



National Aeronautics and
Space Administration

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

**STANDARD OPERATING PROCEDURE
FOR IN-HOUSE CALIBRATION OF
DATA ACQUISITION SCANNERS**

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

THIS PROCEDURE DOES NOT CONTAIN HAZARDOUS OPERATIONS

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**STANDARD OPERATING PROCEDURE
FOR IN-HOUSE CALIBRATION OF
DATA ACQUISITION SCANNERS**

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1.0 GENERAL INFORMATION

1.1 PURPOSE

The purpose of this procedure is to direct calibration of data acquisition scanners including the Hewlett-Packard (HP) Scanners 3497A and 3852A or equivalent digital voltmeters, which measures the voltages of the input signals from thermocouples and other transducer voltage sources used for instrumentation purposes during the performance of environmental tests.

1.2 SCOPE

This procedure prescribes how to perform in-house calibrations of the data acquisition scanners used in the Environmental Test Facility (ETF), located in Buildings 4612, 4619 and 4620.

1.3 APPLICABLE DOCUMENTS

MPR 8715.1 Marshall Safety, Health, and Environmental (SHE) Program
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, unsafe practices, safety incident or near misses to the ETF Branch Chief or the 4619/4612 Assistant Building Manager.

1.5 EMERGENCY TELEPHONE NUMBERS

In case of an emergency, 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, and safety are:

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

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1.6 RESPONSIBILITIES

ETF personnel will be responsible for the safe operation during calibration of data acquisition scanners. These responsibilities include safety for personnel and the facility.

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

2.0 GENERAL DESCRIPTION OF CALIBRATION PROCESS

Before use, the calibration standard must have a current calibration sticker from the NASA/MSFC Calibration Lab.

The calibration standard is connected to a single thermocouple input channel on the Scanner being calibrated. The Scanner is operated through the data acquisition computer running the current data acquisition software (DAS) used by the ETF. With the data acquisition computer, the Scanner is commanded to sense the input channel voltage and transmit this measured data to the computer. The computer displays the data in degrees Fahrenheit or Celsius for observation by the person performing the calibration. Note that since only the voltmeter is being calibrated, only one card slot and card channel is needed for the calibration.

The calibration equipment is defined on the Buy-off Sheet.

Three temperature levels are sequentially output from the calibration standard, each level manually selected by the person performing the calibration. As each temperature level is output by the calibration standard and input to the scanner, the “temperature” signal voltage is:

- Sensed by the scanner
- Transmitted by the scanner to the computer
- Received by the computer
- Displayed by the software

The person performing the calibration records the input temperature level selected and the temperature displayed on the computer. **The unit will be deemed calibrated or in need of repair based on the differences (errors) between the displayed temperature values and the calibration standard temperature values.**

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The difference limits are the limits of error associated with type T thermocouple wire, used as a standard in the Environmental Test Facility. These limits of error are specified for each input “temperature” as:

- 300°F/149°C standard input, Scanner reading between 298°F/148°C and 302°F/150°C;
- 32°F/0°C standard input, Scanner reading between 30.2°F/-1°C and 33.8°F/1°C;
- -300°F/-184°C standard input, Scanner reading between -310°F/-190°C and -295°F/ -182°C

Allowable Type K and Type E thermocouples errors are listed in Sections 3.2 and 3.3 respectively.

3.0 CALIBRATION OF THE DATA ACQUISITION SCANNER

The data acquisition scanners used at the ETF are calibrated using a calibration standard with a Type T, Type K or Type E thermocouple simulation. The scanners shall be calibrated once each 12-months. The calibration methodology is presented in the following sections.

3.1 CALIBRATION WITH TYPE T THERMOCOUPLE

- 3.1.1 Set up the calibration standard operation to output a millivolt signal for a Type T thermocouple.
- 3.1.2 Power **ON** the calibration standard and allow it to warm for 5 minutes.
- 3.1.3 Switch **OFF** the scanner to be calibrated.
- 3.1.4 **CONNECT** calibration standard output to the Type T thermocouple disconnect at the rear of the scanner. Make input connection to the calibration standard at the source input jacks, maintaining like polarity with input leads. Turn on the scanner to be calibrated.
- 3.1.5 If using PACRATS, create a database for the data acquisition software to read data from the channel to which the calibration standard is attached.
- 3.1.6 **START** the data acquisition software, and display the data for the input channel that the calibration standard is attached to.
- 3.1.7 **SET** the calibration standard to output a signal corresponding to +300°F/149°C, and wait for computer display to be updated.
- 3.1.8 **RECORD** both the temperature output from the calibration standard and the temperature displayed by computer on the calibration record (Appendix A).

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- 3.1.9 Repeat steps 3.2.2 and 3.2.3 using +32°F/ 0°C.
- 3.1.10 Repeat steps 3.2.2 and 3.2.3 using -300°F/-184°C.
- 3.1.11 Ensure all entries on the calibration record are completed, especially the determination of whether or not the Scanner is considered calibrated or failed. This depends on the differences between the temperature values output by the calibration standard and the temperatures displayed by the computer. Allowable differences are specified in section 2.0 of this procedure. If the scanner fails calibration, have it repaired or turn-in as surplus.
- 3.1.12 Turn off the scanner that has been calibrated.
- 3.1.13 Remove the Type T thermocouple input used during the calibration.
- 3.1.14 Re-connect the test chamber Type T thermocouple to the scanner if it was removed at the beginning of the calibration procedure.

3.2 CALIBRATION WITH TYPE K THERMOCOUPLE

Although Type T thermocouples are typically used for temperature measurements at the ETF, Type K or Type E shall be used if temperatures higher than 300°F are expected. This section may be omitted if no Type K thermocouples are being calibrated.

- 3.2.1 Set up the calibration standard operation to output a millivolt signal for a Type K thermocouple.
- 3.2.2 Power **ON** the calibration standard and allow it to warm for 5 minutes.
- 3.2.3 Switch **OFF** the scanner to be calibrated.
- 3.2.4 **CONNECT** the calibration standard output to the Type K thermocouple disconnect at the rear of the scanner. Make input connection to the calibration standard at the source input jacks, maintaining like polarity with input leads. Turn on the scanner to be calibrated.
- 3.2.5 If using PACRATS, create a database for the data acquisition software to read data from the channel to which the calibration standard is attached.
- 3.2.6 **START** the data acquisition software, and display the data for the input channel that the calibration standard is attached.
- 3.2.7 **SET** the calibration standard to output a signal corresponding to +1800°F/982°C, and wait for the computer display to be updated.

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- 3.2.8 **RECORD** both the temperature output from the calibration standard and the temperature displayed by computer on the calibration record (Appendix A).
- 3.2.9 Repeat steps 3.2.2 and 3.2.3 using +900°F/ 482°C.
- 3.2.10 Repeat steps 3.2.2 and 3.2.3 using 32°F/0°C.
- 3.2.11 Ensure all entries on the calibration record are completed, especially the determination of whether or not the Scanner is considered calibrated or failed. This depends on the differences between the temperature values output by the calibration standard and the temperatures displayed by computer. Allowable differences are ± 10 degrees F at 900°F and 1800°F and ± 2 degrees F at 32°F. If the scanner fails calibration, have it repaired or turn-in as surplus.
- 3.2.12 Switch **OFF** the scanner that has been calibrated.
- 3.2.13 Remove the Type K thermocouple input used during the calibration.
- 3.2.14 Re-connect the test chamber Type K thermocouple to the scanner if it was removed at the beginning of the calibration procedure.

3.3 CALIBRATION WITH TYPE E THERMOCOUPLE

Although Type T thermocouples are typically used for temperature measurements at the ETF, Type E or K shall be used if temperatures greater than 300°F are expected. This section may be omitted if no Type E thermocouples are being calibrated.

- 3.3.1 Set up the calibration standard operation to output a millivolt signal for a Type E thermocouple.
- 3.3.2 Power **ON** the calibration standard and allow it to warm for 5 minutes.
- 3.3.3 Switch **OFF** the scanner to be calibrated.
- 3.3.4 **CONNECT** the calibration standard output to the Type E thermocouple disconnect at the rear of the scanner. Make input connection to the calibration standard at the source input jacks, maintaining like polarity with input leads. Turn on the scanner to be calibrated.
- 3.3.5 If using PACRATS, create a database for the data acquisition software to read data from the channel to which the calibration standard is attached.
- 3.3.6 **START** the data acquisition software, and display the data for the input channel that the calibration standard is attached.

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- 3.3.7 **SET** the calibration standard to output a signal corresponding to +1100°F/593°C, and wait for the computer display to be updated.
- 3.3.8 **RECORD** both the temperature output from the calibration standard and the temperature displayed by computer on the calibration record (Appendix A).
- 3.3.9 Repeat steps 3.2.2 and 3.2.3 using +32°F/ 0°C.
- 3.3.10 Repeat steps 3.2.2 and 3.2.3 using -424°F/-253°C.
- 3.3.11 Ensure all entries on the calibration record are completed, especially the determination of whether or not the Scanner is considered calibrated or failed. This depends on the differences between the temperature values output by the calibration standard and the temperatures displayed by computer. Allowable differences are ±10 degrees F at 1100°F , ±2 degrees F at 32°F and ± 4 degrees F -424°F. If the scanner fails calibration, have it repaired or turn-in as surplus.
- 3.3.12 Switch **OFF** the scanner that has been calibrated.
- 3.3.13 Remove the Type E thermocouple input used during the calibration.
- 3.3.14 Re-connect the test chamber Type E thermocouple to the scanner if it was removed at the beginning of the calibration procedure.

Calibration of the Data Acquisition Scanner Type E Thermocouple Environmental Test Facility / ET24

Date calibration performed: _____

Person performing the calibration: _____

Check the scanner to be calibrated: HP 3497A
 HP 3852A
 (Other) _____

Enter the scanner Equipment Control Number (ECN): _____

Calibration standard ECN: _____

Calibration due date on the calibration standard: _____

Scanner slot No.: _____ Scanner channel No.: _____

Build a database to display the above-specified Type E thermocouple input.

Use the High, Midrange, and Low outputs on the calibration standard for a Type E thermocouple as the calibration inputs to the scanner.

Complete the temperature matrix below for each output from cal. standard:

	Cal. Standard Temp.	Scanner Temp.	Pass/Fail
High Output			
Midrange Output			
Low Output			

Include Units (F or C)

Date Calibration Due Next: _____