

RED FEATHER DO-IT-YOURSELF WEATHERIZATION





Our homes provide us shelter year round. A properly engineered and constructed home is designed to keep us warm in the winter and cool in the summer. Weatherization is a two-step process designed to save money on heating and cooling, and also to keep your house more comfortable all year.

Step 1: Air Seal your home.

Step 2: Stop heat from escaping by insulating your home.



According to the Department of Energy’s “Energy Efficiency and Renewable Energy” factsheet, “the average household saves \$350 or more per year on energy after [your] home is weatherized.”¹ Simple, do-it-yourself (DIY) weatherization repairs are the first place for the average homeowner or resident to gain the most benefit with the least effort and expense. This guide will help you get started weatherizing your home to save money and help conserve resources.

This chapter offers step-by-step techniques and instructions for homeowners and residents to perform simple, inexpensive weatherization measures that will save money, conserve resources, and keep it warmer. This chapter begins by explaining what weatherization is and how it contributes to the efficiency of your home as a system. Next, we’ll explore the pre-weatherization inspection that will help you identify not only areas to air seal, but also address health and safety considerations and repairs that should be completed before weatherization begins. Finally, we’ll describe how to air seal your home using the free DIY Weatherization Starter Kit.

WHAT IS WEATHERIZATION?

DID YOU KNOW:

The average older, un-weatherized home in the United States leaks air at a rate equal to a four-foot square hole in the wall.²

Put simply, weatherization is the process of identifying and sealing air leaks and adding insulation to reduce the home’s energy use and in turn, the resident’s utility bills. This chapter will walk you through some simple tricks to locate potential air leaks and seal them up. Don’t wait to start saving energy and money; begin assessing your home’s weatherization needs today!

DID YOU KNOW:

Low income households spend nearly 14 percent of their total annual income on energy costs. Other households spend on average 3 percent of their annual income on energy costs. In low income homes, energy costs are often compounded by the fact that many low income people live in older homes that may not have insulation or may have older, less efficient appliances.

Modern **weatherization measures** focus on the results of **blower door** tests to identify air leaks. In order to determine the best weatherization measures, professional energy auditors use a formula to determine the **Savings-to-investment (SIR)** ratio of the weatherization options identified in a particular unit. The SIR shows whether the owner / resident will save money over the improvement’s lifetime – in other words, whether or not the energy cost savings equals or exceeds the cost of materials and labor. Back when weatherization was called “winterization,” many state and local programs focused on installing doors and windows.³ While highly visible, and receiving lots of publicity, doors and windows are not the most effective weatherization measures for the money.³ The two weatherization measures that generate the most energy savings – air sealing and adding insulation – are largely invisible and much of the work can be completed by the typical homeowner.³

► **Weatherization measures or measures** – any repair that improves the air or thermal boundary of a home.

► **Blower door** – a piece of equipment designed to identify air leaks in the pressure boundary of a home.

► **Savings-to-investment ratio (SIR)** : a calculation to determine if the projected savings of installing a measure meets or exceeds the cost of that measure.

Starting around 1990, weatherization became more scientific and focused on the invisible measures that have higher SIR rates of return. Today, “weatherization measures are permanent and cost effective”.³ Some repairs aren’t considered weatherization, but are important for the occupant’s health and safety. Weatherization auditors are increasingly using advanced diagnostic tools and energy audits to focus efforts in each home.³ The following list showcases some of the more common and mostly invisible modern weatherization measures:

- Attic Insulation
- Duct sealing and modification
- Dense-pack sidewall insulation
- Electric base load measures
- HVAC equipment repair and/or replacement
- Air Sealing
- Refrigerator replacement
- Water heater replacement & repair
- Compact fluorescent lights (CFLs)

BUILDING SCIENCE

YOUR HOUSE AS A SYSTEM

Your home is a system of components that work together to keep you safe, dry, and warm. A house is system of interrelated parts; the operation of one part affects many others.⁴ “Changes that you make now can create issues that emerge as damage years later”.⁴ The following are some examples of the systems not working well together:

	An under insulated attic... Makes the heating and cooling systems work harder than necessary. ⁴
	Leaky recessed light fixtures... Increase heat loss/ gain, and can cause ice dams and moisture problems. ⁴



To enjoy a comfortable, healthy, durable and energy efficient home requires the components of your home to work together.⁵ The following components of a fully weatherized home works together so that it is comfortable, healthy, durable and energy efficient:

- A fully insulated **thermal envelope**.
- A well-sealed **air barrier**.
- **Thermal** and **air boundaries** that are in continuous contact with one another.
- Efficient, properly sized equipment to condition the living space and heat water.
- Well-designed and balanced power, heating, and water distribution systems.
- Healthy indoor air quality (IAQ) – see the **Healthy Homes** chapter for additional details on moisture levels and ventilation.

► **Thermal envelope** – the shell of a building that prevents unwanted heat transfer between the inside and outside of the home during changes in temperature and air pressure.

► **Air barrier/boundary** – an attached membrane or other weatherization measure that reduces or eliminates air movement into and out of a building.

► **Thermal barrier/boundary** – restricts or slows the loss/gain of heat in a building.

THERMAL ENVELOPE

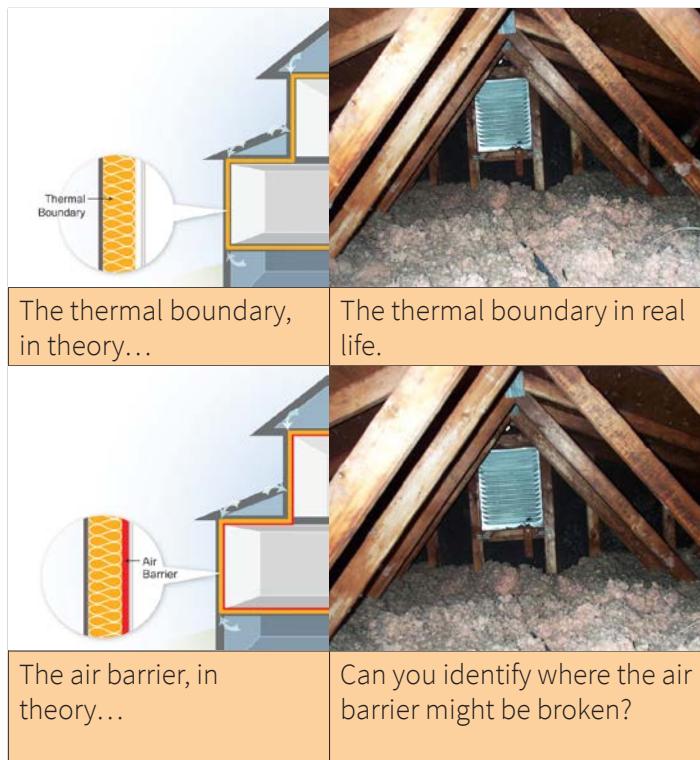
The thermal envelope of a structure refers to the outer shell of a building. It acts as a barrier to the unwanted heat transfer from the inside to the outside of the home that occurs because of changes in temperature and air pressure outdoors.⁶ How effective the thermal envelope is depends on the amount of insulation in the floors, walls, and ceiling, and the rate of air exchange between the inside and outside. A well-sealed air barrier affects the performance and energy efficiency of your home by

reducing heat loss or gain.

Where are the thermal and air boundaries in a typical home? The thermal boundary is easy to identify by the presence of insulation. Insulation limits heat flow between the inside and outside.⁵ The location of insulation in relation to other building components is critical to its effectiveness. Even a small section of missing or compressed section of insulation can reduce the effective **R-Value** by as much as 50 percent.⁵

AIR BARRIER

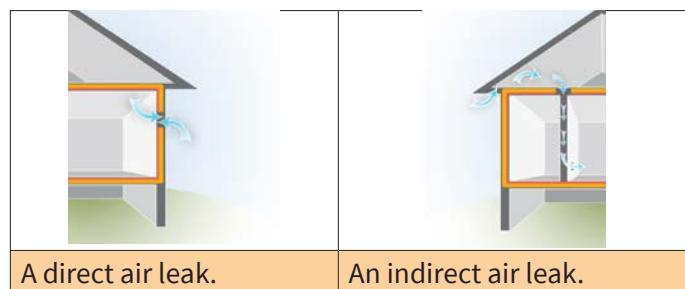
The **air barrier** is more difficult to identify – it limits the airflow between the inside and outside of your home. For example, air cannot pass through a solid wall; but the joint where the wall and ceiling meet could present an opportunity for air to move in and out of the structure. Blower door tests are the best tool to identify and locate breaks in the air barrier.⁵ However, a homeowner can also perform a simple “smoke test” to locate air leaks. (See instructions on the next page.)



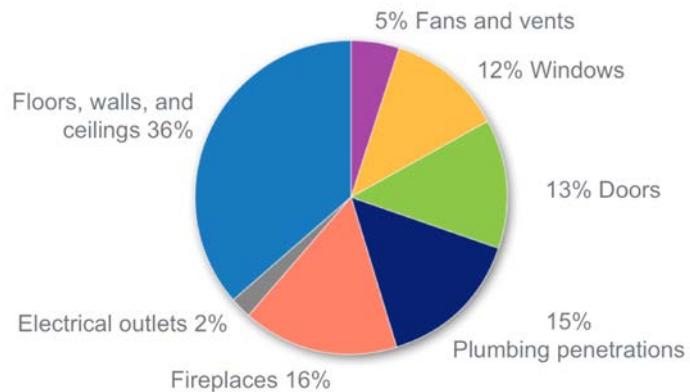
IDENTIFYING BREAKS IN THE THERMAL AND AIR BOUNDARIES

Airflow always takes the path of least resistance.⁵ Just like weather patterns across the country, air in your home typically moves from high- to low-temperature areas.⁵ Air leakage requires a hole or gap, no matter how small, and a pressure difference across that hole⁵. Pressure and temperature differences drive air leakage between

the inside and outside. The driving forces of air leakage are wind, heat (in the form of the “stack effect”), and fans. Direct air leakage “occurs at direct openings to the outdoors. Leakage enters or exits the building envelope directly at this location”.⁵ Indirect air leakage “enters at one location, moves through building cavities, and exits at a different location”.⁵



The following pie chart describes the typical volume of air leakage at specific points in the average home.



“A home energy assessment is the essential first step to lowering your energy bills”.⁷ A home energy audit guide and inspection checklist is included at the end of this chapter to guide you through the necessary first steps of weatherization. Generally, a simple home energy audit involves a diligent walk around and through your home, during which you look at the primary areas where air leaks are common; such as:⁷

- Examine areas where different building materials, such as brick and wood siding, meet. Check foundations, walls and between the chimney and siding.⁷



- Inspect the area around electrical switch plates, outlets, windows and door frames, baseboards, attic hatches, holes for room-sized air-conditioners, mail chutes, and any entrance for electrical, plumbing, cable, or phone line(s).⁷



- Verify that weather stripping and caulking are applied properly and in good condition around doors and windows – especially on the top of window and doorframes.⁷



- Check for air leaks around doors and windows.

DID YOU KNOW:

A simple air leak detection method is to shut a door or window on a piece of paper. If you can remove the paper without tearing it, your home has an air leak.⁷

DIY DEPRESSURIZATION SMOKE TEST

(FOR BEST RESULTS TRY THIS ON A COOL, WINDY DAY.)*

1. Close all exterior doors, windows and fireplace flues.
2. Turn off all combustion appliances, including gas burning furnaces and water heaters. NOTE: if you do not want to turn off your furnace, you can omit step 2 and go to step 3.
3. Turn on all exhaust fans that blow air outside, like bathroom fans or range hoods.
4. Light a smoke or incense stick and pass it around the edges of common leak areas detailed in the picture below. If smoke is drawn into or out of a room, then there is an air leak.
5. Track the smoke until you can identify the likely source of the air leak.

*Adopted from DOE EERE's Guide to Home Energy Assessments FACTSHEET



Air leaks put a heavier burden on heating and cooling equipment, which in turn decreases their efficiency and increases your utility bills. Air leaks can allow moisture into your home that can cause mold or structural damage.⁸ Taking a DIY'er approach to air sealing focuses on obvious spots for air leaks in your home, "such as around door frames and exterior wall penetrations for pipes, vents, electrical fixtures and wires, and around ducts and fans".⁸ However, this approach will not help you identify small, "hard to detect leaks, especially those in attics [...] that may be covered by layers of insulation".⁸

The following diagram illustrates many of the common spots to inspect as you look for air leaks.



Dirty insulation revealed a gap of many square inches. With a hole this size, the attic is open to the home below.⁸



Upon closer inspection, the dirty insulation reveals an air leak at the plumbing chase.⁸

Earlier in this section, we showcased some common areas for air leaks; such as where different building materials meet, around windows, doors, baseboards, on top of attic hatches, and weather stripping. After sealing these easy to spot areas, you can check these other common trouble areas to see if they need attention with additional air sealing and insulation.

- First, check around recessed light fixtures, like lights and fans – fill in any gaps.
- Also, wire pathways in the attic may be positioned so that they compromise the air or thermal boundaries (wires pulled tight across insulation decreases the insulation's effectiveness); re-route wires as necessary to keep the air and thermal boundaries as intact as possible.
- Identify potential areas of air movement and heat loss by inspecting attic insulation for disturbances, dirt, gaps, and uneven distribution such as near the eaves. After sealing suspected air leaks, be sure to back fill with insulation.
- Check chimney and flue penetrations to look for air sealing opportunities. Caulking ages quickly in these areas. Be sure to remove and thoroughly clean out any old caulk. Use **heat resistant caulk** or **heat resistant spray foam** to fill any gaps you identify at penetration points near “hot” ducts.

- **Heat resistant caulk:** a silicon sealant classified for sealing fire-rated service penetrations and construction joints in a wide range of applications where you need a flexible, fire-proof seal.
- **Heat resistant spray foam:** is a polyurethane foam used to seal penetrations between floors and electrical runs through stud wall. The foam is formulated to impede the spread of fire and smoke through service penetrations in residential construction.

In addition to common areas where air and thermal boundaries meet, other construction details can result in gaps in the pressure and thermal barriers, for example:¹⁷

1. Changes in ceiling height
2. Knee-wall attics
3. Walk-up attics
4. Dropped soffits (above cabinets, bathroom vanities, and built ins)

These areas and building features must be carefully scrutinized to ensure continuous air and thermal boundaries.

BEFORE YOU START

Planning is an important part of DIY repairs, particularly in rural areas. If you forget a supply, then you'll waste time and money going to a hardware store for what you need. As a DIY'er, you need to be aware of issues that can affect your health while working in the unit, and your continued health as you live there after air sealing and weatherizing. First, as the worker, you need to protect your health while performing the weatherization repairs. Second, without first performing **health and safety** repairs, the combined effects of weatherization measures in a newly weatherized home can create or worsen health problems. Health and safety repairs are necessary to fix the home so that the occupant – you – will not experience health complications because of the increased air tightness. Health and safety repairs should be corrected before starting any weatherization. Since this section is about preparing for and understanding the effects of your work, let's first focus on health and safety issues that need to be addressed before applying any of the measures in the starter kit. Then we'll describe how to prepare the site and be safe while performing the weatherization.

- **Health and safety**: types of repairs that may impact either the occupant's physical health, such as mold, or safety, such as broken stairs, and must be addressed before any weatherization work..

IDENTIFYING HEALTH & SAFETY CONCERNs

As you perform this initial inspection, you will diagnose pre-existing conditions that must be corrected before beginning to air seal and insulate the thermal envelope. The most important things to look for are: signs of moisture; proper ventilation; evidence of contaminants (like lead paint or asbestos); volatile organic chemicals (VOCs); and combustion appliance safety.

MOISTURE AND VENTILATION

"Moisture problems, or the potential for them, affect the way a home is weatherized."⁹ According to the US Dept. of Energy, "Moisture problems can surface after a home has been weatherized. Air sealing combined with new mechanical interaction on a tighter building shell may exacerbate existing moisture problems."⁹ As a homeowner or resident performing DIY work, you need to assess and give serious consideration to repairing any sources of moisture inside the building before installing any weatherization measures. Why should you be concerned with moisture penetrating your home?

Identify the underlying cause of moisture damage before any weatherization work begins.¹⁰



The simple answer is mold. Mold is an organism that occurs naturally, but requires water to live. Mold can complicate asthma and cause breathing problems to develop. Mold or mildew is an organic substance that will eat almost anything including dust, paper, and carpet, to name only a few. If your home leaks, then you probably have mold. Mold can also occur without a leak, when **relative humidity (RH)** exceeds 50% or if exhaust fans are not properly vented to the outside.

- **Relative humidity** – describes the amount of moisture in the air at a given temperature. Relative humidity (RH) greater than 50% can cause structural damage to homes and encourage mold to grow.



This moisture stain is an indication that the duct for this vent is not venting to the outside.¹¹



This dryer duct, venting directly into the attic space, is causing moisture issues on the roof deck and insulation.¹¹

If you have an improperly vented exhaust fan or are lacking an exhaust fan in the bathroom, mold can grow because of high RH generated from bathing or showering. As a DIY'er, you will need to recognize the signs of water and take appropriate action. Cleaning up and eradicating mold can be quite the task. Most organizations that publish steps and guidelines for the removal of mold do not suggest that untrained workers attempt to remove mold in areas larger than ten square feet (an area roughly three feet by three and a half feet). To remediate mold, see the NYC Dept. of Health and Mental Hygiene's *Guidelines on Assessment and Remediation of Fungi in Indoor Environments*. You can also review the EPA's *Brief Guide to Mold, Moisture and Your Home* and HUD's *Mold Factsheet* for additional information about dealing with mold.

When inspecting, note the location and condition of exhaust vents and fans for both the kitchen hood and bathroom fan(s).¹⁰ Consider the following questions as you survey your ventilation ducts:

1. Do these fans vent directly to the outside?¹⁶ If not, you will need to take steps to vent the fan to the outside. Follow the manufacturer's installation instructions for proper venting.

2. Is it a smooth metal vent pipe? If not, you may need to replace it. Are the seams taped with metal tape?
3. Are there signs of moisture damage around roof **penetrations**? If so, you may need to verify that your **roof flashing** is not damaged or installed incorrectly. Consult with a local roofing contractor to determine next steps.

► **Penetrations:** a hole of any size that connects the exterior and interior through the air and/or thermal barrier.

► **Roof flashing:** metal or some other non-degradeable materials specially shaped to fit over roof penetrations and helps to prevent moisture from entering the building.

CONTAMINANTS

Was your home built before 1978? If so, you might need to worry about airborne contaminants and dust. The two most common contaminants in weatherization and renovation work are lead and asbestos. A study by Oakridge National Laboratory funded by the National Center for Healthy Homes, found that weatherization work can result in high levels of lead dust contamination.¹² The study points to a need for more thorough containment and cleaning after air sealing and weatherizing.



Lead was commonly used as an ingredient in paint until 1978. Aging paint can chip and flake and when it breaks away from the wall, it creates lead dust. According to the US Centers for Disease Control, lead dust has been linked to lower IQ's, learning and behavior problems, hypertension and neurological impairment.¹³ If you are unsure if the paint in your home is lead-based, easy to use, inexpensive test kits are available at your local hardware store that will confirm your suspicions immediately with surprising accuracy. Follow the product's instructions for testing. **Red Feather recommends that if your home tests positive for lead paint, you should consult you consult with a professional before proceeding.** If you chose to complete the repairs on your own, then follow

lead safe weatherization (LSW) practices during repair or repainting to control, contain and clean up lead dust.¹⁴ Search the EPA's **Lead Renovation, Repair, and Painting (Lead RRP)** Program Rule for additional information about safely working with, and containing dust from lead paint in your home. Learn more about lead by checking out the EPA's resources online at: <http://www2.epa.gov/lead>.

► **Lead-safe weatherization (LSW)** – work practices where specific pre- and post- precautions are taken to reduce the risk of spreading lead dust in the home.

► **EPA RRP Rule** – Guidelines published by the US Environmental Protection Agency for working with lead based paint in certain circumstances (such as in a home with children).



Lead paint hazards:

Deteriorated, flaking, or peeling lead paint.
Demolition or renovation exposing lead.



Lead paint surfaces accessible to children.

Asbestos is a mineral that was often used in all sorts of construction products, ranging from ceiling tiles to pipe insulation to spray texture. If your home was built before 1978, then it is likely your home has asbestos in either the insulation or drywall components. Asbestos is mainly hazardous in the dust form, when it can enter your lungs. If you believe asbestos is in your home, use **wet cleaning** techniques to keep dust to a minimum. Avoid disturbing walls or insulation or doing anything that might cause dust. **Red Feather highly recommends seeking professional help if you suspect asbestos was used**

in the construction of your home. Professional help is recommended because of the special equipment needed to protect workers and residents, control the hazard, and reduce airborne dust.

► **Wet cleaning** – a style of cleaning where brooms, mops and rags are damp in order to reduce the possibility of airborne dust.



If you suspect asbestos, contact a licensed inspector to sample and test the material



In addition to special equipment and training to remove, asbestos must be disposed of properly

Another health and safety concern for the DIY weatherization worker is **volatile organic chemicals (VOCs)** that will be used to weatherize your home and are included in your kits (spray foam, for example). These are chemicals that may come in contact with your skin, lungs or eyes and cause anywhere from virtually no irritation to a severe allergic response. Always be aware of potential dangers from construction products, especially those that can cause a chemical reaction with your body. When working with and around VOCs, follow the manufacturer's instructions precisely. Work in a well-ventilated area. If you can smell it, and sometimes even if you can't, use lung protection, such as an **N-95 respirator**. If a sensitive person lives in the home (i.e. someone with asthma

or other breathing related condition) then perform weatherization work when they are not around, to limit their potential exposure and reaction. Allow the space to air out thoroughly before that person returns.

► **Carbon Monoxide (CO)** – an odorless, colorless, poison gas produced by the combustion of fossil fuels.

► **Volatile Organic Chemicals (VOCs)** – include both human made and naturally occurring chemical compounds. Most scents or odors emitted from a household product (furniture, paint, carpet) are VOCs and can be harmful to humans, animals and the environment.

► **Respirator** – a mask worn over the mouth and nose, or whole face that protects from dust, smoke, or other VOC. (Minimum suggested mask: N-95 or similar).



Respirators should meet or exceed the MSDS requirements and be properly fitted per OSHA's standards.

3M paper N-95 facemask with respirator valve

Proper ventilation is the solution to both moisture and CO control with combustion heaters. As a DIY'er, you need to make sure all your exhaust fans function and vent to the outside, not just into the attic or crawl space. Getting your fan to work may be as simple as cleaning the blades of the fan. A common vent to forget to inspect is your dryer vent. When was the last time it was cleaned? Does the vent hose and ductwork connect and terminate outside the structure at a covered, louvered vent? If you live in a mobile home, does the dryer duct go beyond the skirting? Consider all of these ventilation inspection requirements and repairs before beginning to air seal.

FURNACE INSPECTION

"When we air seal and insulate, we change how the house operates".¹⁸ Making the house tighter could make existing problems worse and create new problems.¹⁸ Existing or new furnace problems like gas leaks, carbon monoxide, and back drafting can be lethal to occupants.¹⁸ "Most of the potentially lethal problems involve appliances" like the gas-fired furnace, gas or pellet stoves, wood or coal burning fireplaces or the gas hot water heaters.¹⁸

Red Feather highly recommends that before you begin any weatherization work, hire a trained HVAC technician to inspect all gas or fuel-burning appliances.

COMBUSTION APPLIANCE SAFETY

Next, inspect your combustion appliance and ducts. Unvented or improperly vented combustion heating appliances can generate moisture by increasing RH and **carbon monoxide (CO)** to dangerous levels. Combustion heaters, like kerosene, with improper venting can cause headaches, nausea, and even death. These risks are more likely after taking steps to air seal your home. **Red Feather recommends that a professional HVAC technician inspect your appliance to determine how it is running and if it is properly vented.** If your heating appliance is old or poorly maintained, consider replacing it; there are state and federal programs that offer tax credits and rebates to replace older units with higher efficiency ones. Check your utility provider's website for programs and incentives to reduce the cost of a new appliance. After you improve the air barrier, an improperly vented heater can cause relative humidity levels to increase in your home, which in turn could give mold a foothold.

During an inspection, the chimney, vent pipes, fans, ducts and the heat exchanger will be checked. Deficiencies or damage to wiring will be checked inside the appliance itself. The technician will also perform multiple tests to determine if safety devices are functioning correctly, fuel input rate is appropriate, the amount of combustion air is sufficient, and look for evidence of excessive carbon monoxide. While some of these inspections are visual in nature, specialized tools and engineering formulas play a critical role in figuring the appliance's efficiency and safety.

WORKING SAFE AND PROTECTING YOURSELF WHILE WEATHERIZING

In addition to the health and safety concerns related to your furnace, other conditions exist that could hinder weatherization work. Consider where you'll be working; if your crawl space or basement is wet, then accessing ducts and the floor cavity becomes more difficult. Problems of standing moisture need to be solved before any weatherization work can begin, or else you risk impacting

your own health.¹⁰



A wet crawl space like this can hinder a worker's access to ducts and the floor cavity.¹⁰ Also the resident's health can be impacted because of this amount of bulk moisture.¹¹



Bulk moisture problems like in this basement must be solved before weatherization work can begin.¹¹

As you inspect the attic and crawl space look for electrical hazards that pose a danger to weatherization measures.¹⁰ Be aware of the following electrical concerns:

1. **Knob and tube wiring** – while most reservations do not have building codes, most state and local building codes prohibit insulation over this antique wiring system¹⁰. **Red Feather recommends not placing insulation over this system.**



Photo shows knob and tube and other wiring hazards.

2. Open wire splices are a fire danger. All wire splices must be in an approved **junction box (j-box)** with a cover.¹⁰

3. Uncovered junction boxes are an electrocution and fire hazard. All boxes must have a cover designed for and securely screwed onto the box.¹⁶
4. Frayed wire can cause a short, electrical shock or even a fire.¹⁶ Replace frayed wire with new wire and place the splices in junction boxes.

► **Knob and tube wiring** – an antique type of wiring that if not weatherized properly creates a fire hazard.

► **Junction box (j-box)** – a metal, plastic, or Bakelite™ box where electrical connections are made).

D-I-Y WORKER SAFETY

Everyone deserves a safe work environment. Whether you are an employee working with hazardous chemicals or working with risky materials as a DIY'er, you should know what steps to take in order to protect yourself from hazards that might cause a work-related injury. In this next section, we present ways to protect your personal health with **Personal Protective Equipment (PPE)** for airborne hazards. Then, follow up with some suggestions for electrical and fall safety, and conclude with advice for handling and loading materials safely.

► **Personal Protective Equipment (PPE)** – equipment designed to protect workers from the hazards of work. For example, respirators, gloves, and disposable suits.

Because of the wide range of activities involved in weatherizing a home, Red Feather suggests minimizing your exposure to health risks associated with lead, asbestos, VOCs, or biological contaminants by using appropriate PPE and common sense precautions before starting work.¹⁹ Depending on what part of the house you are going into, such as the attic or crawl space, the selection of proper PPE for the situation is serious business. For example, to work around asbestos, a trained worker would wear a protective, disposable suit taped at all joints – wrists and ankles – employ a positive-pressure respirator, gloves, and heavy (steel toe) work boots. **Red Feather does not recommend that you ever attempt to remediate or remove asbestos. Always contact a professional when dealing with this contaminant.**

Did you know you are more likely to be injured in your home as a result of a fall than any other single type of accident? A fall can happen anytime. A fall doesn't have

to be from very high to be serious. You could be walking down a clean hallway and catch a sneaker on the floor; miss a step on a ladder; or, tumble through the ceiling while crawling around in the attic. When you inspect your attic, be sure to stand or crawl only on the wooden cross members of the **rafters** or **trusses**.¹⁹ The hard surface the insulation sits on may seem sturdy, but it will not support even a child's weight. When you stand on your roof to inspect it from the top, ask someone to hold the ladder when you climb up and down. Wear rubber soles with plenty of grip. Don't go up on the roof if it is wet, icy or snowy. Most of all: BE CAREFUL. Use ladders the way they were designed, never stack ladders on top of each other. Always apply the 4:1 ladder rule that states for every four feet of rise, the base needs to be at least one foot from the wall.¹⁹ Keep the bottom of the ladder free of obstructions and slipping hazards.¹⁹ To reduce the possibility of a trip, take steps to limit clutter around your work area.¹⁹ Put tools away or back in their box.

► **Rafter(s)** – one of a series of sloped structural beams used to support the roof. Rafters can be identified by the presence of a ridge board sandwiched between the right and left sides of the roof.

► **Truss(es)** – one of a series of manufactured structural units that support the roof. Trusses can be identified by the presence of square or rectangular metal attachments at the joints of the truss).

Material Safety Data Sheets (MSDS) describe the potential health risks of working with a specific product, like spray foam. These documents describe the proper use, handling, and storage of virtually every product used in building.¹⁹ Most hardware stores will have MSDS's on all the products they carry, or if not at least show you how to access them online. **Red Feather recommends and uses www.msds.com.**

► **Material Safety Data Sheet (MSDS)** – a report of a product's ingredients, risks, treatments, and other pertinent information related to the use of the product.

Believe it or not, many workers every year are severely hurt and even die because of electric shock. Sources vary, but on average thousands die of electrocution and electric shock every year. Your own toolbox is the source of most of the electrical problems you'll encounter.¹⁹ For example, if you have a frayed or cut cord on a power tool it or cut off the damaged section and install a new plug or receptacle end.¹⁹ Going to be working outside or around water? Then

use a **Ground Fault Circuit Interrupter (GFCI)** plug that can cut the power off to a tool you are using if potentially deadly variations in electrical current occur.¹⁹

► **Ground Fault Current Interrupter (GFCI)** – is a device that protects the user of an electrical tool or appliance from electric shocks and faults.

Some construction materials can be quite heavy. Lifting heavy (over 40 pounds) objects improperly can result in significant back injuries. When lifting, always keep your back straight, place your feet comfortably apart, secure a good grip, bend your knees and lift with your legs,, and keep the object close to your body.²⁰



AIR SEALING THE ENVELOPE

Most homeowners and residents know that properly installed insulation helps keep a home warm in the summer and cool in the winter.⁸ Insulation works by slowing down the transmission of heat through surfaces such as a roof or wall.⁸ But as we learned in the "Your House as a System" section, insulation does not block the flow of air. In a typical house, this is especially true when there are cracks, holes or other penetrations all around the structure.⁸

Insulation is like a sweater, it can keep you warm in the cold air, but it doesn't really block the wind; think of air sealing like a windbreaker.⁸

SITE PREPARATION

Preparing where you will be working before starting to work is just as important as remembering all the supplies and tools necessary to perform the weatherization work. If your work will involve demolition, then the best way to minimize cleanup, reduce the risk of contamination, and prevent property damage is to use disposable plastic barriers in the work area – both inside and outside.¹⁰

"When you work on a job you must contain the work area to prevent the escape of dust and debris. The goal of proper work area setup is to keep dust in the work area and non-workers out".¹⁰ The following is a list of typical materials you might use to protect the work area from contamination and cover the floor:

1. Heavy-duty plastic sheeting. **Red Feather recommends 0.005 mil or thicker plastic.** Normally sold in 5'x100' or 10'x50' rolls.
2. Painter's, masking, or duct tape
3. Stapler – if you don't have a staple gun, then use a desk stapler that opens. This will allow you to staple plastic over doorways.
4. Utility knife or scissors for cutting plastic sheeting.

In addition to covering the ground inside, Red Feather recommends removing all objects (like furniture and toys) from the work area. You should cover all surfaces, windows, doors and all ducts.¹⁰ If you are working outside, cover the ground with plastic 10 feet beyond the work area.¹⁰

To remove old caulking around windows and other penetrations, use a commercial **caulk and adhesive remover** to soften the caulk. After a few hours the silicone will soften and can be removed with a plastic putty knife. Clean the area with rubbing alcohol and wipe dry with a clean rag. Only remove caulking on a clear day when you will be able to replace it and allow enough time for the product to dry.

► **Caulk and adhesive remover** – a chemical that softens caulking and other adhesives so that it can be removed from a surface.

RECOMMENDED TOOLS & MATERIALS

The weatherization measures included in your starter kits do not require any specialized, expensive tools. The following listing names the tools Red Feather recommends and describes how each will be used to install the weatherization measures. In addition to the items needed to prepare the site ,you will want the following tools handy:

- **Adjustable wrench or channel lock.** Used to loosen and tighten the showerhead and aerator. May also be necessary to address other moisture problems, plumbing, and health and safety repairs.
- **Disposable vinyl or nitrile gloves.** Used to protect skin while applying caulking and spray foam. Heavier gloves may be necessary if mold remediation is one of your pre-weatherization, health and safety repairs.
- **Eye protection.** Used to prevent debris from falling or shooting into your eyes while working. Select glasses or goggles depending upon the location, material, and circumstances.
- **Flathead and Philips Screw Drivers.** Specifically included to hand tighten weather stripping on doors. May also be handy for other health and safety repairs.
- **Respirator.** A properly fitted respirator will protect your lungs from airborne hazards; like lead, asbestos, biological, or fiberglass insulation contaminants. See the video "Health & Safety Series: Respirators & Personal Protective Equipment" on www.wxtvonline.org for proper fitment guidelines. **Red Feather recommends a minimum N-95 Respirator, but a more protective filter may be necessary – depending on your unique circumstances.**
- **Pencil or sharpie marker.** For marking measurements on items in order to fit them into the required space.
- **Philips bits (various sizes) for drill.** These drill bits will be used to attach the weather stripping to the door. May also be used for health and safety repairs.
- **Tape measure.** To be able to cut materials to fit openings.
- **Teflon tape.** To seal threads on shower arms and faucets.
- **Utility knife.** Used for cutting plastic, removing old caulking, and various other cutting and scrapping needs associated with weatherization and health and safety repairs.
- **Variable speed drill (corded or cordless).** Used to install weather stripping on doors. May also be used for other weatherization and health and safety repairs.

- **Shop vacuum.** Used to clean up the work area after all work is done. If you are dealing with hazardous chemicals, like lead, you may need a HEPA vacuum.
- **Durable Large Trash bags.** Used to removed debris and left over construction canisters from the work area.
- **Optional: Disposable Suit.** If you will be working around hazardous materials, like lead, biological contamination, asbestos, or any other health hazards, a disposable suit will help to keep contaminants off your clothes and body.
- **Hacksaw.** Used for cutting plastic weather stripping.
- **Finishing Hammer.** Used for setting nails or installing weather stripping.
- **Torpedo Level.** Used for ensuring removable window film is installed level.
- **Staple Gun.** Used to attach plastic film to minimize cleanup.
- **Ladder.** Used to inspect the attic and work in areas out of reach.

DIY WEATHERIZATION STARTER KITS

Red Feather worked with grantors and sponsors to assemble a starter weatherization kit for Native American communities. Measures included in the kit fall into three general categories: air sealing, insulating, and conservation. For each category, this section describes what and why the measure was included and then the basic steps to install the measure.

AIR SEALING

Measure	Why?	How?
FOAM BACKER ROD 	Backer rod creates an even depth and supports the caulk allowing it to form the proper shape.	<ol style="list-style-type: none"> 1. Be sure the joint or opening is clean, dry, frost free, and free of contaminants and loose materials.²¹ 2. Compress the backer rod into the joint before applying caulk.²¹ Use a blunt tool or handle to push the foam to its proper depth. 3. Gently force the backer rod into the joint so the backer rod fits tight against the sides of the joint.²¹
GREAT STUFF™ FOAM (including: Door and Window; Gap and Crack; Large Gap and Crack; and Fireblock) 	Easy to use foam sealant that fills, air seals, and insulates gaps up to one inch. It expands to fill the crack exactly, inside or out.	<p>IMPORTANT: Minimal expansion foam should be used around doors and windows. Be sure to use heat resistant foam at gaps that are exposed to high temperatures.</p> <ol style="list-style-type: none"> 1. Be sure to use proper protective equipment like gloves, goggles and ground cover.²² The work area should be well-ventilated.²² 2. Shake the can well.²² 3. Attach the included dispensing straw and point it at the crack or gap and pull the “trigger.”²² Fill approximately half way as the foam will continue to expand.²² 4. After curing for 12 hours, use a serrated edge to cut off extra foam.²²

ROPE CAULK		Used primarily for sealing joints at windows. Caulk seals out water, air, pollution, insects and noise.	<ol style="list-style-type: none"> 1. The ideal temperature to apply caulk is between 50 and 90 degrees Fahrenheit; fall is the best season to apply.²³ 2. Prepare the surface by cleaning out any old caulking.²³ Allow the area to dry thoroughly before going to the next step.²³ 3. Measure the length of your window, cut the rope caulk to length.²³ 4. Dip the rope caulk into warm water for just a few seconds; this makes the product softer and more workable.²³ 5. Simply press the caulk into the gap or crack and allow it to dry and set.²³
TUBE CAULK		For gaps that are $\frac{1}{4}$ inch or less. Caulk seals out water, air, pollution, insects and noise.	<ol style="list-style-type: none"> 1. Ideal temperature for application is between 50 and 90 degrees Fahrenheit; fall is the best time to apply.²³ 2. Prepare the surface by cleaning out any old caulking.²³ 3. If the gap is wider than $\frac{1}{4}$ inch, then use Foam Backer Rod (instruction above) 4. Apply the caulk/ sealant properly. Cut the nozzle to correspond to the correct bead size for your application.²⁴ 5. Hold the caulking gun at a 45-degree angle parallel to the joint and apply the sealant.²⁴ 6. Work the caulking with your finger (or expired credit card) to ensure proper adhesion and sealing to the surfaces at the joint.²⁴ 7. Allow to dry per the manufacturer's guidelines.²⁴ <p>IMPORTANT: Use heat resistant caulk at gaps that are exposed to high temperatures.</p>
INSULATED OUTLET COVERS		To prevent air leakage at j-box penetration points.	<ol style="list-style-type: none"> 1. Unscrew the plastic cover. 2. Push out the appropriate knock out for your application (switch or receptacle) 3. Lay the foam cover over the switch/ receptacle, being careful to line up the screw holes etc. 4. Replace the plastic cover.
V-WEATHER STRIP FOR DOORS		To prevent air leakage at entry points.	<ol style="list-style-type: none"> 1. Place along the top and sides of the doorframe.²⁵ 2. Using scissors cut the foam to the desired length for the top and two sides.²⁵ 3. Clean all of the surfaces where the tape will stick with rubbing alcohol and allow to dry.²⁵ 4. Peel the backing paper off and stick to the doorjamb frame.²⁵ OR use finishing nails to attach the foam to the frame.²⁵

TRIPLE SEAL DOOR SWEEP	To prevent air leakage at the bottom of doors.	<ol style="list-style-type: none"> Determine if you can use a door sweep in your situation. Look at the threshold of your doorframe. If the floor in the room is higher or even with it, you probably cannot use a door sweep and need to attach weather stripping to the threshold itself.²⁶ Measure the width of your door then buy a door sweep that is at least as big as your door. Cut the sweep down to the appropriate size. Use a hack saw to cut through the metal and a heavy-duty scissors to cut through the vinyl part of the sweep.²⁶ Remove the old door sweep and any other hardware on the bottom of the door.²⁶ Shut and lock the door to ensure that you do not place the sweep in a way that will make it hard to shut or lock the door later.²⁶ Position the door sweep so that the metal strip is lined up with the bottom of the door and the vinyl sweep hangs underneath. Use masking tape to hold it in place.²⁶ Attach the door sweep using the screws that came with it. If none came with it, use 1/4 to 1/2-inch screws that match the color of the sweep.²⁶ Test the door to ensure that it still opens, closes and locks easily. Readjust the sweep if the door does not function properly.²⁶
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CO DETECTOR (BATTERY OPERATED)	To warn residents about harmful levels of CO.	<ol style="list-style-type: none"> Placement is the most critical decision. If you only have one CO detector, place it outside the sleeping areas.²⁷ Do not place the CO detector near combustion appliances. Use the included screw hardware (normally "molly" type screws) to mount the detector on the wall or ceiling.²⁷ Test the detector monthly to ensure it is working properly.²⁷
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INSULATING		
STORM WINDOW – PVC, REUSABLE	Window shrink film seals windows airtight, eliminates condensation, cold drafts and heat loss.	<ol style="list-style-type: none"> Wash glass and frames.²⁸ Caulk gaps around windows.²⁸ Measure the tracking to size and carefully line up and plumb the track.²⁸ Slowly stick onto the window frame. If necessary, use a staple gun or small nails (called brads) to reinforce the tracking.²⁸ Be sure to set the nails to avoid snags on the PVC film. Put up the entire sheet of plastic before cutting it. Use pieces of the locking strips as placeholders.²⁸ Once in place, remove extra film with a utility knife.²⁸ Use a blow-dryer on HIGH heat to shrink the PVC film into place.²⁸ <p>Warning: don't get too close, the hot air from the hair dryer will melt most films.</p>

PIPE WRAP INSULATION		Insulating hot water pipes reduces heat loss and can raise water temperature 2 – 4 degrees at the faucet or shower.	<ol style="list-style-type: none"> Polyethylene Hot Water Pipe Insulation is flexible, 100% pre-slit and easy to install. Simply slip the insulation foam over the hot water pipe that leads out of your hot water heater. A bend in the pipe may require duct tape to hold the foam in shape. Or a ‘v-shaped’ cut to make the bend. Excess foam can be removed with a utility knife.
WATER HEATER BLANKET		If your water heater’s insulation R-value is below R-24 (check the label on the tank) or is warm to the touch,” TO “If your water heater is warm to the touch or its insulation R-value is below R-24 (check the label on the tank).	<ol style="list-style-type: none"> Turn off the water heater.²⁹ For gas heaters, turn the gas valve to the “pilot” position. For electric heaters, turn the breaker at the panel “OFF.” Measure the height of the water heater and cut the blanket to fit, if necessary. Leave the top of the water heater open – do not block the top of the heater on a gas unit.²⁹ Wrap the blanket around the heater and temporarily tape in place. Position the blanket so that the ends do not come together at the access panels.²⁹ Using a marker, mark the areas where controls are so you can cut them out or leave flaps for easy access later. “For gas, you’ll need to mark an arch-shaped hole around the gas valves and burner. Be sure to leave plenty of room around the valve and burner areas below. Make the opening at least 1 inch wider than the valve and burner area. Also, mark the area where the pressure relief valve and pipe are. This will be a pipe that sticks out of the side or top of the water heater.²⁹ Install the blanket.²⁹ Be careful to align the cutouts and tape permanently in place. Turn the water heater back on. Be sure that the temperature does not exceed 120 degree at the tap.²⁹ Adjust the temperature setting accordingly. <p>**Watch the video <i>10 Steps to Energy Efficiency</i> available for free on www.WxTVonline.org for a demonstration on installing a water heater blanket.</p>
BUTYL BACKED FOIL TAPE		Despite its name, duct tape is not for use on ducts. Ductwork should always be sealed with a metal butyl backed tape.	<ol style="list-style-type: none"> Identify seams and joints in combustion, supply and return ductwork where old tape has failed or the screws have fallen out. If a joint is not connected thoroughly, then you may need to use sheet metal screws to re-attach each side of the duct to the joint. Once re-screwed into place, wrap the joint with the Butyl foil tape.

CONSERVATION

SHOWERHEAD (LOW FLOW)



To reduce the amount of hot water used when showering.

Warning: Do not apply too much torque to the shower arm, as you could damage the plumbing in your walls.

1. Remove the old showerhead by turning it by hand counterclockwise – if it doesn't come off, place a rag, tape or towel over the **shower arm** to protect the finish. Use an **adjustable wrench or channel lock** and turn counter clockwise. Use two adjustable wrenches – one to hold the shower arm and the other to turn the old head off.³⁰ The showerhead arm should remain attached in the wall.
2. Remove any old rust, mineral deposits and tape from the threads of the shower arm.³⁰
3. Wrap the threads with Teflon tape in a clockwise direction 2-3 times, break it off the roll and press the tape into the threads of the shower arm.³⁰
4. Screw the new showerhead onto the arm by hand turning it clockwise. When the showerhead stops turning by hand, use the adjustable wrenches to turn the head onto the arm one-quarter turn more.³⁰
5. Check for leaks by turning on the water.³⁰ If the head leaks, then carefully tighten it up to one-quarter turn more. If the leak persists, then take it off and add more Teflon tape.
6. If at any time you feel extra pressure on the arm, back off the showerhead and apply more Teflon tape.³⁰ Repeat the installation steps.

► **Shower arm:** the short, usually angled pipe that connects the showerhead to the water supply in the wall.

► **Adjustable wrench or channel lock:** pliers with an adjustable undercut tongue and groove design that eliminates jaw slipping. Most useful for plumbing applications.

<h3>AERATOR (LOW FLOW)</h3> 	<p>To reduce the amount of water used at the sink.</p>	<ol style="list-style-type: none"> 1. Remove the old aerator (if there is one) by hand by unscrewing it counterclockwise.³¹ If the aerator is difficult to remove, place tape or a rag over it and use an adjustable wrench or channel lock pliers to loosen it – once loose, remove by hand by unscrewing it smoothly and steadily to avoid damaging the threads. 2. To reinstall, apply a single wrap clockwise of Teflon tape around the threads of the aerator. Place the rubber washer inside the aerator and screw the new aerator onto the faucet by hand.³¹ 3. Run the water to test for leaks; if it leaks out the side try tightening more by hand. If that does not stop the leak, use the rag and adjustable wrench trick to turn the aerator no more than ½ a turn – this should stop any leaking.³¹ <div style="border: 2px dashed orange; padding: 5px; margin-top: 10px;"> <p>► Aerator: a small round apparatus that exposes water coming from the tap to air in order to regulate the force of the water.</p> </div>
<h3>ALL WEATHER REPAIR TAPE</h3> 	<p>To temporarily repair broken glass or attach items together</p>	<ol style="list-style-type: none"> 1. Multi-purpose. 2. Clear and strong. 3. Can be used both indoors and out.

WEATHERIZATION VOCABULARY

Air barrier/ boundary – an attached membrane or other weatherization measure that reduces or eliminates air movement into and out of a building

Air pressure – the weight of the air as it pushed by the wind

Savings-to-investment ratio (SIR) – a calculation to determine if the projected savings of installing a measure meets or exceeds the cost of that measure

Weatherization measure or measures – any repair that improves the air or thermal boundary of a home

Thermal barrier/ boundary – restricts or slows the loss/gain of heat in a building

Penetration – any hole in the exterior of the building

Flashing – specially shaped metal pieces that interlock with the roof components to keep moisture out of the home

Relative humidity (RH) – describes the amount of moisture in the air at a given temperature. Relative humidity greater than 50% can cause structural damage to homes and encourage mold to grow

Air seal – applying weatherization measures to improve and protect the air boundary of a building

Insulation – a light, non-heat conductive material designed to keep warmth where it belongs

Personal Protective Equipment (PPE) – equipment designed to protect workers from the hazards of work. For example, respirators, gloves, and disposable suits

Ground Fault Current Interrupter (GFCI) – is a device that protects the user of an electrical tool or appliance from electric shocks and faults

Material Safety Data Sheet (MSDS) – a report of a product's ingredients, risks, treatments, and other pertinent information related to the use of the product

Volatile Organic Chemicals (VOCs) – include both human made and naturally occurring chemical compounds. Most scents or odors emitted from a household product (furniture, paint, carpet) are VOCs and can be harmful to humans, animals and the environment

Respirator – a mask worn over the mouth and nose, or whole face, that protects from dust, smoke, or other VOC. (Minimum suggested mask: N-95 or similar)

Junction box (j-box) – a metal, plastic, or Bakelite™ box where electrical connections are made

Splice – a connection between two wires; splices should always be made in an approved junction box (j-box)

Shower arm – the short, usually angled pipe that connects the showerhead to the water supply in the wall

Aerator – a small round apparatus that exposes water coming from the tap to air in order to regulate the force of the water

Caulk – a silicone, latex or fire resistant gel-like material used to seal cracks less than 1/8" in width. Use the correct type of caulk for the application

Insulating Foam – a chemical compound used to seal cracks larger than 1/8" in width. Use the correct foam compound for the application.

Lead-safe weatherization (LSW) – work practices where specific pre- and post- precautions are taken to reduce the risk of spreading lead dust in the home

EPA RRP Rule – Guidelines published by the US Environmental Protection Agency for working with lead based paint in certain circumstances (such as in a home with children)

Health and Safety – basic repairs that must be completed to ensure the occupants' health and safety during and after the installation of weatherization measures

Knob and tube wiring – an antique type of wiring that if not weatherized properly creates a fire hazard

Joint – any point where two building materials come together. Can also be where two or more planes come together; for example, the 90° angle where a wall and ceiling meet

Blower door – a testing technique designed to identify air leaks in the pressure boundary of a home

Thermal envelope – the shell of a building that prevents unwanted heat transfer between the inside and outside of the home due to changes in exterior temperature and air pressure.

R-value – a measure of thermal resistance used when building homes

Wet cleaning – a style of cleaning where brooms, mops and rags are damp in order to reduce the possibility of airborne dust

Carbon Monoxide (CO) – an odorless, colorless, poison gas produced by the combustion of fossil fuels

Rafter(s) – one of a series of sloped structural beams used to support the roof. Rafters can be identified by the presence of a ridge board sandwiched between the right and left sides of the roof

Truss(es) – one of a series of manufactured structural units that support the roof. Trusses can be identified by the presence of square or rectangular metal attachments at the joints of the truss

Heat resistant caulk – a silicon sealant classified for sealing fire-rated service penetrations and construction joints in a wide range of applications where you need a flexible, fire-proof seal.

Heat resistant spray foam – is a polyurethane foam used to seal penetrations between floors and electrical runs through stud wall. The foam is formulated to impede the spread of fire and smoke through service penetrations in residential construction.

Health and safety – types of repairs that may impact either the occupant's physical health, such as mold, or safety, such as broken stairs, and must be addressed before any weatherization work.

Adjustable wrench or channel lock – pliers with an adjustable undercut tongue and groove design that eliminates jaw slipping. Most useful for plumbing applications.

Penetrations: – a hole of any size that connects the exterior and interior through the air and/or thermal barrier.

Roof flashing – metal or some other non-degradeable materials specially shaped to fit over roof penetrations and helps to prevent moisture from entering the building.

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