



ET24-ETF-OWI-001
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National Aeronautics and
Space Administration

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

**ORGANIZATIONAL WORK INSTRUCTIONS
FOR
ENVIRONMENTAL TEST FACILITY
TEST OPERATIONS**

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

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DOCUMENT HISTORY LOG

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Environmental Test Facility
(ETF) Test Operations

1. SCOPE

1.1 Scope

This organizational work instruction (OWI) describes the operation of the Environmental Test Facility (ETF). The ETF performs thermal vacuum, thermal altitude, vacuum bakeouts, launch depressurization, re-entry repressurization, leak test and thermal humidity environmental testing. The ETF provides the customer with environments of simulated high altitude pressures, high vacuums, extreme temperatures, and controlled humidity. Additionally, the ETF provides the customer with data records of the environmental tests.

1.2 Purpose

The purpose of this OWI is to establish the methodology used for testing at the ETF. Additionally, this OWI provides instruction for test support activities including quality record control, test anomaly reporting, personnel training, tools/equipment and material allocation, and safety precautions.

1.3 Applicability

This OWI applies to the personnel performing environmental testing at the ETF Building 4612, 4619, 4620 and at other locations under the direction of the ETF, ETF equipment and ETF quality documents and quality records.

2. APPLICABLE DOCUMENTS

The latest revision of the following documents forms part of this instruction.

- | | | |
|-----|--------------|---|
| 2.1 | MWI 3410.1 | Personnel Certification Program |
| 2.2 | MWI 6410.1 | Packaging Handling and Moving Program
Critical Hardware |
| 2.3 | MPR 8730.5 | Control of Inspection Measuring and
Test Equipment |
| 2.4 | ED26 (02-01) | Memorandum for Record, Safety
Assessment for the ETF (soon to be
numbered under the ET24
organization) |

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3. DEFINITIONS

- 3.1 CCI Chamber Calibrated Items; an ETF document that is maintained with the TPS to record calibrated equipment.
- 3.2 CSP Customer Supplied Product
- 3.3 CTA Customer Test Agreement (MSFC Form M4337); an ETF record filed with the TPS
- 3.4 DR Discrepancy Report.
- 3.5 ESD Electrostatic Discharge; a transfer of electrostatic charge between bodies.
- 3.6 ETF Environmental Test Facility.
- 3.7 FAP Facility Activation Procedure.
- 3.8 FOP Facility Operation Procedure.
- 3.9 GN₂ Gaseous Nitrogen
- 3.10 JHA Job Hazard Analysis. A copy of ETF JHA is available in the ETF Library.
- 3.11 LN₂ Liquid Nitrogen
- 3.12 MLR Marshall Lead Representative.
- 3.13 MSDS Material Safety Data Sheet
- 3.14 OJT On-the-job Training
- 3.15 PACRATS Payload and Components Real-time Acquisition Test System, MSFC developed data acquisition software.
- 3.16 PCH Program Critical Hardware; flight or other hardware that because of its high value or critical importance requires special handling. The customer identifies a test article as PCH.
- 3.17 PPE Personal Protective Equipment. A copy of ETF PPE is available in the ETF Library.
- 3.18 RGA Residual Gas Analyzers. An instrument used to monitor the composition and quantities of

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the gases in the chambers at high vacuum.

- 3.19 SOP Standard Operation Procedure.
- 3.20 TDR Test Discrepancy (MSFC Form 460); a document for recording test anomalies and documenting troubleshooting activities.
- 3.21 TPS Test Preparation Sheet (MSFC Form 248); a document used to authorize the test and record the test requirements.
- 3.22 TQCM Temperature-controlled Quartz Crystal Microbalance. An instrument used in vacuum chambers to monitor relative levels of condensable gases and contaminants.
- 3.23 Test Anomaly Any event during testing that departs from the planned test process.
- 3.24 ETF Branch Chief Designated person with management authority at the Environmental Test Facility.

4. INSTRUCTIONS FOR TESTING

The following delineates processes required for thermal vacuum, thermal altitude, and thermal humidity testing at the ETF.

4.1 Scheduling and Customer Test Request

The customer shall submit a written request for testing using the ETF Customer Test Agreement (CTA), Form M4337, or a Fabrication Shop Work Order. The request shall be submitted to the ETF test schedule administrator or to ETF management who shall coordinate with the ETF test schedule administrator. The ETF test schedule administrator or ETF management shall confirm scheduled test dates with the customer. The ETF test records administrator keeps a copy of the CTA in the test file. At least once a month, the test schedule administrator shall publish a comprehensive ETF schedule, showing all planned tests.

4.2 Customer's Test Requirements

If the customer has detailed testing requirements beyond what was specified on the CTA, the customer shall document these testing requirements, reference the requirements document in the CTA and provide a copy of the requirements document to ETF personnel prior to test start. If all testing requirements are specified in the CTA, The CTA shall be the documented testing requirements.

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4.3 Receive Test Article

ETF test personnel shall coordinate receipt of the test article with the customer. A lost, damaged or unsuitable test article is a test anomaly, which shall be recorded in the chamber log and reported to the customer. If the test article is identified as Customer Supplied Product (CSP), ETF test personnel shall notify the Marshall Lead Representative (MLR) whenever it is lost, damaged or found unsuitable for use. CSP is identified using a blue colored tag. Information on the CSP tag includes the name of the MLR.

4.4 TPS Development

The ETF personnel shall develop a test preparation sheet (TPS) after receiving the customer's test article and testing requirements. The TPS shall be completed prior to starting the test. The ETF chamber calibrated items (CCI) sheet shall be attached to the TPS. The CTA shall be maintained by the test record administrator in the TPS file. The test shall be recorded in the ETF Test Logbook.

4.5 Facility Preparations

The ETF facilities shall be prepared prior to performing the test. Facilities shall be adequate to provide testing in accordance with test requirements. Equipment used to measure data for the test shall be recorded on the ETF CCI.

4.6 Installation of the Test Article

ETF test personnel shall coordinate the test article installation with the customer. The test article shall be installed following development of the TPS and after completion of facility preparations. The test article shall be installed in accordance with the test requirements. The test article shall be photographed in the test chamber prior to sealing the chamber except when the customer specifies no photographs. Photographs of the test article are test data and shall be forwarded to the test data administrator.

4.7 Perform Test and Acquire Data

The test shall begin soon after installation and photographing of the test article in the chamber. The test shall be conducted in accordance with the customer's test requirements and the ETF TPS. The TPS shall be at the test chamber during the test with the CCI attached. Data acquisition shall begin prior to chamber evacuation or operation. ETF shall provide data acquisition to record conditions of the environment including vacuum chamber pressure and temperature, test article temperatures, and TQCM data as required. Optical witness samples and RGAs are available in some of the thermal vacuum chambers when needed. Temperature shall be recorded

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in the thermal humidity chambers. Temperature and/or simulated altitude pressure shall be recorded in the thermal altitude chambers.

4.7.1 Chamber Log Books

The test operator and other test technicians on the test are responsible for updating the test chamber logbook to record all activities at the chamber before during and after the test.

4.7.2 Procedure "As-Run" Record Copy

The test operator shall record execution of the test. A copy of the test procedure shall be used as the "As-Run" record copy, except for frequently run tests. An As-run Buy-off Sheet, which lists all of the procedure steps executed during the test, shall be used as the record copy for frequently run tests. Hand written entries into the "As-Run" Record Copy shall be in ink and legible.

4.7.2 Chamber Operations Responsibility

The name of the individual responsible for test chamber operation shall be recorded as "Operator" in the chamber logbook at the start of the test and at shift changes. This individual has the responsibility and authority to restrict any activities around the test facility that could damage the test article or test facility, or jeopardize the safety of personnel.

4.7.3 Changes to the Procedure

Changes to the procedure needed before a revision could be written shall be processed as follows.

4.7.3.1 Pen and Ink Changes are changes which do not modify the intent of the procedure, but are required to adequately record the function performed. They shall be annotated in the procedure. Approval from a systems manager by initialing and dating is required prior to resuming the test. Changes shall be incorporated into the next revision of the document.

4.7.3.2 Technical Deviations are changes to the intent or technical content. Test Procedure Deviation Sheets (MSFC form 3959) shall be incorporated into the procedure. Deviations that are permanent shall be marked P in the right column. Changes that are one time or one test shall be marked T in the right column. The deviation sheets shall be inserted into the procedure in front of all pages with changes. All changes shall be in red ink. All deviation sheets shall be included with Buy-off Sheets. Changes shall be authorized by an ETF Systems

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Manager and the ETF Technical assistant or Branch Chief. Changes shall be communicated to all organizations that approved the procedure. Comments from these organizations shall be resolved.

4.7.4 Discontinued Procedure

If a procedure is discontinued prior to completion, it shall be annotated, after the last completed entry, with "DISCONTINUED," the reason for the discontinuance, the test operator's initials, and the date.

4.7.5 Procedure Re-runs

If an entire procedure or major sequence is rerun a new copy of the AS-run Buy-off Sheet shall be used.

4.7.5 Troubleshooting

Troubleshooting and modification activity on the test chamber shall be restricted during testing. Pre-approval by the ETF Technical Assistant or ET24 Branch Chief is required prior to any troubleshooting or modification activity during testing. The activity shall be documented in the chamber logbook with the approving authorities' initials. Approval by telephone conversation shall be allowed provided the approving authority initials the logbook within 60 hours after authorizing the activity by telephone conversation.

4.7.6 Procedure Record Copy Disposition

For quality sensitive tests, the original record copy of the test, copies of the procedure deviations, and the original TPS shall be forwarded to the Quality Assurance Records Center after they have been accepted and signed or stamped by Quality. Duplicates of all ETF Records sent to Quality shall be maintained in ETF Test Records file by the ETF Test Records Administrator. For non-quality sensitive tests, the quality records shall be maintained in the ETF's Test Records file.

4.7.7 Quality Assurance

For quality sensitive tests, monitoring and acceptance by the Quality Assurance Office shall be required. The Quality Assurance Office shall be notified prior to the start of the test. The Quality Assurance Office shall witness and stamp each line item designated as a NASA Mandatory Inspection Point (MIP) and the acceptance at the end.

4.7.8 Safety

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Execution of safety critical test procedures shall be subject to monitoring by the Industrial Safety Department, QD50.

4.8 Data Reduction

ETF personnel shall reduce stored electronic data to a format that satisfies the customer's preference, constrained only by the ETF's capabilities. ETF personnel shall maintain an archived record of the raw data along with calibration information per Section 8 of this OWI. Electronic copies of test article photographs shall be maintained as test data. RGA data shall be kept as a separate data record.

4.9 Transmit Data to Customer

ETF shall provide a copy of reduced test data to the customer. Media used shall be either printed hard copy or digital media such as E-mail or floppy disk unless the customer requests data on a different media. Also, copies of the photographs shall be transferred to the customer when requested. Copies of photographs shall be either electronic media or printed.

4.10 Test Article Return

ETF personnel shall return the test article to the customer at the ETF following completion of testing and when the chamber has returned to ambient conditions.

4.11 Handling

ETF personnel shall handle all test articles per customer procedures and direction.

4.11.1 Lifting Equipment

All handling of test article requiring overhead crane and/or fork truck operations shall be performed by certified personnel only and shall be performed under customer's procedure and/or direction. Proof load dates for all lifting equipment shall be verified to be current when lifting PCH. PCH moved with lift equipment shall move in accordance with its move plan. If no move plan is available, move per a TPS authorized by the PCH Project Engineer, the ETF Move Manager and S&MA in accordance with MWI 6410.1.

4.11.2 PCH Hand Carry

Any PCH requiring hand carry shall be hand carried by personnel with PCH hand-carry certification. PCH moved by hand carry does not require an approved move plan. Personnel shall wear clean room gloves when performing any handling operations requiring manual moving.

4.11.3 Electrostatic Sensitive Devices (ESD)

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Any test hardware that is ESD sensitive shall be handled by ESD certified personnel per customer procedure and/or direction. The ESD designation shall be specified by the customer in customer test agreements. In addition, an ESD sensitive test article shall be labeled with a sensitive electronic device symbol.

4.11.4 Customer Supplied Product

CSP hardware shall be processed in accordance with MPR-4000.1. The test engineer is responsible for ensuring the proper care of the CSP hardware while it is in his possession. If the CSP hardware is lost, damaged, or found unsuitable, then the test engineer shall notify the Marshall Lead Representative (MLR) and Branch Chief.

4.11.5 Packaging

The ETF shall single or double bag small sized test articles per customer request and procedure. Only small sized test articles capable of being hand carried to the ETF bagging stations shall be bagged. The ETF maintains nylon internal film and polyethylene outer film for bagging of test articles. The customer shall provide any special bagging material. PCH that requires bagging shall be bagged per customer procedure by personnel with PCH hand-carry certification.

4.12 Customer Survey

Following completion of the test, ETF personnel shall present a customer survey form to the customer representative and request it be completed and returned to the ETF.

4.13 Equipment Calibration

All data records shall be obtained using calibrated equipment. All ETF calibrated equipment shall be calibrated by either the MSFC Calibration Laboratory, by the ETF, or by the instrument manufacturer. Calibrations performed by ETF shall be in accordance with ETF calibration procedures. The ETF or instrument manufacturer shall only calibrate equipment that the MSFC Calibration Laboratory cannot calibrate.

4.13.1 Indication Equipment

Equipment used for indication only shall not require calibration. The measured parameter of indication equipment shall not be recorded and shall not provide information on a parameter that could cause an unsafe condition. Indications from this equipment can be used to observe trends but not for analysis. A "Calibration Not Required" label shall be placed on or near indication equipment. A typical "Calibration Not Required" Label is shown in Appendix A.

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4.13.2 Calibration Recall

Upon the receipt of an out-of-calibration instrument notification from the MSFC Calibration Laboratory, the instrument manufacturer, or discovery of out of calibration condition on equipment calibrated by the ETF, the ETF calibration administrator shall inform the ETF Branch Chief and test records administrator. The test records administrator shall determine all tests that recorded data with this instrument during the notification period. The ETF test records administrator shall then inform the affected customers by memorandum or e-mail that these tests have questionable data. The ETF test records administrator shall record the calibration recall, the customer contacted, and any follow-up action in the test TPS files. The customer shall determine the impact on the test and hardware and then implement appropriate corrective action.

4.13.3 Excess Equipment

The ETF calibration administrator shall inform the MSFC Calibration Laboratory if any calibrated equipment is taken out of service and submitted as excess.

4.13.4 Equipment Calibrated By The ETF

Equipment calibrated by ETF shall have a "Calibrated" label conspicuously attached on or near the equipment. This label shall list the individual performing the calibration, the date calibrated and the due for calibration date. Loss of the "Calibrated" label does not void the calibration provided there is a record to establish the calibrated status of the equipment. A typical "Calibrated" label is shown in Appendix A.

4.13.5 Loaned Equipment

Calibration of loaned equipment is the responsibility of the user. The ETF calibration administrator shall maintain calibration of that loaned equipment consistent with MSFC calibration policy at the user's request, where the user's request is documented in the CTA. When the loaned equipment is returned to the ETF, the ETF calibration contact resumes responsibility for calibration of that equipment.

4.13.6 Calibration Data Base

The ETF calibration administrator shall maintain a list of all calibrated equipment used by the ETF in the ETF Calibration Database. The ETF Calibration Database tracks where the equipment was installed during the calibration period. This calibration database shall exclude the customer's calibrated equipment. This calibration database shall be kept in accordance with the test equipment listing requirements of MPG 8730.5.

4.14 Software Verification

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Software used in recording test data shall be verified either by the software provider or by the ETF using a procedure for verification of that software. The software provider shall correct any software that fails the ETF's verification before that software is used to record data.

4.15 Equipment Storage

Equipment not in use now but intended for use on future tests shall be stored in a controlled temperature dry environment. Follow equipment manufacturer's recommendations for maintenance while in storage. Metal materials are allowed to be stored outdoors provide piping and tubing are protected from insects and these material will be use before there is significant corrosion or rust.

5. NOTES

None

6. SAFETY PRECAUTIONS AND WARNING NOTES

All personnel working in the ETF shall report any safety hazards, unsafe practices, safety incidents or near misses to the ETF Branch Chief, the 4619 Building Manager Assistant, or the Building Managers Assistant.

ET24 Safety Assessment, Memorandum of Record ED26 (02-01) (soon to be superseded by an ET24 safety assessment, document number unknown) lists procedures, PPE requirements and JHAs for hazards associated with operations for most tasks at the ETF. Personnel shall review the safety assessment, JHAs and PPE that applies to the particular operation. Use the correct procedure, implement the risk mitigation methods listed in the JHAs and use the required PPE to minimize risk from potential hazards during ETF operations.

6.1 LN₂ Precautions

All personnel involved in facilities using cryogenics shall be aware of possible severe cold burns caused by contact with cold surfaces or liquids. Cryogenic PPE including eye protection and gloves shall be worn by all personnel involved in handling of cryogenics or when making repairs/modifications to cryogenic facilities. Handling of cryogenic liquids and repairs/modifications to cryogenic systems shall be performed by certified cryogenic handlers. In the event of a cryogenic spill, line rupture, or similar emergency, personnel shall first ensure that there is no possibility of asphyxiation due to oxygen displacement. ETF personnel shall use a portable oxygen monitor to verify oxygen is adequate before entering a LN₂ spill area.

Never allow LN₂ to be trapped in a closed container or in a line without a relief valve.

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Barricade areas where there are overhead LN₂ pipes with icing. Wear a hard hat when under pipes with icing.

6.2 Precautions for Lifting and Handling

Special precautions shall be taken when accessing high positions, including shelves and cabinets. Appropriate stools/ladders shall be used when working above shoulder level. Height of the ladder shall be such that the work can be performed between waist and shoulder height while standing on the ladder. Ladder shall be used in accordance with manufacturer's recommendations.

Use lifting devices like a fork truck, dolly or cart when moving heavy equipment. Get assistance or use lifting equipment when lifting over 40 pounds. Wear ANSI approved steel toe shoes when moving heavy equipment.

When bagging test articles and bakeout hardware, avoid contact with the sealer's hot surfaces and cutting knives.

6.3 Precautions for Work on Elevated Platforms

Fall protection harness shall be used if working six feet above the ground or floor level and where there are no proper guardrails. Fall protection shall be worn if on personnel lift equipment that elevates and rotates or elevates and translates. Fall protection is not required on approved ladders or on lift equipment that only elevates and has approved guardrails. Remove trip hazards from the platform. Stay away from overhead electrical and cryogenic lines. Place the base of ladders on firm level surfaces. Get assistance when ladder is extended 20 feet or more. All ladders shall be placed to prevent slippage or lashed so it is firmly held in position. Never stand on the top of a stepladder. Use a man lift instead of a ladder if reasonably possible.

6.4 Precautions for Welding and Machine Shop Operations

Rings, loose jewelry, and exceptionally loose clothing shall not be worn while operating machine shop tools. All personnel shall wear safety glasses and hearing protection while in the machine shop when any of the machine shop equipment is being operated. Secure work when machining. Shut off machine when finished or when repositioning work. Allow time for machine to come to a complete stop. Frequently remove debris on and around machine. Position available shields properly. Only trained machinists shall operate machines. Verify chuck is removed following completion of the work. Verify cutting tools are secure. Maintain adequate lighting. Air used for cleaning shall be from a regulated pressure less than 30 psig or from regulated pressure less than 120 psig with a vented safety tip nozzle that limits spray pressure to 30 psig maximum. Verify saw blades are in good condition and are properly tensioned.

Rings shall not be worn while welding. While welding wear protective clothing/equipment to protect the body, arms, hands,

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face, and eyes from heat and radiation. Wear tinted eye protection when welding thermocouples. Obtain a burn permit when welding outside the weld shop. Avoid breathing weld fumes. Only weld where there is good ventilation. Read MSDS sheets on materials used in welding. Use a fire watch when using an open flame torch. Open and close gas valves slowly. Keep gas bottles properly secured using metal chains. Pacemaker recipients shall stay away from electric welding operations.

6.5 Precautions for Modifications and Repairs

Rings shall not be worn while performing electrical troubleshooting or while working in electrical panels. Electrical technicians shall perform all repairs and modifications to electrical power devices. Personnel shall have locked-out and/or tagged-out equipment in accordance with "Control of Hazardous Energy (Lockout/Tagout) Procedure for the Environmental Test Facility," MSOP-FA-ETF-413, prior to modification or repair.

Wear eye protection when soldering. Avoid contact with hot solder and soldering tools. Place debris in metal containers.

Only trained personnel shall work on refrigeration equipment. Personnel shall use eye protection and insulated gloves when working on refrigeration equipment.

Only trained and certified personnel shall operate high-pressure panels. ETF personnel shall not repair or modify high-pressure panels except to connect to the output of the panel.

6.6 Precautions for Heavy Lifting

Heavy lifting requires the use of the fork truck or the overhead crane. The personnel authorized for heavy lifting operations are certified by NASA and are identified by their signature in the ETF procedures MSOP-SC-ETF-408 and/or MSOP-FA-ETF-414. Other personnel not meeting these two requirements shall stay clear of the lifting area. Wear a hard hat and steel toe shoes when performing heavy lifts.

6.7 Precautions for Chemical Handling

Work at the ETF typically does not require the handling of chemicals that are a risk to personnel safety. If chemical handling is required, handle these in accordance with their MSDS sheets. At a minimum wear gloves, inhalation protection and eye protection.

6.8 Precautions for Using Compressed Air

Compressed air shall not be direct at persons. Suitable locking devices shall be used at connections that could be unsafe when the

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connection fails. Compressed gas shall not be used to empty containers of liquid unless that container is stamped with an ASME code and rated for the pressure or is analyzed and documented to be able to withstand the maximum regulated pressure of the gas system. The analysis shall be performed by an engineer certified to perform pressure vessel or piping calculations by the American Society of Mechanical Engineer (ASME). Compressed air systems used for blast cleaning shall have a manual isolation valve easily closed by the blast cleaning operator using one hand. When air is used to inflate an automobile tire, a clip-on-chuck and an inline regulator set at 40 psig shall be used. Dust that is potentially combustible shall not be cleaned using compressed gas. All air tanks shall be stamped with an ASME code for air tanks. Cleaning of clothing and work surfaces with compressed gas is prohibited. Compressed air may be used to clean tools and equipment provided the nozzle limits the spray pressure to 30 psig and air is from a low pressure system regulated to less than 120 psig or the pressure is regulated to less than 30 psig. When cleaning chip, chip guards shall be in place and a minimum PPE of eye protection and gloves worn.

6.9 Precautions for Working Near Energized Electrical Parts

Electrical parts inside the test chamber typically are not insulated. Therefore, special precautions shall be taken when working near these bare electrical parts. All bare electrical parts inside the chamber with a potential to ground of 50 volts or greater shall remain de-energized when the chamber is open when feasible. If this is infeasible, then safety related work practices shall be employed to prevent electrical shock. Wear insulating gloves and use insulated tools when working with bare electrical conductors energized at 50 volts or greater.

6.9.1 Safety Related Work Practices

The safety related work practices shall be documented and approved by a senior ETF electrical engineer. All work near energized bare electrical parts shall be performed by qualified persons.

6.8.2 Proper Illumination

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.

6.8.3 Removal of Conductive Apparel

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Personnel shall remove all conductive apparel before working near energized bare electrical parts, including jewelry, watches, key chains, metalized aprons, and metal head gear.

6.8.4 Housekeeping

Personnel shall 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.

6.8.5 Insulated Ladders

Any ladder used to enter chambers containing bare electrical parts energized at 50 volts or greater shall have nonconductive side-rails.

6.8.6 Protective Equipment

Personnel working near bare electrical parts energized at 50 volts or greater shall be provided protective equipment adequate to insulate the potential shock hazard including insulated gloves. Personnel shall use insulating tools when working near energized bare electrical parts.

6.8.7 Safety Signs and Barricades

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. Barricades shall be used in conjunction with signs or tags to limit personnel access.

6.8.8 Lock-out Tag-out of De-energized Circuits

Any de-energized electrical parts that are not locked-out, tagged-out, or unplugged shall be considered energized. If tag-out alone is used, implement two or more safeguard measures such as opening and tagging-out two isolation switches. 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.

6.8.9 Guarding Electrical Parts Outside The Chambers

All live electrical parts located outside the chamber and energized at 50 volts or greater shall be guarded against accidental contact. Guarding methods include approved enclosures, permanent partitions or screens that restrict access by non-qualified personnel.

6.8.10 Wet Conditions

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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.

6.8.11 Locking Connectors

Locking type connectors shall be properly secured.

6.8.12 Protective Devices

After a circuit has been de-energized by the opening of a protective device, an ETF electrical technician shall inspect the circuit before the circuit is re-energized. Over-current protective devices shall not be modified.

6.9 Precautions for Test Chamber Operations

Keep clear of the sealing surfaces when sealing the chamber. Avoid contact with hot and cold surfaces including the diffusion pumps and LN₂ cold traps. Adjust air panel only when necessary and maintain pressure to chamber systems at 120 psig or less. Avoid contact with viewing windows on vacuum chambers at high vacuum since this could cause a window failure leading to a sever implosion into the chamber. Use calibrated regulators and gauges when recharging a helium compressor. Use caution when wearing clean room apparel inside a vacuum chamber as the slick chamber surfaces can cause falls.

6.10 Precautions for Portable Power Tool Operations

All portable power tools shall be inspected for safe condition prior to use. PPE shall be used per the ETF PPE requirements when operating tools. All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains and other moving, reciprocating, rotating or moving parts shall be guarded to prevent accidental contact. All tools brought from home shall be subjected to the same safety requirements as ETF provided tools. All belt sanders shall have guards at the nip points where the belt runs on the pulley.

6.10.1 Electric Power Tools

Electric power tools used at the ETF shall be properly grounded or shall be double insulated. The electrical cord shall be protected from damage and shall never be used as a handle to hang the tool. All woodworking tools shall meet the American National Standard Institute (ANSI) code requirement for safety. All power tools shall be energized by applying force on a pressure switch and the tool shall shut off when pressure is released on the switch. This pressure switch shall be located such that accidental operation is minimized.

6.10.2 Pneumatic Power Tools

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All pneumatic tools shall have the air hose connected by some positive means that prevents the tool from being disconnected. All pneumatic tools using a supply hose ½ inch or larger shall have a safety device that reduces hose pressure in case of a hose failure. Safety clips or retainers shall be used to securely install and maintain attachments on pneumatic impact tools to prevent attachments from being expelled. All pneumatic staplers and nail drivers shall have a safety device that prevents the tool from ejecting fasteners unless the muzzle of the tool is pressed against the work surface. All hoses and connections shall be connected to a supply pressure regulated to less than their design pressure. The hose shall be protected from damage and never used as a handle to support the tool. Hoses shall be inspected and damaged hoses replaced or repaired prior to use.

7. APPENDICES, DATA, REPORTS, AND FORMS

7.1 Forms

MSFC Form 248	Test Preparation Sheet (TPS)
MSFC Form 248-1	TPS Continuation Sheet
MSFC Form 4083	Personnel Certification
MSFC Form 4258	Lift Truck Operators Daily Report
MSFC Form 4287	MSFC Lockout/Tagout Procedure
MSFC Form 4329	Aerial Lift Pre-start Inspection Checklist
MSFC Form 4332	Crane Daily Inspection Checklist
MSFC Form M4337	Customer Test Agreement Environmental Test Facility

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8. QUALITY RECORDS

8. QUALITY RECORDS AND DOCUMENTS

The following table presents the file retention, dispositions, and maintenance for ETF quality records and documents. Specific locations, filing instructions and responsible administrators/custodians are listed in the ETF Master List. All of these quality records are maintained by the ETF, ET24.

RECORD	LOCATION	RETENTION	DISPOSITION
OWIs	ED Master List	Retain until superseded or obsolete.	Destroy by replacing the file when superseded or obsolete.
ETF Memorandums	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
FOP	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
SOP	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
FAP	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
Configuration Control Plan	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
Active Data Files	4619/ETF	Retain until archived.	Archive 90 day or sooner after completion of test.
Archived Data Files	4619/ETF	Retain until last record end date exceeds 5 years old. Retain two copies, one on removable media.	After last record end date exceeds 5 years, destroy, delete, or mark as history record and removed from the quality record file.
Active TPS	4619/ETF	Retain during test.	Archive 30 day or sooner after completion of test.
Archived TPS	4619/ETF	Retain until no longer needed for reference, or upon completion, termination, cancellation, or suspension of the project, or when 5 years old whichever is sooner.	Destroy when no longer needed for reference, or upon completion, termination, cancellation, or suspension of the project, or when 5 years old whichever is sooner.
Chamber Calibrated Items Sheet	4619/ETF	Paper copy maintained with TPS. Retain with applicable TPS.	Disposition with applicable TPS.
Customer Test Agreement	4619/ETF	Retain in TPS file with applicable TPS from initiation of TPS until TPS is disposed.	Disposition with applicable TPS.
Active Test Log Books	4619/ETF	Retain until completion of last page.	Archive after completion of last page.
Archived Test Log Books	4619/ETF	Retain until when last record exceeds 5 years.	When last record is 5 years old destroy by discarding or mark as history record and removed from the quality record file.
Active Chamber Log Books	4619/ETF	Retain until completion of last page.	Archive after completion of last page.
Archived Chamber Log Books	4619/ETF	Retain until last record exceeds 5 years	When last record is 5 years old destroy by discarding or mark as history record and removed from the quality record file.
ETF Master List	4619/ETF	Retain until superseded or obsolete.	Destroy when superseded or obsolete.
Training Matrix	4619/ETF	Retain until superseded or obsolete	Delete copies or mark copies as historical and relocated to historical file when superseded or obsolete.
ETF Credit Card Procurement Files	4619/ETF	Retain for 3 years after final payment	May be destroyed three years after final payment
ETF Calibration Data Base	4619/ETF	Retain until superseded or obsolete.	Delete when superseded or obsolete.

8.1 ETF Master List

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The ETF latest revision of OWIs, procedures and records are listed in the ETF Master List along with their locations and custodians. The ETF Master List is posted on the bulletin board outside Room 104 in building 4619.

8.2 ETF OWIs and Procedures

The ETF OWIs and procedures for the Environmental Test Facility Branch/ET24 are located at the Engineering Directorate Master List uniform resource locator (URL):

<https://masterlist.msfc.nasa.gov/e/>

Paper copies of facility operation procedures shall be at the test chambers, in the ETF Library and with the document originator. Paper copies of standard operating procedure (SOPs) and facility activation procedures (FAPs) shall be located in the ETF Library and with the document originator. When a paper copy of a document is not the latest revision listed in the ETF Master List, return that copy to the document originator for resolution.

8.3 Log Books

Test logbook entries shall be made by personnel assigned to the test. The chamber operator shall make the initial and last entries to begin and close the test.

8.4 Test Record

Test records that shall be present at the test chamber during testing are:

1. Test Preparation Sheets (TPS)
2. Chamber Calibrated Items (CCI)

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9. Document Control

9.1 Document Authorization

Test logbook entries, TPS sheets, and chamber calibrated items (CCI) sheets shall be authorized by one of the following: ETF test records administrator, ETF Branch Chief or the ETF Technical Assistant. The test records administrator shall be listed in the ETF master list. The ETF personnel making that entry shall authorize chamber logbook entries. Data files do not require authorization. Master lists are authorized by the master list custodian/administrator.

10. TOOLS, EQUIPMENT, AND MATERIALS

The ETF shall provide test chambers and instrumentation to measure chamber environments per paragraph 4.8. Any other tool, equipment, and/or materials shall be provided by the customer. The customer shall coordinate with ETF for additional instrumentation, electrical power and/or test fixtures through test requirement and specification documents.

11. PERSONNEL TRAINING AND CERTIFICATION

11.1 ETF Training Records

If specific skills, certifications, or training is required for a position, this need shall be identified by the branch technical assistant. All training records are the responsibility of the Learning and Organization Development Office, HS40. All certification records are the responsibility of the Certification Administrator Safety and Mission Assurance (S&MA) Office. The only exception to this is On-the Job Training (OJT) records, which shall be the responsibility of the ETF Branch Chief and maintained by the ETF Training Administrator. The ETF training record shall be an electronic record with one hard copy kept in the ETF Library at Building 4619. The hard copy of the training record shall be updated annually or more often as needed. The electronic copy shall be a living document updated as required.

New hires shall be evaluated by ETF Branch Chief or Contractor's supervisor for applicable prior experience before being considered qualified. Additional training shall be required for new hires unless the ETF Branch Chief determines prior training and experience is adequate. The qualified status of all personnel shall be recorded in the On-the-job training (OJT) record. OJT at the ETF shall be Type B and recorded on MSFC Form 4083 in accordance with MWI 3410.1.

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11.2 ETF OJT Plan

The ETF requires special skills that are best developed by OJT. ETF special skills requiring OJT include:

- Thermal Vacuum Chamber Operation
- Thermal Humidity and Thermal Altitude Chamber Operation
- Machine Shop Operation
- Clean Room Access

A record of successfully completed OJT for all ETF personnel is maintained as part of the ETF training record.

Any employee that ceases employment at the ETF shall be purged from the training record matrix within 180 days. Should that individual return, the ETF Branch Chief shall determine if that individual receive additional OJT.

11.2.1 Thermal Vacuum Chamber OJT

Within the ETF, electrical and mechanical work experience is needed to effectively learn the processes involved with operation of vacuum chambers. Trainees are taught the basic concepts of vacuum technology including the different levels of vacuum, types of pumps, and the use of various types of vacuum gauges. Each vacuum system is similar but different in particulars, therefore, training for each system is slightly different. The technical aspects of performing vacuum testing are taught by having a trainee involved in the entire process from start to finish. This includes the installation of hardware into a chamber, instrumentation installation, setup, checkout, vacuum system startup, operation, and shutdown.

A trainee shall be classified "Trained" on a particular vacuum system when the trainee has achieved the ability to perform the operation of that system without having to rely on instructions from others. The trainee shall know the sequence of events required for test operations, and understand the procedures for that thermal vacuum chamber. The trainee's supervisor and the ETF Technical assistant shall make evaluation of the trainee's performance. OJT status shall be recorded in the ETF training record.

11.2.2 Thermal Humidity and Thermal Altitude Chamber OJT

Within the Environmental Test Facility, electrical and mechanical work experience is needed to effectively learn the processes involved with operation of thermal humidity and thermal altitude chambers. Trainees are taught the basic concepts of thermal control technology including the interrelationship between temperature and humidity. Each thermal humidity chamber is similar but different in particulars, therefore, training for each chamber is slightly

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different. The technical aspects of performing thermal humidity testing are taught by having a trainee involved in the entire process from start to finish. This includes the installation of hardware into a chamber; installation, setup, checkout, and operation of instrumentation; startup, operation, and shutdown of thermal chamber.

A trainee shall be classified trained on a particular thermal humidity or thermal altitude chamber when the trainee has achieved the ability to perform the operation of that chamber without having to rely on instructions from others. The trainee shall know the sequence of events required for test operations, and understand the procedures for that thermal chamber. The ETF Branch Chief or Technical Assistant shall make evaluation of the trainee's performance. OJT status shall be recorded in the ETF training record.

11.2.3 Clean Room OJT

Activities in the ETF clean rooms shall be conducted in accordance with "Environmental Test Facility Standard Operating Procedure Clean Room System," MSOP-GS-ETF-401 (soon to be superseded by ET24-CleanRoom-SOP-001). ETF personnel require experience and training before working in a controlled clean room environment. Thermal Vacuum Chambers V-7 and Sunspot can only be accessed via the clean room. Testing in Chamber V-7 or Sunspot often requires personnel remain in the clean room for several hours during test preparations. Therefore, clean room training is required for personnel performing thermal vacuum tests in these chambers.

The ETF personnel shall be classified as "trained" in clean room activities after viewing the video titled "Clean Room Orientation," and adequate OJT. In addition to viewing the video, personnel shall also participate in Clean Room activities until that employee's immediate supervisor determines that the employee can demonstrate safe and proper clean room techniques. The supervisor and the ETF Technical assistant shall make evaluation of the trainee's performance. OJT status shall be recorded in the ETF training record.

11.2.4 Machine Shop OJT

ETF personnel shall be skilled in blue print reading, knowledgeable in math, and have mechanical work experience to effectively learn the operation of the machine shop equipment. The trainee is taught the basic concepts of welding, sawing, clamping, cutting, grinding, drilling, sanding, milling, rotation speeds of cutting tools, and equipment safety. Each machine is designed to perform a certain type of operation, therefore, OJT is required on each machine.

The technician shall be classified as "trained" on a machine when the trainee has demonstrated the ability to perform a particular operation on a machine. The technician shall learn how to operate each machine and the sequence of events required to complete an

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operation successfully and safely. Evaluation of the trainee's performance shall be made by the supervisor and the ETF Technical assistant. OJT status shall be recorded in the ETF training record.

12. FACILITY CONFIGURATION CONTROL

The ETF facility configuration shall be controlled in accordance with Environmental Test Facility Configuration Management Plan.

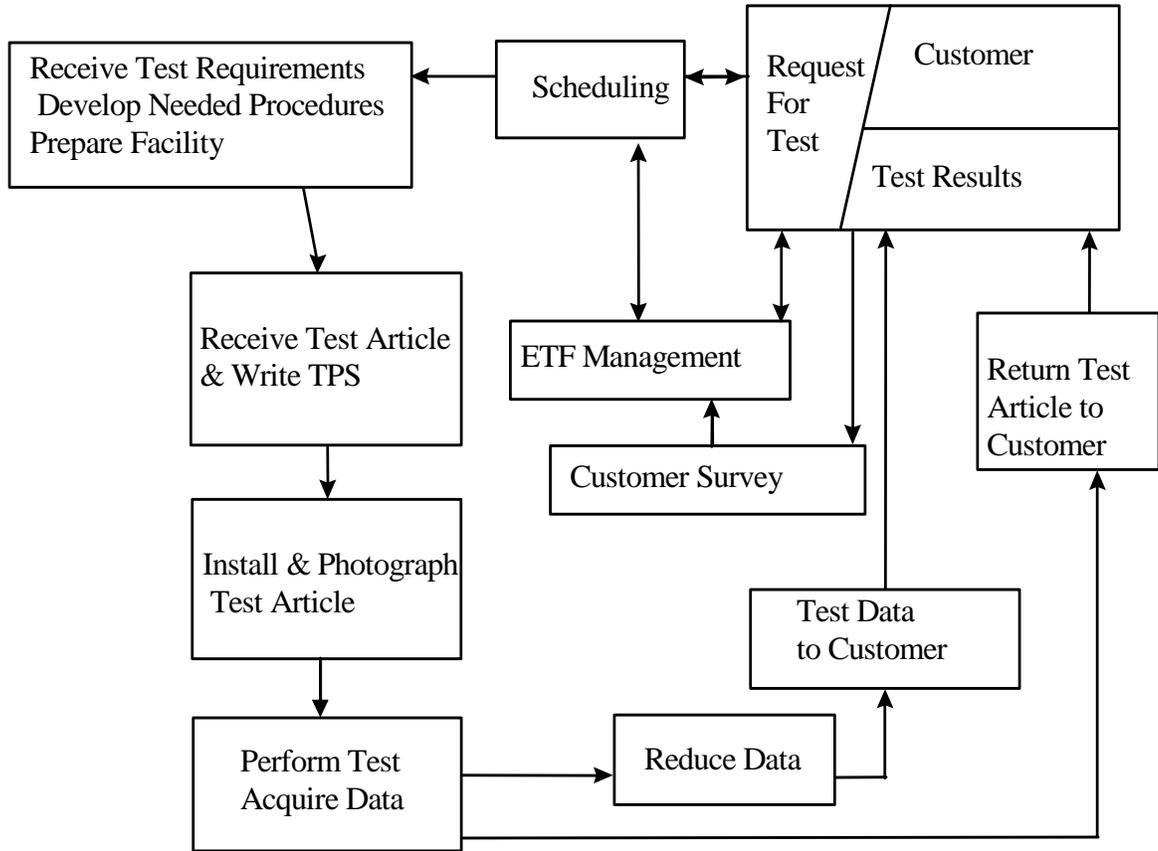
13. TEST NON-CONFORMANCE, DEVIATION, AND ANOMALIES

The ETF facility shall document test anomalies in the affected test chamber's logbook. Information recorded shall include the time and description of the anomaly, and name of customer informed of the anomaly. A test deviation is not a discrepancy if the deviation or human factor is immediately recognized and corrected so there is no impact to the test process or test article. The ETF personnel shall inform the customer of all test anomalies. The customer shall determine if the anomaly should be escalated to a discrepancy report (DR) or test discrepancy report (TDR). The customer is responsible for requesting assistance from the Safety, Reliability, and Quality Assurance in developing DRs and TDRs.

Any test article or equipment identified as CSP requires additional notification. ETF test personnel shall notify the MLR and the Chief of the Property Management Group, the Center Operation Directorate whenever CSP is lost, damaged or found unsuitable for use.

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14. FLOW DIAGRAM



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Appendix A
ETF Customer Test Agreement Form M4337

CUSTOMER TEST AGREEMENT		
ENVIRONMENTAL TEST FACILITY (ET24)		
Customer Organization:	Customer Contact Person and Phone:	
Task Agreement Number -Project Charge Code (UPN) & Project Name & Test Article Name:		
MSFC Project Office, Chief Engineer or Other MSFC Contact and Phone If Customer Organization not a MSFC Org.:		
Type of Test (one per test)	Environment Requirements	Equipment Requirements
<input type="checkbox"/> Vacuum Bakeout <input type="checkbox"/> MSFC-1238-Bakeout <input type="checkbox"/> Thermal Vacuum <input type="checkbox"/> Ascent Rate Depress <input type="checkbox"/> Thermal/Humidity <input type="checkbox"/> Life Cycle	Items Max Dimensions: _____ Pressure (Vacuum): _____ High Temp Extreme: _____ Low Temp Extreme: _____ Temp Ramp Rate Limit: _____ Maximum Humidity: _____ Minimum Humidity: _____ Number of Cycles: _____	<input type="checkbox"/> Test Article Shroud <input type="checkbox"/> Cold Plate-# _____ <input type="checkbox"/> Lamp Array-# zones _____ <input type="checkbox"/> Electric Power-V _____ A _____ <input type="checkbox"/> Thermocouples # _____ <input type="checkbox"/> Other Instrumentation # _____ <input type="checkbox"/> Special Requirements: _____
Expected Start Date and Duration / Explanation of Special Requirements and Other Instrumentation:	<input type="checkbox"/> NASA Quality Required <input type="checkbox"/> Customer Provided Quality Function <input type="checkbox"/> No Quality Doc. Required Test Support/Coverage Requested: <input type="checkbox"/> Day Shift Only: _____ # of days <input type="checkbox"/> 2 Shift/Extended day: _____ # of days <input type="checkbox"/> Run to Completion (24/7): _____ # of days <input type="checkbox"/> Addn. Weekend/Holiday: _____ # of days	
Test Article Cleanliness: Has test article been cleaned with ethanol/isopropanol, and is it visibly clean? <input type="checkbox"/> Yes <input type="checkbox"/> No Are all component materials rated as vacuum compatible per MAPTIS? <input type="checkbox"/> Yes <input type="checkbox"/> No Have connectors been vacuum baked to MSFC-SPEC-548B? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A Have cables been vacuum baked to MSFC-SPEC-684? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A		
Customer Procedure Name and Number:		
Fill in the above portion only and e-mail form to Debra Terrell (544-6857)		
Date of First Contact:	Test Number Assigned:	Chamber Assigned:
Notes:		
Date of Arrival :	Date Test Began :	Date Test Ended :

MSFC Form 4337B

Computer Generated

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APPENDIX A

"Calibration Not Required" and "Calibrated" Labels

