests and equipment except those involving hazardous operations and program critical hardware (PCH). Tests or equipment involving hazardous operations or PCH shall not be left operating unattended.

The maximum time permitted for unattended operation can vary for each test. If checks in addition to those normally performed by the security guards are required, these shall be directed by individual test procedures.

### 1.3 APPLICABLE DOCUMENTS

NPR 8715.3	NASA Safety Manual
MPR 8715.1	Marshall Safety, Health, and Environmental (SHE) Program
MWI 8715.1	Electrical Safety Program
MSOP-FA-ETF-413	Control of Hazardous Energy (Lockout/Tagout) Procedure for the Environmental Test Facility (soon to be superseded by ET24-LOTO-SOP-001)
ET24-ETF-OWI-001	Environmental Test Facility Test Operations

### 1.4 SAFETY

All test personnel working in this facility shall be familiar with the safety documents listed above, and shall report any safety hazards or unsafe practices to the ETF Branch

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Chief or the 4619/4612 Building Manager Assistant. In the event of serious personnel injury, do not move the injured person unless necessary to prevent further serious injury. The emergency telephone number is **911** as listed in section 1.5.

Personnel involved in cryogenics facilities operation, repairs or modifications shall wear protective clothing including face shields and gloves. Personnel shall be aware of the possibility of freeze burns by contact with cold surfaces or liquids. In the event of a cryogenics spill, line ruptures, or similar emergencies, personnel shall ensure that there is no possibility of asphyxiation due to oxygen displacement. Use a portable oxygen monitor to verify the area is safe before entering.

ET24 Safety Assessment, Memorandum of Record ED26 (02-01) (soon to be issued as an ET24 memo, Number unknown) lists procedures, personal protective equipment (PPE) requirements and job hazard analysis (JHAs) for hazards associated with operations at the ETF. Operators must review the safety assessment to determine the JHAs and PPE that applies to a test. Implement the risk mitigation methods listed in the JHAs and use the required PPE to minimize risk from potential hazards during test operations.

## 1.5 EMERGENCY TELEPHONE NUMBERS

Dial **911** for all emergencies, including medical, fire, ambulance, security, and chemical spills

Other numbers that can be used to obtain information about emergency, security, safety, and utilities, and general help are:

Medical Center	544-2390
Security	544-4357
Safety	544-0046
Utilities	544-3919
Help Desk	544-HELP (4357)

## 1.6 HAZARDS LIST

- 480, 208 and 120 volts AC electrical power
- Extreme temperatures in the chambers (hot and cold)
- Extreme heat at the diffusion pumps
- Liquid nitrogen (LN<sub>2</sub>)
- High kinetic energy in turbo pump
- Vacuum pump oil

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\*\*\*\*\* WARNING \*\*\*\*\*

Maintenance or operating procedures, techniques, restrictions, etc., may result in severe personnel injury, loss of life or major equipment damage if not followed exactly.

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- 1.6.1 Minimizing Electrical Shock Hazards
  - 1.6.1.1 All electrical repairs and modifications shall be performed by electrical technicians to minimize the electrical shock hazard.
  - 1.6.1.2 All bare electrical parts inside a test chamber with a potential to ground of 50 volts or greater shall remain de-energized when the chamber is open. If this is infeasible, then safety related work practices shall be employed to prevent electrical shock. The safety related work practices shall be documented in accordance with MWI 8715.1 and approved by a senior ETF electrical engineer. All work near energized bare electrical parts shall be performed by qualified persons.
  - 1.6.1.3 Personnel shall not enter into or reach into a chamber with energized bare electrical parts where there is a lack of illumination or an obstruction of view. Personnel shall never blindly reach into an area that may contain energized bare electrical parts.
  - 1.6.1.4 Personnel shall remove all conductive apparel before working near energized bare electrical parts, including jewelry, watches, key chains, metalized aprons, and metal head gear.
  - 1.6.1.5 Personnel may not perform housekeeping duties at close distances to energized bare electrical parts unless adequate safeguards are provided. Only non-conductive cleaning materials shall be used.
  - 1.6.1.6 Any ladder used to enter chambers containing bare electrical parts energized at 50 volts or greater shall have nonconductive side-rails.
  - 1.6.1.7 Personnel working near bare electrical parts energized at 50 volts or greater shall be provided protective equipment adequate to insulate the potential shock hazard. Personnel shall use insulating tools near energized bare electrical parts.
  - 1.6.1.8 Safety signs or tags shall be used to warn personnel that electrical shock hazard is present when there are bare electrical parts energized at 50 volts or greater.
  - 1.6.1.9 Barricades shall be used in conjunction with signs or tags to limit personnel access.
  - 1.6.1.10 Any de-energized electrical parts that are not locked-out, tagged-out, or unplugged shall be considered energized.
  - 1.6.1.11 If tag-out is the method used, two or more isolation safeguard measures shall be used. Any bare electrical part that is energized at less than 50 volts to ground need not be locked-out or tagged-out provided there is no risk of burns or arcing.
  - 1.6.1.12 All live electrical parts located outside the chamber and energized at 50 volts

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or greater shall be guarded against accidental contact. Guarding methods include approved enclosures or permanent partitions or screens that restrict access by non-qualified personnel.

- 1.6.1.13 Personnel shall not handle, energize or de-energize, plug-in or unplug any electrical device when the device is wet, the employee is wet, or the floor is wet.
- 1.6.1.14 Locking type connectors shall be properly secured when connecting.
- 1.6.1.15 After a circuit has been de-energized by the opening of a protective device, the circuit shall be inspected by an ETF electrical technician before the circuit is re-energized.
- 1.6.1.16 Over-current protective devices shall not be modified.

\*\*\*\*\***WARNING**\*\*\*\*\*

**Prior to performing maintenance on any equipment, lockout and tag the equipment in accordance with Lockout/Tagout Procedure MSOP-FA-ETF-413 (soon to be superseded by ET24-LOTO-SOP-001). Maintenance shall be performed by qualified technicians only.**

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- 1.6.2. The test chamber and test article shall be given sufficient time to return to ambient temperature range of 32°F to 104°F (0°C to 40°C\_) before removing the test article in order to minimize the extreme temperature hazard.
- 1.6.3. Stay clear of diffusion pumps to minimize the burn hazard. A diffusion pump can reach a temperature of 600°F.
- 1.6.4. All personnel involved in facilities using cryogenics shall be aware of possible freeze burns by contact with cold surfaces or liquids. In the event of a cryogenic spill, line rupture, or similar emergency, personnel must first be sure that there is no possibility of asphyxiation due to oxygen displacement. Use a portable oxygen monitor to verify oxygen is adequate before entering the area.
- 1.6.5. There is a risk that the test article could be contaminated with diffusion pump oil. The chamber shall only be operated by trained personnel to minimize the risk of oil contamination. Ensure all cold traps are operational to reduce the oil contamination risk.
- 1.6.6. The turbo pumps have several rotors, each with numerous thin blades that rotate from 25,000 rpm to 50,000 rpm. Mechanical shock and particles in the flow stream can cause rapid unpredictable failure of the pumps. Allow adequate time for the rotors to come to a complete stop before any work is performed on the turbo pumps. Never allow the pumps to be mechanically shocked or moved when they are operating

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The vacuum pump oil can cause skin irritation. Wear eye protection when changing oil. Remove oil from the eyes by flushing with water for 15 minutes. Avoid skin contact with the oil. Remove this oil from the skin using soap and water. Avoid breathing vacuum oil mist. Seek medical attention for anyone that breathes the oil mist.

Any spilled oil is a slip hazard. Clean the area of any spilled oil immediately. Use barricades to limit access in the area until the spill is cleaned.

## 1.7 RESPONSIBILITIES

ETF personnel are responsible for the operation of the ETF test facilities during unattended periods. This responsibility includes safety for personnel, the test article, and the facility. The last operator of a test chamber shall record his name in the chamber's logbook.

Other task assignments and responsibilities at the ETF shall be in accordance with ET24-ETF-OWI-001.

## 2.0 PROCEDURE

### NOTE

Maintenance or operating procedures, techniques, restrictions, etc., requires emphasis for safe operation.

## 2.1 GENERAL FACILITIES

- 2.1.1 An inspection shall be made by the operator of each chamber to insure that tests, data recording equipment, and the building are left in a safe and secure condition.
- 2.1.2 Verify that facility utilities including electrical power, high purity (hp) air, water, GN<sub>2</sub>, and LN<sub>2</sub> are available when required, and are expected to remain available for the duration of unattended test operations.
- 2.1.3 Close all doors and secure all outside storage cabinets. Return all equipment requiring weather protection to proper location inside the building.
- 2.1.4 Check that all corridors, aisles, and passageways are clear and unobstructed.
- 2.1.5 Check for clear accessibility to all fire extinguishers and that nothing is blocking the automatic fire sprinkler system.
- 2.1.6 Return all tools, unused material, and equipment to appropriate toolboxes or bins.

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- 2.1.7 Return all flammable liquid containers to the appropriate storage cabinet.
- 2.1.8 Check valves on all compressed gas cylinders and dewars for safe unattended storage. Check each cylinder for a metal chain restraint.
- 2.1.9 Place all disposable combustible material found around test chambers, on workbenches, in instrumentation room, or in office area into trashcans. If the materials are rags that are contaminated with flammable liquids or grease, dispose in a flame-retardant can. Flame retardant cans are metal with an air gap at the bottom, a metal lid and are usually painted yellow.
- 2.1.10 Switch off all unnecessary lights.
- 2.1.11 Remove any source of ignition not necessary for test. Check all other sources for protection against accidental ignition.

**2.2 INSTRUMENTATION**

- 2.2.1 Verify that date(s) and time(s) are correct and on all operating data acquisition computer(s).
- 2.2.2 Check all operating data acquisition computer(s) for nominal display; verify no improper or missing data readings.

**2.3 OPERATING THERMAL VACUUM TEST CHAMBERS**

All systems operating unattended shall have a monitoring / alarm system incorporating fail safe features that protect the test item and test chamber in the event of operational anomalies. The individual monitoring / alarm systems are covered in the operating procedure for each test chamber; when preparing a test chamber for unattended operation, refer to the appropriate section(s).

- 2.3.1 Check test chambers for proper operation, verify no anomalies.
- 2.3.2 Verify convectron and ion gages (pressure) are operating correctly.
- 2.3.3 Verify the safety interlock for a pressure increase is set within a operating pressure of  $5 \times 10^{-4}$  torr on the pressure gauge controller.

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- 2.3.4 Verify air pressures at chamber solenoid valves are set at approximately 80 PSI.
- 2.3.4 Set all temperature-limit controllers for specified high and low extremes.
- 2.3.5 Verify adequate LN<sub>2</sub> tank levels to maintain LN<sub>2</sub> flow to chamber(s).

## 2.4 OPERATING THERMAL HUMIDITY AND THERMAL ALTITUDE CHAMBERS

All systems operating unattended shall have a monitoring / alarm system incorporating fail safe features that protect the test item and test chamber in the event of operational anomalies. The individual monitoring / alarm systems are covered in the operating procedure for each test chamber; when preparing a test chamber for unattended operation, refer to the appropriate section(s).

- 2.4.1 Verify that the test chamber is operating properly with no anomalies, and that controllers are set for desired mode(s) of operation.
- 2.4.2 Verify that required air, industrial water, potable water, and de-ionized water supplies are available, and are set to proper pressures (see individual chamber operating procedures for required fluids and pressures).
- 2.4.3 If applicable, verify adequate LN<sub>2</sub> tank levels to maintain LN<sub>2</sub> flow to chamber(s).
- 2.4.4 Ensure that temperature safety limits are set (usually 10°F below and above the temperature test band).

## 2.5 NOTIFICATION

- 2.5.1 Notification by Security  
The MSFC security guards routinely check this building every two hours during post-business periods. They check for fire and other hazards only. They are not responsible for any functional or operational checks. Requests for MSFC security guards to check specific areas or chambers shall be made through MSFC Security. The ETF Branch Chief is responsible for posting a list of names, pager numbers, and home telephone numbers of at least three people who shall be called in case of an emergency. Verify this list is posted at the end of each shift proceeding an unattended operational period.