



Weatherization Technician

This Green Collar Zone workstation will teach you the basic principles of weatherization, as you acquire skills by performing hands-on activities. No prior knowledge of alternative energy trades is required as the Green Collar Zone curriculum will introduce you to professional tools and materials and provide step by step instructions to use them in skills practice.

Before working on the skill set activities, you will learn:

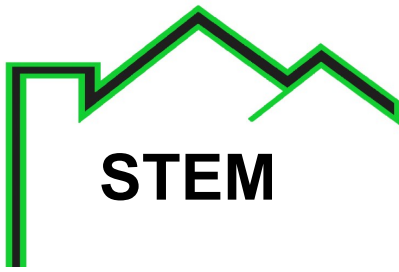
- What weatherization and energy audits encompass
- The career opportunities that exist in the weatherization industry
- Building fundamentals and modern weatherization practices in new construction

After you have learned about weatherization, you will use professional testing tools including a blower, smoke pencil, and non-contact thermometer to perform energy audit tests. You will weatherize the building using industry grade materials such as blanket insulation, caulk, weatherstrips, and duct seal putty. You will use a staple gun, portable drill, caulk gun, tape measure, utility knife, and heat gun. You will learn about and use personal protective equipment including gloves, safety glasses, a dust mask, and a hard hat.

WORKSTATION OVERVIEW

You will complete the following tasks:

- Perform several blower door tests to determine areas of air leakage and assess the effectiveness of weatherization techniques
- Perform several thermal tests to determine how much heat is escaping the station and assess the effectiveness of weatherization techniques
- Install weatherstrips in a door frame
- Use caulk to seal a dryer vent, light fixture, hose bib, and corner seam
- Caulk a window frame
- Use duct seal putty to seal an opening around an A/C disconnect
- Install plastic film insulation using a heat gun
- Install blanket insulation in wall and attic cavities
- Use an energy usage monitor to compare power consumption of various types of light bulbs
- Install, caulk, and insulate a double pane low-e window
- Disassemble the workstation using deconstruction techniques



Throughout the Weatherization Technician curriculum you will see **STEM ENHANCEMENT** sections. These may be additional activities, projects, reading, or presentations that students can complete to strengthen their core skills in the areas of science, technology, engineering, and mathematics.

STEM ENHANCEMENT

S = Science concepts

T= Technology concepts

E= Engineering concepts

M= Mathematics concepts

WEATHERIZATION TECHNICIAN SKILLS OBJECTIVES

Activity Day 1

- Define weatherization
- Define thermal envelope
- Identify common sources of air leaks in a home
- Define insulation
- Define renewable and non-renewable energy
- List non-renewable energy sources
- List renewable energy sources
- Define energy audit
- List the skills required of a weatherization technician

Activity Day 2

- Define foundation
- Define basement
- Identify the different parts of a basement
- Define slab
- Identify the different parts of a slab foundation
- Define crawl space
- Identify the different parts of a crawl space foundation
- Define framing
- Identify and define the different elements of a floor frame
- Identify and define the different elements of a wall frame
- Identify and define the different elements of a roof frame

Activity Day 3

- Define joint
- Define sill plate sealer
- Define backer rod
- Identify foam board insulation on a sample wall section
- Define housewrap and identify it on a sample wall section
- Define siding and identify it on a sample wall section
- Define flashing tape
- Define ice dam membrane and identify it on a sample roof section
- Define roofing felt and identify it on a sample roof section
- Define starter strip and identify it on a sample roof section
- Define roofing material and identify it on a sample roof section
- Define tape measure
- Identify the different parts of a tape measure

Activity Day 4

- Define portable drill
- Define the terms bit and chuck
- Identify the different parts of a portable drill
- Define hard hat
- Demonstrate how to correctly wear a hard hat
- Distinguish between clockwise rotation and counter-clockwise
- Define washer
- Define fender washer
- Safely use a portable drill to install foam board insulation with fasteners
- List the functions of an energy audit

Activity Day 5

- Define blower door test
- Define air change
- List some common air leak areas in homes and buildings
- Define blower
- Define smoke pencil
- Identify the different parts of a smoke pencil
- Safely operate a blower and smoke pencil to observe air leaks in a structure
- Complete an energy audit checklist

Activity Day 6

- Define the terms weatherstrip and weatherstripping
- Define V-strip and state its function
- Define adhesive-backed foam and state its function
- Define tubular gasket and state its function
- Define interlocking metal and state its function
- Define felt and state its function
- Install a tubular gasket weatherstrip
- Define threshold
- Install a vinyl weatherstrip in a bulb style threshold

Activity Day 7

- Define caulk
- Define and state the function of silicone caulk, latex caulk, acrylic caulk, acrylic latex caulk, acrylic latex silicone blend caulk, and butyl rubber caulk
- Define caulk gun
- Identify the different parts of a caulk gun
- Define utility knife
- Identify the different parts of a utility knife
- Use a caulk gun to neatly apply caulk to various surfaces

Activity Day 8

- Define pane
- Define single pane window
- List weep hole
- Define drip cap
- Use a caulk gun to apply sealant around a single pane window
- Define duct seal compound
- Install duct seal compound around a cable entrance
- Perform a blower door test and compare results to previous test to assess the effectiveness of installing a door weatherstrip, caulking to seal air leaks, caulking around a window, and installing duct seal

Activity Day 9

- Define plastic film insulation
- Define heat gun
- Identify the different parts of a heat gun
- Define pressure sensitive tape
- Define double-sided tape
- Safely use a heat gun to shrink plastic film insulation
- Perform a blower door test and compare results to previous test to assess the effectiveness of installing plastic film insulation

Activity Day 10

- Define infrared thermography
- Define thermogram
- Define non contact thermometer
- Identify the different parts of a non contact thermometer
- Define temperature sensor
- Identify the different parts of a thermometer with a temperature sensor
- Define fan heater
- Identify the different parts of a fan heater
- Take surface temperatures using a non contact thermometer

Activity Day 11

- Define heat transfer
- Define radiation
- Define conduction
- Define convection
- Define insulation
- Define bulk insulation and list the types of heat transfer it inhibits
- Identify four common types of bulk insulation
- Define reflective insulation and list the types of heat transfer it inhibits
- Define R-value
- Determine recommended R-values for various climate zones and types of building heat
- Define and examine four common types of bulk insulation—blanket, rigid foam board, loose fill, and spray foam

Activity Day 12

- Identify trapped air pockets in cured spray foam insulation
- Define staple gun
- Identify the different parts of a staple gun
- Define framing square
- Identify the different parts of a framing square
- Define batt
- Define facing material
- Use a dust mask and gloves to handle bulk insulation
- Safely measure and cut fiberglass blanket insulation to size
- Install fiberglass insulation in wood stud cavities
- Modify insulation to fit around a dryer vent, light fixture, and electrical boxes

Activity Day 13

- State the purpose of properly ventilating an attic
- Define soffit vent
- Define rafter vent
- Define ridge vent
- Locate a soffit vent and ridge vent on the workstation
- Measure, cut, and slit blanket insulation to fit into a cavity featuring a can light
- Install blanket insulation between wood ceiling joists

Activity Day 14

- Define can light
- Differentiate between IC rated housings and non-IC rated housings
- Define screwdriver
- Identify the different parts of a screwdriver
- Define insulation gasket
- Install foam insulation gaskets under outlet and switch plates
- Perform a thermal test and compare results to previous test to assess the effectiveness of installing blanket insulation in a wall and attic and installing insulation gaskets behind receptacle outlet and switch plates
- Define energy usage monitor
- Identify the different parts of an energy usage monitor
- Read an energy usage monitor to compare the energy consumption of various types of light bulbs
- Define and list the benefits and disadvantages of incandescent, compact fluorescent, and LED light bulbs

Activity Day 15

- Perform a blower door test and compare results to previous tests to assess the effectiveness of installing blanket insulation and insulation gaskets
- Remove plastic film insulation
- Define multipurpose tool
- Identify the different parts of a multipurpose tool
- Safely use a portable drill and multipurpose tool to remove a window and its caulk

Activity Day 16

- Define double pane window
- Define transmittance, absorption, and reflectance, and state their relationship to one another
- Define emissivity and state its relationship to absorption
- Define low-e glass
- Define soft coat
- Define hard coat
- Define solar gain
- Define SHGC
- Explain why different solar gains are desirable in different climates
- Install a double pane window and window trim
- Perform a blower door test and compare results to previous tests to assess the effectiveness of installing a double pane window without caulk
- Apply caulk around window exterior
- Install insulation around window interior

Activity Day 17

- Define footing drain
- Define waterproof membrane
- Define interior perimeter drain
- Define French drain
- Define sump pump
- Define grade
- Define gutter
- Define downspout
- Define leader
- Define rain water harvesting
- Define rain water catchment system
- Identify various gutter system parts on the workstation

Activity Day 18

- State the function of a final blower door test
- Perform a blower door test and compare results to previous tests to assess the effectiveness of applying caulk to a double pane window
- State the function of a final thermal test
- Perform a thermal test and compare results to previous tests to assess the effectiveness of replacing a single pane window with a double pane window

Activity Day 19

- Define deconstruction
- Define sustainability
- Define tack puller
- Identify the different parts of a tack puller
- Remove and salvage blanket insulation
- Remove and salvage rafter vents
- Remove and salvage insulation gaskets

Activity Day 20

- Remove and salvage a double pane window and trim
- Install a single pane window
- Define AFUE and list the appliances to which it is applicable
- Define SEER and list the appliances to which it is applicable
- Define EER and list the appliances to which it is applicable

Activity Day 10

Thermal Testing

Weatherization Technician Skills Objectives

1. Define infrared thermography
2. Define thermogram
3. Define non contact thermometer
4. Identify the different parts of a non contact thermometer
5. Define temperature sensor
6. Identify the different parts of a thermometer with a temperature sensor
7. Define fan heater
8. Identify the different parts of a fan heater
9. Take surface temperatures using a non contact thermometer

Day 10 Activities





1. Read the sections *Activity Introduction*, *Infrared Thermography*, *Using the Non Contact Thermometer*, *Using the Temperature Sensor*, and *Using the Fan Heater*.
2. Complete the step-by-step directions to perform a thermal test on the workstation thermal envelope.
3. Complete the Activity Day 10 workbook questions.

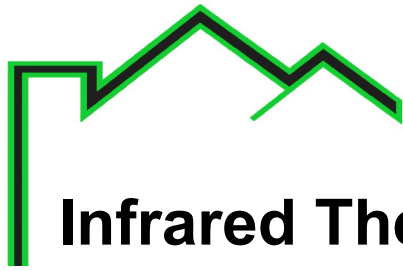


Activity Introduction

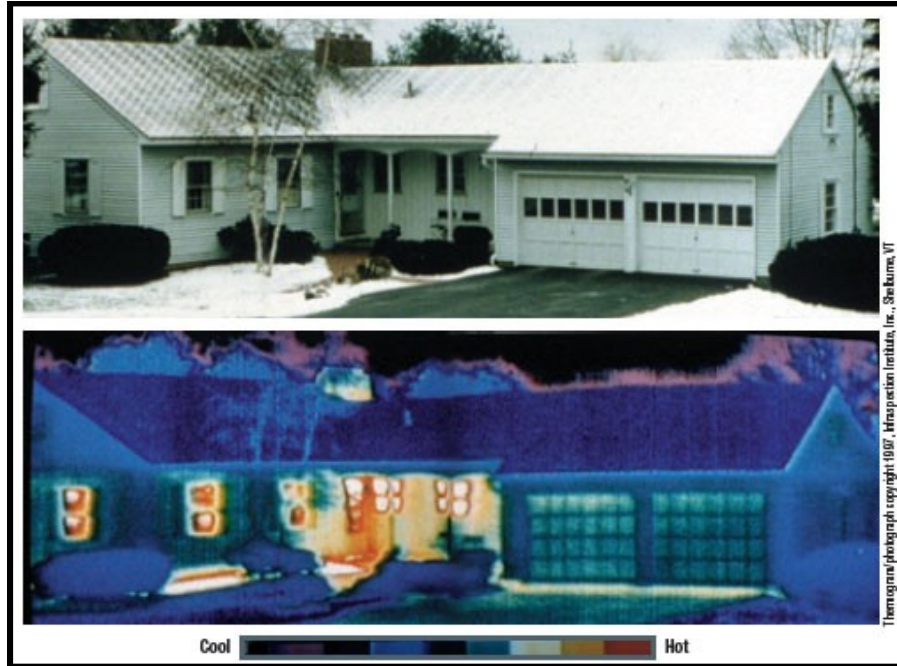
Your task is to perform a thermal test on the workstation structure to determine whether heat loss is occurring through the walls and windows. Before you begin, you will learn about infrared thermography and how to use a non contact thermometer, a thermometer with a temperature sensor, and a fan heater.

To perform a thermal test, you'll need the tools pictured below. Each is either labeled in the tool module or is kept in the drawer at the base of the workstation. When you have finished using a tool, return it to the labeled tool holder.

Activity Day 10 Tools and Materials	
 <i>Safety Glasses</i>	 <i>Non Contact Thermometer</i>
 <i>Temperature Sensor</i>	 <i>Fan Heater</i>



Infrared Thermography



Infrared Imagery

Infrared thermography, also known as infrared imaging or thermal imaging, is a means of measuring the heat emission from a home or building with infrared cameras that detect radiation in the infrared range of the electromagnetic spectrum. Infrared cameras see light that is in the heat spectrum and can detect the thermal patterns created by leaks and gaps and missing and damaged insulation. Weatherization technicians perform infrared surveys to determine the areas of greatest heat loss from a home or building.

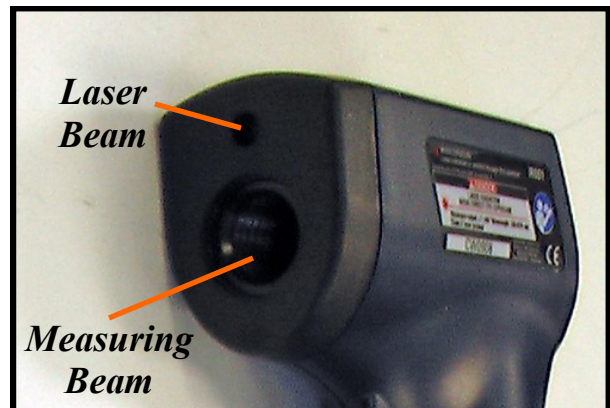
A thermogram is an image of infrared radiation where different temperatures appear as a range of colors on film. The colors range from white for warm regions to black for cooler areas. Thermograms help energy auditors determine whether insulation is needed. They also serve as a quality control tool, to ensure that insulation has been installed correctly. Infrared thermography is commonly carried out during blower door testing. The blower door helps exaggerate air leaking through defects in the building envelope. Air leaks appear as black streaks in the infrared camera's view finder.

Using the Non Contact Thermometer

The parts of a non contact thermometer are called out in the photos below.



*LCD
Temperature
Display*



*Laser
Beam*

*Measuring
Beam*

Non Contact Thermometer

A non contact thermometer is a hand held infrared thermometer that measures temperature without making physical contact. Non contact thermometers measure temperature quickly and from a distance. Infrared imaging is accurate and highly valuable, but expensive. A non contact thermometer can be used instead to detect hot and cold spots in door and window seals to locate drafts and leakage of warm or cool air.

Non contact thermometers measure only surface temperatures. To use a non contact thermometer, hold the meter by its handle less than two feet away from the surface to be measured and point it toward the surface. For a spot reading, aim at the target. Press and release the trigger once. The temperature reading is displayed on the screen for approximately seven seconds after the trigger is pressed. After this, the meter shuts off automatically. For a continuous reading, aim at one location. Press and hold the trigger. Move the laser beam to another location. The temperature reading is displayed, and will change when the target object changes. The temperature reading is displayed on the screen for approximately seven seconds after the trigger is pressed.

The thermometer featured at the Weatherization Workstation can measure temperatures from -4° F to 600° F.

When using a non contact thermometer, follow these safety suggestions:

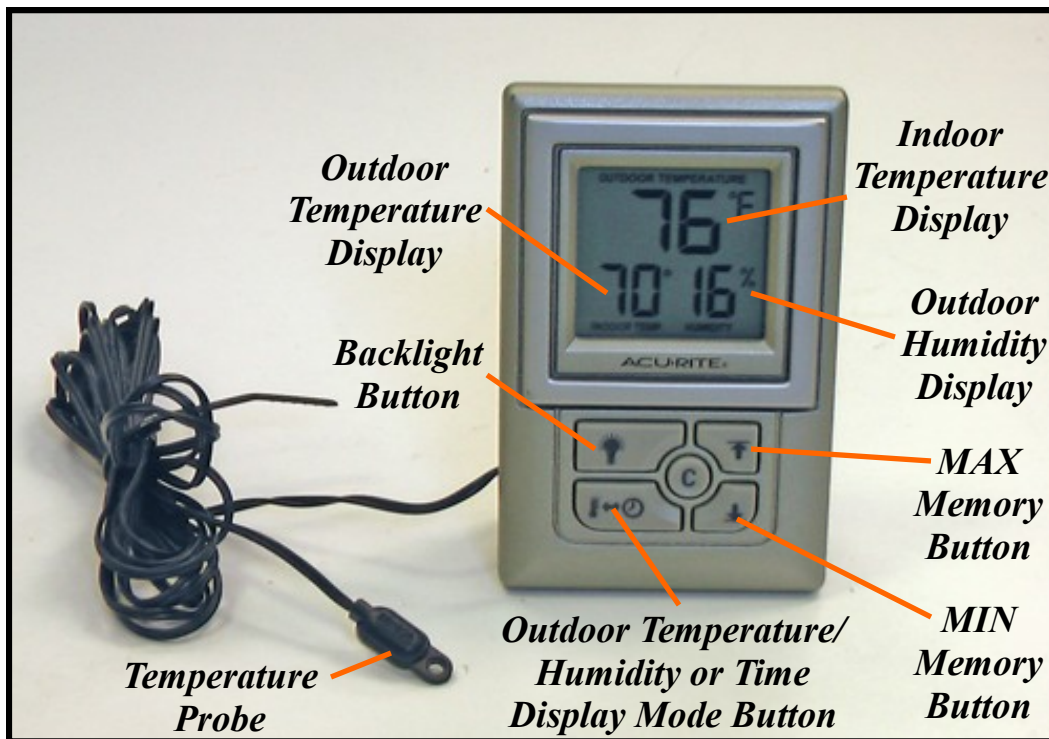


- Do not point the laser beam toward anyone's eye or allow the beam to strike the eye from a reflective surface. Do not stare into the beam.
- Do not operate the laser around children or allow children to operate the infrared thermometer
- Do not use the thermometer to measure body temperature. Never aim the beam at a person.



Using the Temperature Sensor

The parts of the thermometer with temperature sensor are called out in the photo below.



Thermometer with Temperature Sensor

A temperature sensor is a thermometer that can be routed to a separate location than its display. Thermometers with temperature sensors are often used to view outdoor temperatures from an indoor setting. You will use a thermometer with a temperature sensor to do the opposite—view indoor temperatures from an outdoor setting. Therefore, note that the labels on the thermometer display vary from the call outs shown above.

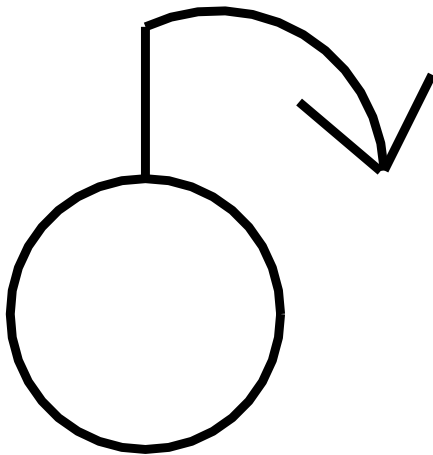
To use the thermometer with a temperature sensor, mount the probe in the area to be measured. Read the sensor's measurements on the top line of the digital display area. The thermometer with temperature sensor featured at the Weatherization Workstation can measure temperatures from -40° F to 158° F.



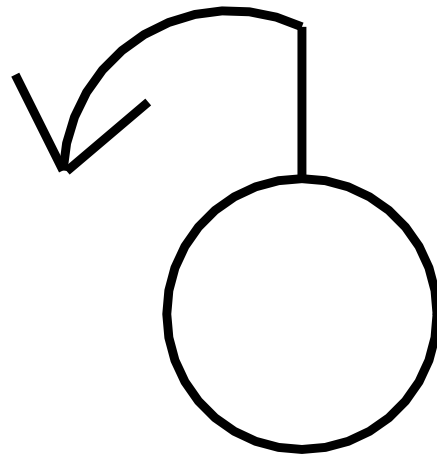
Directional Symbols

Some of the tools used by weatherization technicians in their daily work must be applied in two directions: clockwise and counter-clockwise.

Think about the way the hands of a clock turn--that is the clockwise direction. Counter-clockwise is the opposite direction--the hands of a clock turning backwards. The symbols for these two directions are below.



Clockwise



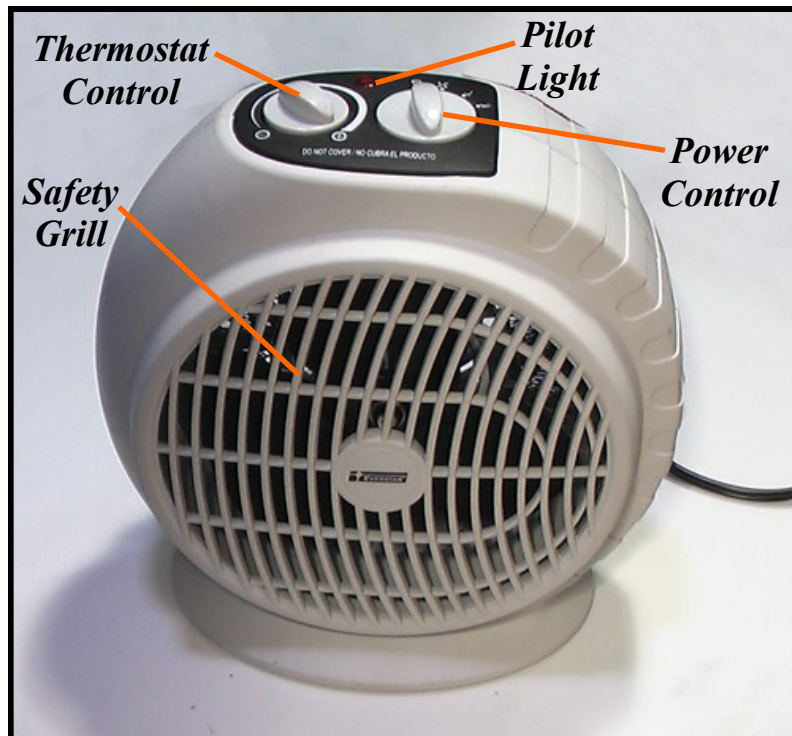
Counter-clockwise

You will see these symbols in the workbook instructions whenever turning in a specific direction is required.



Using the Fan Heater

The parts of the fan heater are called out in the photo below.



Fan Heater

A fan heater is an electric heater that blows out a current of warm air using a fan. It is composed of an electric motor that rotates thin, rigid vanes in order to move air past a heating element.

To use the fan heater, set the heater on a dry, level surface. Turn the power control to the OFF (⊗) position. Plug the power cord into an electrical outlet. Set the thermostat control to the maximum setting (⊕) by turning it clockwise ⤴. Set the power control to the high heat setting (SS) to quickly warm up the area. Power control can then be turned to the low heat setting (S). To reduce the heat output, turn the thermostat control counter-clockwise ⤵. For fan only operation, without any heat output, turn the power control to the fan setting (✖).

The pilot light glows whenever the heater is plugged in and turned on.

When using a fan heater, follow these safety suggestions:



- The heater is hot when in use. Do not let bare skin touch the hot surfaces.
- Keep combustible materials, such as furniture, pillows, paper, and fabric at least three feet from the heater
- Use caution when using the heater near children or pets
- Do not leave the heater on unattended. Always unplug the heater when not in use.
- Do not use the heater if the cord or plug has been damaged
- Ensure that the heater is on a stable, secure surface so that it does not tip over

Step-By-Step Instructions

To perform a thermal test on the workstation envelope:

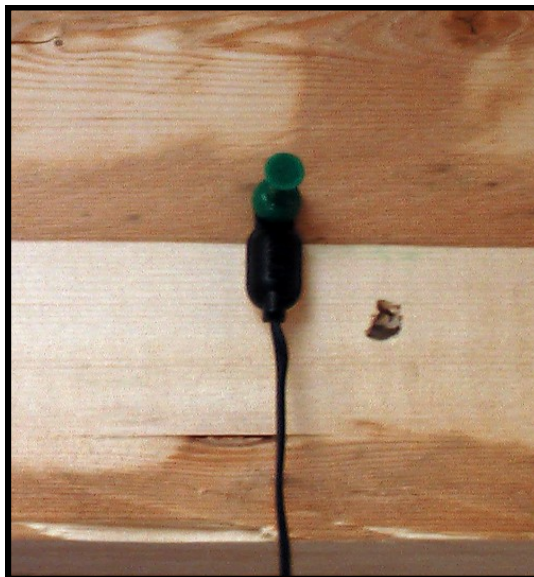


1. Put on your safety glasses and hard hat.
2. Retrieve the fan heater. Place the heater in the middle of the workstation floor.



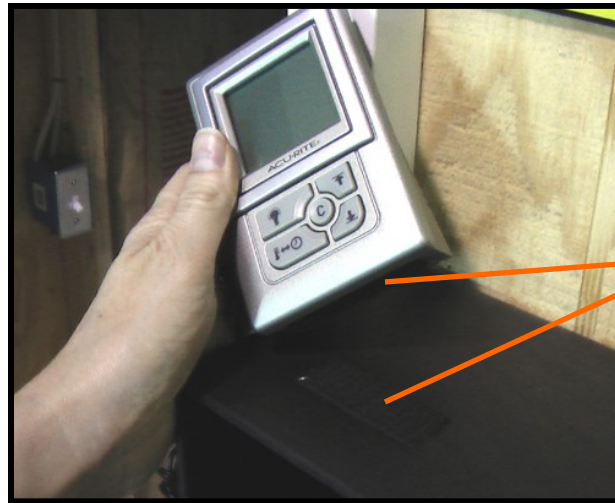
Fan Heater on Workstation Floor

3. Retrieve the thermometer with the temperature sensor and a push pin from the tool module. Hang the temperature probe over the window of your assigned wall.



Temperature Sensor Over Window

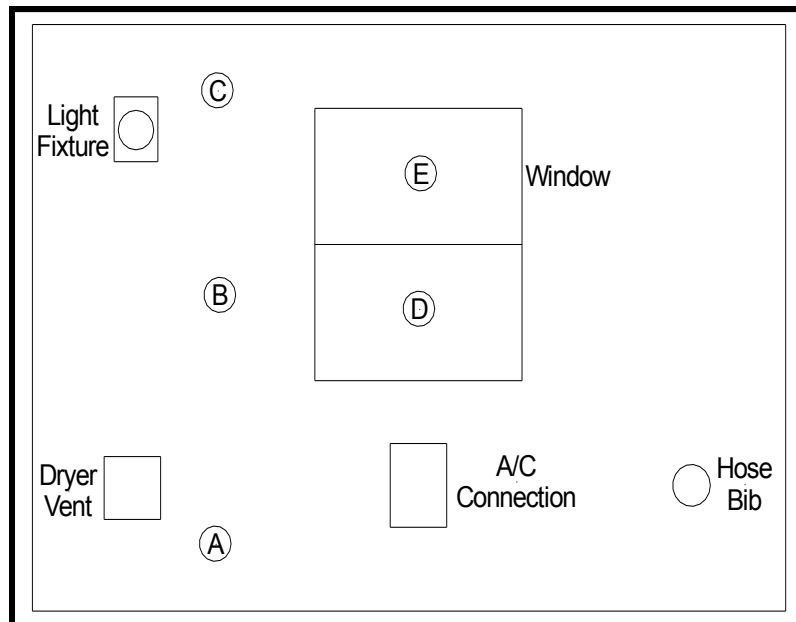
4. Bring the thermometer outside the workstation. Attach the thermometer to the top of the tool module by connecting the hook-and-loop fasteners.



*Hook-and-Loop
Fastener System*

Thermometer on Tool Module

5. Plug the heater power cord into the electrical outlet. Set the thermostat control to the maximum setting (\oplus) by turning it clockwise \curvearrowright . Exit the workstation, and close the door.
6. Retrieve the non contact thermometer and the Energy Audit Checklist. You will immediately take surface temperature readings at the locations shown below.



Temperature Reading Locations

7. Hold the meter by its handle less than two feet away from your assigned wall. Point it toward the surface at Location A. Press and release the trigger once. Note the temperature reading on the Energy Audit Checklist.

8. Staying less than two feet away from the wall, take temperature readings at Locations B through E. Note the results on the Energy Audit Checklist.



Using Non Contact Thermometer

9. Wait approximately one half hour for the workstation to heat up. Ideally, the inside temperature of the workstation should reach approximately 100° F. The inside temperature appears on the top line of the thermometer display.



*Indoor
Temperature
Display*

Indoor Temperature Display

10. Retest the surface temperature of the workstation. Hold the meter by its handle less than two feet away from the wall. Point it toward Locations A through E, and note the temperature readings on the Energy Audit Checklist. Did the surface temperature of the workstation wall increase? Did the surface temperature of the window increase? What does this imply about heat loss through these surfaces?



Taking Window Surface Temperature

11. Return all tools and safety equipment to their places in the workstation. Clean up the workstation and put away unused materials.

DO NOT WRITE ON THIS PAGE - ASK YOUR INSTRUCTOR FOR A COPY

Weatherization Technician - Activity Day 10 Workbook Questions

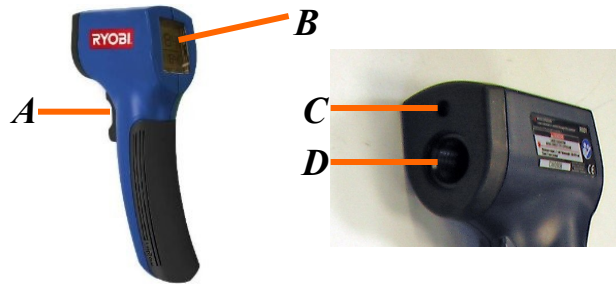
1. Define infrared thermography.

2. Define thermogram.

3. Define non contact thermometer.

Match the terms on the left with the parts of a non contact thermometer.

- 4. Measuring Beam _____
- 5. Temperature Display _____
- 6. Laser Beam _____
- 7. Trigger _____



8. Define temperature sensor.

9. Which reading below displays the inside temperature of the workstation during the thermal test?



10. Define fan heater.



Optional STEM Activity

Use the following question or activity to strengthen your core skills in the areas of science, technology, engineering, and mathematics.

STEM ENHANCEMENT

STEM:

Your television remote control works by using infrared radiation rather than visible light. This is why you cannot see the beam as you use the remote. Because infrared radiation has a longer wavelength than visible light, it behaves differently when it encounters objects that get in its way. Using your television's remote control as a source of infrared radiation and a flashlight as a source of visible light, compare the behavior of the different beams.

Darken the room as much as possible. Stand about 10 feet away from the set. Test your flashlight by shining it against the dark television screen. Have a friend stand about halfway between you and the television, directly in front of the screen. Try turning on the television using the remote control. Then shine the flashlight onto the television screen. Note what happens in each case.

Place a glass of water directly in front of the remote control unit and try to turn on the television. Then shine the flashlight through it. Note what happens in each case.

Which of the objects interfered with the flashlight beam?

Which stopped the infrared beam?

How does the longer wavelength of infrared radiation help to explain your observations?