



National Aeronautics and
Space Administration

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

**FACILITY OPERATING PROCEDURE
FOR
THERMAL HUMIDITY CHAMBER
TH9**

**ENVIRONMENTAL TEST FACILITY
THERMAL AND FLUID SYSTEMS GROUP
STRUCTURES, MECHANICS, AND THERMAL DEPARTMENT
ENGINEERING DIRECTORATE**

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

**FACILITY OPERATING PROCEDURE
FOR
THERMAL HUMIDITY CHAMBER TH9**

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Attachment A

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1.0 GENERAL INFORMATION

1.1 PURPOSE

This document describes the operation of portable Thermal Humidity Chamber TH9 located at the Environmental Test Facility (ETF), the Marshall Space Flight Center (MSFC) Buildings 4612 and 4619.

1.2 SCOPE

The procedures and practices outlined in this document are to be followed in the operation of Thermal Humidity Chamber TH9. This document provides a record copy of Chamber TH9 operation.

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MSOP-FA-ETF-413	Control of Hazardous Energy (Lockout/Tagout) Procedure for the Environmental Test Facility (soon to be superseded by ET24-LOTO-SOP-001)
MFOP-FA-ETF-426	Unattended Operation of the Environmental Test Facility (soon to be superseded by ET24-UnattnOps-SOP-001)
ET24-OWI-ETF-001	Environmental Test Facility Test Operations
ED26 (02-01)	Memorandum for Record, Safety Assessment for the ETF (soon to be re-issued as an ET24 memo, number unknown)

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, unsafe practices, safety incident or near misses to the ETF Team Leader or the 4619 Building Manager Assistant.

In addition to the above safety precautions, all personnel involved in facilities using cryogenics shall be aware of the possibility of freeze burns by contact with cold surfaces or liquids. Protective clothing shall be worn by all personnel involved in handling of cryogenics or when making

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repairs/modifications to cryogenic facilities including eye protection, gloves and clothing that has no catch points. Only certified cryogenic handlers shall perform repairs/modifications to cryogenic systems. In the event of a cryogenics spill, line ruptures, or similar emergencies, personnel shall 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 spill area.

Review the ETF's Safety Assessment ED26 (02-01) and follow the PPE and JHA requirements for this chambers. If this chamber is not yet listed, follow the PPE and JHA requirements for TH5.

The chamber can reach extreme temperatures both hot and cold. The test chamber shall be given sufficient time to return to ambient temperature ± 10 degrees C (± 18 degrees F) before opening the door in order to minimize the extreme temperature hazard.

1.5 EMERGENCY TELEPHONE NUMBERS

In case of emergencies Call **911**;

Medical	911
Ambulance	911
Fire	911
Security	911
Chemical Spills	911

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

Medical Center	544-2390
Security	544-4357
Safety	544-0046
Utilities	544-3919
Other Assistance	544-4357 (4-HELP)

1.6 CHECKOUT TEST

A dummy test article should be used for determining program set-points for the thermal controllers and safety devices prior to testing, especially for critical qualification tests. Use a dummy test article that provides an accurate thermal simulation of the actual test article.

1.7 HAZARDS LIST

- 230 AND 120 volts AC electrical power
- Extreme temperatures in the chamber (hot and cold)

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*****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.

1.7.1 Minimizing Electrical Shock Hazards

- 1.7.1.1 All bare electrical parts with a potential to ground of 50 volts or greater shall remain de-energized except when required to be energized for check-out by an electrical technician.
- 1.7.1.2 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 if possible. 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.
- 1.7.1.3 Personnel must not enter into or reach into areas with energized bare electrical parts where there is a lack of illumination or an obstruction of view. Personnel must never blindly reach into an area that may contain energized bare electrical parts.
- 1.7.1.4 Personnel shall remove all conductive apparel before working near energized bare electrical parts, including jewelry, watches, key chains, metalized aprons, and metal head gear.
- 1.7.1.5 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.
- 1.7.1.6 Personnel working near bare electrical parts energized at 50 volts or greater shall use protective equipment adequate to insulate the potential shock hazard. Personnel shall use insulating tools near energized bare electrical parts.
- 1.7.1.7 Safety signs or tags shall be used to warn personnel that an electrical shock hazard is present when there are bare electrical parts energized at 50 volts or greater.
- 1.7.1.8 Barricades shall be used in conjunction with signs or tags to limit personnel access.
- 1.7.1.9 Any de-energized electrical parts that are not locked-out, tagged-out, or unplugged will be considered energized. Lockout/Tagout shall be in accordance with MSOP-FA-ETF-413. 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.
- 1.7.1.10 All live electrical parts located outside the chamber and energized at 50 volts or greater must be guarded against accidental contact.
- 1.7.1.11 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.
- 1.7.1.12 Locking type connectors shall be properly secured after connection.

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- 1.7.1.13 After a circuit has been de-energized by the opening of a protective device, the circuit shall be inspected by a senior ED26 electrical engineer, electrician, or an ED26 electrical technician before the circuit may be re-energized.
- 1.7.1.14 Over-current protective devices shall not be modified.

1.7.2 Minimizing Extreme Temperature Hazards

The test chamber and any test article shall be given sufficient time to return to ambient temperature ± 10 degrees C (± 18 degrees F) before opening the chamber door in order to minimize the extreme temperature hazard.

1.8 RESPONSIBILITIES

ETF personnel will be responsible for the operation of the TH9 Thermal Humidity Chamber. The designated operator of the chamber will be responsible for the safe operation and conduct of the facility. This responsibility includes safety for personnel, the test article, and the facility. The name of the responsible operator shall be recorded in the chamber logbook.

Other task assignments and responsibilities at the ETF will be in accordance with the Organizational Work Instruction c.

2.0 CHAMBER DESCRIPTION

2.1 CHAMBER DESCRIPTION AND DIMENSIONS

Chamber TH9 is a cube shaped vessel with polished stainless steel interior surfaces. The interior dimensions are 30 inches width by 36 inches height and 31 inches depth. Access for connecting to the test article is provided by two 5 1/8 inch feed through holes on the side. There is a 5/8-inch drain in the bottom center of the chamber and a 1-1/2 inch vent pipe near the top on the side.

This chamber is Model T20RS, Serial Number 12807-2 manufactured by Tenney Engineering.

2.2 CONTROL SYSTEM

The control system consists of switches for power and the VersaTenn II controller. All control is located on right outside of the chamber.

2.3 VERSATENN II CONTROLLER

Temperature and humidity can be maintained at a constant value or continuously varied according to a predetermined program manually entered into the VersaTenn II controller. The VersaTenn

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controller allows the operator to manually enter up to 99 temperature/humidity profile segments, with segment times up to 99 hours. A segment or a group of segments can be repeated by a loop command up to 255 times. The controller is capable of storing up to ten programs. Operating personnel should be thoroughly familiar with VersaTenn instructions manual for Tenney Engineering Model T-20RS prior to programming the controller.

2.4 PERFORMANCE

Performance must be determined during activation. The chamber should be capable of achieving temperatures from -40°C to $+200^{\circ}\text{C}$.

3.0 OPERATIONS

Complete the As-run Buy-off Sheet when operating the chamber. This sheet is typically provided with the TPS. If none is provided, use a copy of Attachment A.

The operation of chamber TH9 will vary according to the temperature range, and specific requirements of the test. The procedure provides sufficient detail to operate the chamber in manual or steady state mode through one cycle. This procedure does not cover details for every feasible scenario such as for varying environments but it should be followed as closely as reasonable. Any variation should be noted in the chamber logbook. Use as many Buy-off sheets as needed if the test is required to re-start. Buy off sheets must be numbered if multiple sheets are used.

*******WARNING*******

Lockout and tag the equipment in accordance with Lockout/Tagout Procedure MSOP-FA-ETF-413 when performing maintenance activities. Only qualified technicians may perform maintenance activities.

3.1 CHAMBER PREPARATION

- 3.1.1 Review the safety assessment, Memorandum of Record ED26 (02-01), to determine the JHAs and PPE that applies to operation of this chamber. If this chamber is not yet listed, use the PPE and JHA requirements of TH5. Implement the risk mitigation methods listed in the JHAs and use the required PPE to minimize risk from potential hazards while operating this chamber. Verify the chamber has been activated by MFAP-FA-ETF-431.
- 3.1.2 Ensure that all connections to the chamber are compatible with proper operation of the chamber. Verify the test is ready to start.
- 3.1.3 Verify the 1CB breaker switch on the back of the control panel is **ON**.

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- 3.1.4 Verify the small instrument-cooling fan is running. It should be running even if the 1CB breaker is off.
- 3.1.5 Verify the white Power light and green Normal lights are illuminating. Verify the red Alarm and red Over Temp lights are not illuminated.
- 3.1.6 Install thermocouples inside the chamber to verify the chamber and test article temperatures.
- 3.1.7 Photograph the test article and test setup. Take as many photographs as necessary dependent on the complexity of the test setup. Copies of these photographs shall be given to the ETF Test Data Administrator before or immediately following the end of testing.
- 3.1.8 Verify that the chamber is closed and sealed.
- 3.1.9 **START** data acquisition.
- 3.1.10 Switch **ON** the breaker 1CB at the rear of the control panel. **WARMSTRT** should appear in the controller readout.
- 3.1.11 Press the ON/OFF key until the **AUTO** light is out. This disconnects the controller outputs so the chamber will not operate.

3.1.12 **Clock Setup**

Verify the clock is operational and has the correct time. If it is switched off or needs the time corrected, complete the following section.

- 3.1.12.1 Press the **MODE** key until **RETURN** is displayed, and then press **ENTER**. **SYSTEM** should be displayed.
- 3.1.12.2 Press the **MODE** key until **SETUP** is displayed.
- 3.1.12.3 Press **ENTER** and **CALIB** should appear.
- 3.1.12.4 Press **ENTER** and **TI** and number indicating the clock time should appear. Time is in 24 hour format (i.e. military time)
- 3.1.12.5 Press **MODE** and **HOUR** and a number will appear.
- 3.1.12.6 Press the up ▲ or down ▼ delta keys until the correct hour is displayed, then press **ENTER**.
- 3.1.12.7 Press **MODE** and **MIN** should appear.
- 3.1.12.8 Press the up ▲ or down ▼ delta keys until the correct minute is displayed, then press **ENTER**.

3.1.13 **Alarm Set-up**

- 3.1.13.1 Press the **MODE** key until **RETURN** is displayed, and then press **ENTER**. **SYSTEM** should be displayed.
- 3.1.13.2 Press **MODE** until **SETUP** is displayed.
- 3.1.13.3 Press **ENTER** and **CALIB** should be displayed.

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- 3.1.13.4 Press **ENTER** and TI (clock time) should be displayed.
- 3.1.13.5 Press **MODE** five times. A1L and a number should be displayed. A1L is channel 1 low temperature alarm set point.
- 3.1.13.6 Set A1L at **40°C** to verify the alarm is operating. Use the delta (**▲** or **▼**) keys to select the low temperature set point for the alarm, and then press **ENTER**.
- 3.1.13.7 Once the alarm sounds, press **ENTER** once to silence the alarm for 60 seconds.
- 3.1.13.8 Press **MODE** until A1L is displayed. Set A1L at -10°C lower than the lowest temperature. Use the delta (**▲** or **▼**) keys to select the low temperature set point for the alarm, and then press **ENTER**.
- 3.1.13.9 Press **MODE** and A1H should be displayed. A1H is channel 1 high temperature set point for the alarm.
- 3.1.13.10 Set A1H at **0°C** to verify the alarm is operating. Use the delta (**▲** or **▼**) keys to select the high temperature set point for the alarm, and then press **ENTER**.
- 3.1.13.11 Once the alarm sounds, press **ENTER** once to silence the alarm for 60 seconds.
- 3.1.13.12 Press **MODE** until A1H is displayed. Set A1H at +10degrees C higher than the high set point temperature. Use the delta (**▲** or **▼**) keys to select the low temperature set point for the alarm, and then press **ENTER**.

3.2 CHAMBER OPERATIONS

- 3.2.1 The controller should be in the SYSTEM mode. If not, press the **MODE** key until the controller displays RETURN, then press the **ENTER** key. SYSTEM should be displayed.
- 3.2.2 Press **ENTER** and **SP1** should be shown in the lower display. This is the temperature set point.
- 3.2.3 Press the **▲** or **▼** key until the required temperature is displayed, and then press **ENTER**.
- 3.2.4 Press the Mode key. **SP2** should be displayed. This is the humidity set point.
- 3.2.5 Press the **▲** or **▼** key until the required humidity is displayed, then press the **ENTER**. If no controlled humidity is required, Press the **▲** or **▼** key until **-0.1** is displayed, then press the **ENTER**. This cuts off the relative humidity control.
- 3.2.6 Press the **ON/OFF** key until the **AUTO** light is illuminated. If the **HOLD** light is illuminated, press the **RUN/HOLD** key until the **HOLD** light goes out. The chamber will now start-up.
- 3.2.7 To verify the humidity, press the **MODE** key three times and RHA should be shown in the lower display. The actual relative humidity should be displayed.
- 3.2.8 Verify the chamber achieves the required humidity.
- 3.2.9 Press the **MODE** key until **SP2** is displayed.
- 3.2.10 Verify the temperature has achieved the required temperature ± 2 deg. C.

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- 3.2.11 Press the **MODE** key until SP1 is displayed.
- 3.2.12 Press the **▲** or **▼** key until **25** is displayed, then press the **ENTER**.
- 3.2.13 Verify the chamber return to a temperature of +25 °C \pm 10 deg. C.

3.3 CHAMBER SHUTDOWN

*******WARNING*******

The chamber can reach extreme temperatures both hot and cold. The test chamber shall be given sufficient time to return to ambient temperature (ambient \pm 10 °C) before opening the door in order to minimize the extreme temperature hazard.

- 3.3.1 Set the temperature to ambient \pm 10 degrees C (\pm 18 degrees F). If humidity was controlled, set the humidity to ambient condition. Allow the chamber and test article to return to ambient temperature and to a temperature above the dew point before proceeding.
- 3.3.2 Press the **ON/OFF** key to switch off the AUTO light.
- 3.3.3 Switch **OFF** breaker 1CB.
- 3.3.4 Open chamber door only when there is no risk of injury to personnel or equipment damage.
- 3.3.5 Inspect the chamber for any problem such as fluid leakage or overheated electrical components. Repair any damage. The chamber should be run again to establish its operability after any repair.

4.0 EMERGENCY SHUTDOWN

- _____ 4.1 Switch **OFF** system power at the chamber breaker 1CB.
- _____ 4.2 **CLOSE** the LN₂ supply valve if LN₂ is connected to the chamber.
- _____ 4.2 Switch **OFF** the supply switch that powers the chamber.
- _____ 4.3 Open the chamber door only when there is no risk of injury to personnel or little risk of damage to the equipment.

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TH9 Buy-off Sheet

Test Number _____ Customer Contact _____

Calling TPS or Work Instructions _____ Start Time & Date _____

Test Description _____ End Time & Date _____

Data Process Rate _____

Initial each step once completed. If test exceeds one day, date the first step each new day.

3.1 FACILITY PREPARATION

- 3.1.12.5 _____
- 3.1.12.6 _____
- 3.1.12.7 _____
- 3.1.12.8 _____
- 3.1.13.1 _____
- 3.1.13.2 _____
- 3.1.13.3 _____
- 3.1.12.4 _____
- 3.1.13.5 _____
- 3.1.13.6 _____
- 3.1.13.7 _____
- 3.1.13.8 _____
- 3.1.13.9 _____
- 3.1.13.10 _____
- 3.1.13.11 _____
- 3.1.13.12 _____
- 3.1.1 _____
- 3.1.2 _____
- 3.1.3 _____
- 3.1.4 _____
- 3.1.5 _____
- 3.1.6 _____
- 3.1.7 _____
- 3.1.8 _____
- 3.1.9 _____
- 3.1.10 _____
- 3.1.11 _____
- 3.1.12.1 _____
- 3.1.12.2 _____
- 3.1.12.3 _____
- 3.1.12.4 _____

3.2 SYSTEM OPERATION

- 3.2.1 _____
- 3.2.2 _____
- 3.2.3 _____
- 3.2.4 _____
- 3.2.5 _____
- 3.2.6 _____
- 3.2.7 _____
- 3.2.8 _____
- 3.2.9 _____
- 3.2.10 _____
- 3.2.11 _____
- 3.2.12 _____
- 3.2.13 _____

3.3 SYSTEM SHUTDOWN

- 3.3.1 _____

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TH9 Buy-off Sheet

3.3.2 _____

3.3.3 _____

3.3.4 _____

3.3.5 _____

QA _____ NA
if not applicable