



HERS Rating Field Guide for Auditors
SPRING 2019 VERSION

Submitted to:
Northwest Energy Efficiency Alliance

Submitted by:
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1 Introduction

1.1 Purpose and Organization of Manual

This manual is meant to provide both explicit instruction and general guidance to NMR auditors when conducting HERS ratings and similar residential on-site energy audits. This document will be provided to all NMR auditors and, in conjunction with the NEHERS Training & Reference Manual used to achieve HERS certification, will be used as the main reference material for NMR auditors.

The manual covers many aspects of conducting audits, including preparation for site visits, diagnostic protocols, and safety and customer service issues. The guide assumes that auditors already have a high level of building science knowledge, as it is designed for NMR's certified HERS raters. Accordingly, this manual does not focus on every detail of how to conduct a HERS rating, but includes NMR-specific guidance on protocols based on the firm's experience with conducting field work.

1.2 Priorities: Safety, Customer Service, and Quality Data

Our three main priorities when conducting fieldwork are safety, customer service, and quality data collection. NMR strives to meet the highest standards in our work, and we pride ourselves on superior data collection practices based on thorough building science knowledge and extensive fieldwork experience.

Figure 1-1 illustrates the priority of these principles. Safety is the number one priority, followed by superior customer service, and then quality data collection. Our ultimate goal is obtaining quality data for our research studies, but that cannot be accomplished in the short or long term without ensuring the safety of our employees and customers and meeting our customers' expectations by treating them courteously and respectfully. Specific guidance on safety protocols can be found in Section 4.

Figure 1-1: Pyramid of Priorities



2 Pre-Site Visit Preparation

NMR auditors practice thorough data collection practices that require many pieces of equipment. This section includes lists of items to bring to all site visits.

2.1 Items to Bring to On-Sites

2.1.1 Materials for the Customer

- Background information sheet on study (Appendix A.1)
- Incentive receipt form (Appendix A.3)
- Money or incentive checks
- NMR business cards

2.1.2 General Supplies

- AA and AAA batteries (carton of each)
- Appointment list (printed) with customers?:
 - names
 - addresses
 - phone numbers
 - day/time of on-site
- Car charger for electronics
- Cell phone
- Clipboard
- GPS with charger
- Hotel reservation
- ID badge (project-specific)
- On-site handbook
- Pens/pencils
- Shirt with NMR logo
- Vehicle with full gas tank

Auditor Tip:

- Do not remove shared tools from vehicles being used for on-sites!
- Replace any depleted supplies that the next auditor will need.
- Refuel vehicles after site visits.

2.1.3 Cleanliness items

- Broom
- CFL cleanup kit
 - Sealable and sturdy plastic bags
 - Disposable wipes
 - Vacuum
 - Duct tape
 - Flat brush
 - Paper bags
- Drop cloth
- Shoe covers (large supply; at least 2 pairs per home)
- Rags

2.1.4 Personal Protective Equipment (PPE)

- Gloves
- Eye protection
- First aid kit
- Hard hat/helmet
- Outer garments
 - Long-sleeves and pants
- Respirator
 - With additional HEPA filters
- Shoes or boots
 - Sturdy, with closed toe
- If taking electrical measurements:
 - Rated electrical gloves
 - Helmet with arc-resistant face shield
 - Arc-resistant jacket

2.1.5 Tools

- Camera (digital)
- Drill with:
 - Assorted screw bits
 - Sheet metal bit
 - Charger
- Flashlight
- IR camera
- Knife
- Ladder
- Laptop
- Ratchet/socket set
- Screwdrivers
 - Philips and flat
- Stepstool
- Tape
 - Duct tape
 - Wide masking tape
 - Silver metal duct tape
- Tape measures
 - Standard
 - Laser
 - Long real estate tape/wheel
- Thermometer (digital)
- Tool bag
- Utility belt (optional, but recommended)
- Wood BBQ skewers (with notched/barbed ends)



2.1.6 Blower Door Equipment

- Fan with cover
- Power cord
- Frame bag
- Red door frame cover
- Medium-sized bag with:
 - Manometer (pressure measurement gauge)
 - Extra hoses with extra connectors
 - A, B, and C flow rings

2.1.7 Duct Blaster Equipment

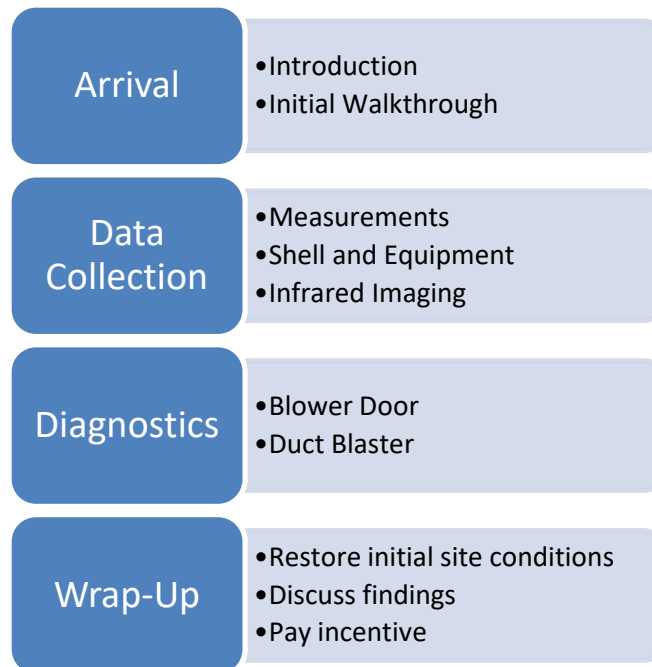
- Duffel bag with:
 - Fan
 - Power cord
 - Silver flex duct
 - Black plastic transition piece (collar that attaches to end of silver flex duct)
 - Nos. 1, 2, and 3 flow rings
 - Manometer (pressure measurement gauge)
 - Duct mask (at least 2 rolls per car)
- Broom (with long handle for applying duct mask to hard-to-reach registers)

3 On-Site Protocols

3.1 Overview and Phases of On-Site Visit

This guide is not meant to provide a comprehensive, step-by-step guide for every aspect of conducting HERS ratings. Before conducting audits, NMR auditors will already possess a high level of building science knowledge, as they will have been previously trained through HERS certification classes and their fellow NMR auditors. This guide is meant to supplement this knowledge and provide protocols and guidance specific to NMR's field work practices. Excellent customer service is critical to all onsite visits, as described in Section 5, and should be practiced throughout the visit.

The phases of an on-site visit are:



The remainder of this section provides guidance for each of these phases.

3.2 Arrival at On-site

Arrive on time. Call the customer if you are going to be late, and politely explain your delay.

When the customer answers the front door, make sure you do all of the following tasks:

- Introduce yourself and any other auditors with you
- Hand them your business card(s)
- Show your ID badge
- Ascertain that the person at the door is the scheduled interviewee and expecting you
 - Mention the name of the NMR scheduler they likely talked to on the phone
- Ask to come in
- Offer them the background sheet on the study, and explain the study briefly
- Clarify the distinction between NMR (a contractor) and the client
 - Do not represent yourself as an employee of the client
- Describe the incentive being offered
- Describe how long the audit will take
- Describe what the audit entails, including:
 - Data collection (measurements, shell and equipment info, etc.)
 - Diagnostic tests
- Ask about the presence of any pets or children to watch for
- Mention that collected information is confidential/anonymous

3.2.1 Sample Introduction

The following is not to be read verbatim, but is an example of the information that an auditor would want to relay to a customer in their initial conversation. Some auditors may provide some of the information discussed in this sample introduction while they are conducting the initial walkthrough of the home.

*Hello, my name is _____, and I work for NMR. NMR is working under contract with [CLIENT]. I'm here to meet with _____. I believe you talked to [name of NMR SCHEDULER] on the phone about us conducting an energy audit of your home today. **[Customer should be expecting you].** May I/we come in?*

You probably received this document in the mail, describing the study we're doing. [Offer them the background information flyer.] Our company was hired by [CLIENT] to conduct research on the energy efficiency of homes, and that involves sending people out into the field to gather concrete information on how homes are actually built.

We're offering ___ dollars today to thank you for participating in the audit, so when we're finished, we can give you the [CASH or CHECK] right away.

Our basic goal is to collect as much information as possible about how your house is physically constructed. We spend time inside and outside the house, and measure the windows, walls, the size of the house. We also look at all the insulation in the basement, walls, and attic, and record information on the appliances and mechanical equipment in the house. It takes us roughly ___ hours, depending on the house. I'll be doing the measurements I mentioned, so I'll be coming in and out, and spending a fair amount of time in the basement recording information.

[AUDITORS SHOULD ALSO DESCRIBE THE DIAGNOSTIC TESTS. IF THERE ARE TWO AUDITORS, THE AUDITOR WHO WILL DO THOSE TESTS MIGHT WANT TO EXPLAIN THE FOLLOWING WHILE THE FIRST AUDITOR STARTS BRINGING IN SUPPLIES.] While my colleague is taking those measurements, I will be performing some diagnostic tests on the house. I will set up a large fan in the front door, and it will test the envelope of home. This test pressurizes the home and makes it easier to measure any air leaks. I will also use smaller fan to blow air into your duct system to measure how the air moves through your ductwork. We'll need to turn off your heating and hot water systems, and close and open some windows during that process, but we'll let you know when we're doing any of that, and we'll make sure that, before we leave, everything is turned back on the way we found it. Do you have any pets we should watch for when running these tests?

We are visiting ___ randomly selected homes across the state. Any data we collect during the audit will be confidential. For our report, information related to your home will be aggregated with all of the other homes visited as part of the study.

Do you have any questions regarding our visit?

3.2.2 Initial Walkthrough

After introducing yourself and describing the work you will be doing, ask to conduct an initial walkthrough with the homeowner. This presents an opportunity to:

- Identify safety hazards
- Identify inaccessible areas
- Gather preliminary information about the home, including the layout, shell, and location of mechanical equipment
- Estimate how long the audit will take
- Provide more details about what you will be doing in the home
- Answer questions

3.3 Data Collection

After conducting the walkthrough, you can get started collecting data. The following section discusses some of the general guidance NMR has developed over its years of conducting fieldwork, but it is not meant to be an exhaustive guide. NMR auditors follow HERS rating protocols. This section offers selected NMR-specific guidance and tips that NMR auditors have found helpful in conducting HERS ratings. HERS standards combined with individual project-specific guidance will provide more detailed instructions on recording information about mechanical equipment.

3.3.1 Drawing Floor Plans

Auditors should draw floor plans of all audited homes, identifying windows and doors. There should be one floor plan for each floor. Some auditors prefer to do this on paper, while others prefer electronic drawing tools, but clarity and detail are necessary in either case. Draw large enough to allow for notes, such as indicating where some assemblies may differ from others. Some auditors who use paper have had good experiences working with graph paper and drawing buildings to scale.

3.3.2 Selected Building Components

3.3.2.1 Basements

There are many “gray areas” when it comes to basements. Some may be clearly unconditioned or conditioned according to HERS standards, but many fall somewhere in between. NMR has developed clear guidance on how it approaches the diagnostic testing of basements for fieldwork studies, as described in the decision tree shown in Figure 3-4. NMR’s general standard is to test semi-conditioned basements—or any basement in which the thermal boundary line is unclear—once as conditioned and then again as unconditioned, so we have both sets of data for analysis purposes.

How we model basements in REM/Rate may depend on the specific project, because some clients may have particular reasons to prefer modeling the semi-conditioned basements in one way or another. Project managers will provide project-specific guidance on REM/Rate modeling regarding how to deal with semi-conditioned basements.

3.3.2.2 I-Joists

I-joists are engineered wooden I-beams that may be used instead of conventional framing (2x8, 2x10, etc.) in floor and roof joist applications. These are common in newer homes.

- In our data collection forms, specify the presence of I-joists, as distinct from conventional “two-by” framing.
- For REM/Rate: Treat as normal framing—i.e., an 8” I-joist would be a 2x8.

- Note that insulated I-joist frame floor assemblies often have insulation that settles to rest on the lower flange of the joist, creating an air-gap between the insulation and floor above. Look for this when determining the insulation's grade.

Figure 3-1: Wood I-Joists



Source: LP Building Products (http://lpcorp.com/au/i_joists/i_joists.html)

3.3.2.3 Insulation: Steps for Identifying Wall Insulation and Stud Depth

In existing homes, identifying the type and amount of insulation in walls can be difficult. Following is a brief description of the recommended methods for identifying wall insulation and stud depth in residential applications.

- 1) If drilling a hole in walls is not permitted (this will vary from project to project), remove an outlet plate from one of the outlets on the wall in question.
- 2) Notch a wooden barbecue skewer to create barbs on the end to serve as a probing device.
 - a. A thin plastic crochet needle with a hook on the end works well if the probing opening is sufficiently large to accommodate it.
- 3) Slide the probe into the gap between the outlet box and the surrounding sheetrock to determine the stud depth of the wall. The outlet box itself is usually plastic, and even if there appears to be no space between the box and the surrounding plaster, the side of the box will usually flex inward enough to allow you to fit a skewer into this small gap. Sometimes there is plenty of space to insert the skewer into this gap, but sometimes plaster fully covers this space, leaving no room for a skewer. If there is absolutely no space for a skewer to fit, find a different outlet to probe.
- 4) Probe to determine the presence or lack of insulation. *Always err on the side of caution so as not to damage the sheetrock, paint, or wiring in the home.*
 - a. If insulation is present, use the skewer to aid in determining what type of insulation is present. The barbed or hooked skewer can be used to pull out a small sample of insulation.
 - i. If the insulation type is a fiberglass batt with a kraft facing, then the auditor may feel the skewer pierce the kraft facing.
 - ii. If the insulation type is a fiberglass batt with no kraft facing, then the skewer should penetrate the insulation relatively easily, but there will be enough resistance that the auditor will recognize the presence of insulation. Fiberglass and other compressible materials are typically recognizable by a springy feeling, much like that of pushing into pillow stuffing.
 - iii. If the insulation type is open cell spray foam, then the skewer will penetrate the insulation, but the resistance will be greater than that of a fiberglass batt. A key way to determine the difference between open cell foam and a compressible material like fiberglass batts, cellulose, or rock wool is that the compressible materials typically will feel springy against the pressure of the skewer even after repeated probing, whereas with foam, the rater will feel a consistent resistance against the skewer as it fully penetrates the foam, and the foam will *not* spring back into place, but will leave an open cavity behind, much like sticking a skewer through a soft foam packing peanut.
 - iv. If the insulation type is closed cell spray foam, then the skewer will barely, if at all, penetrate the insulation. This material is typically very hard and difficult to pierce with a skewer.

- v. If the insulation is a blown-in product (fiberglass or cellulose), the resistance may feel similar to that of a fiberglass batt. If it is a blown-in material, small pieces will typically fall out of the wall around the outlet box during probing. The resistance will feel much greater if the cellulose is dense-packed. Use the barbed probe to attempt to pull out some insulation to confirm.
 - b. Use a flashlight to help determine the type of insulation. The auditors may be able to bend the outlet box (if it is plastic) to help see the insulation.
- 5) Other areas of the home, such as the basement, may help the auditors determine the type and R-value of insulation installed in the walls.
- a. Basements often have visible stud walls that are insulated.
 - b. Rim joists in the basement are often visible and may be insulated by the same materials found in the exterior walls, but this is not necessarily the case, and it is important to check.
 - c. Rim joist areas, particularly in balloon-framed homes or around pipe and wiring penetration points, may provide a space for auditors to see up into wall cavities to identify insulation.
- 6) Repeat these steps for all walls that are part of the thermal boundary. Pay particular attention to kneewalls and walls and floors between the house and garage, as builders sometimes use a different stud type in these locations. For example, builders using 2x6 framing for outer walls may use 2x4 framing for kneewalls or walls separating the house from a buffer space like a garage.
- a. For kneewalls, look for hatches that provide access to the unconditioned kneewall crawl spaces, where insulation may be directly visible. This is important because inserting a probe into a kneewall to test for insulation thickness is not effective if the insulation is not enclosed on the attic side.
 - b. For frame floors over garages, the insulation is typically accessible only from the garage side via small holes or openings in the sheetrock in the garage ceiling. Identifying the type of insulation in this case may be possible, though identifying the thickness is more difficult, as the insulation will have settled to the bottom of the cavity, possibly with an air gap at the top of the assembly.

3.3.2.4 Insulation: Default R-Values and Grades

Insulation R-Values. Auditors record the nominal R-value of insulation whenever possible unless the insulation is significantly degraded, in which case auditors would record both the nominal and effective R-value. If the insulation in a home is not labeled with its nominal value, auditors should use the default R-values provided in Table 3-1. For any other materials not included in this table, use the default values found in the REM/Rate “Insulating Materials” help file.

Table 3-1: Default Insulation R-Values

Insulation Material	R-Value/Inch
Fiberglass batts	3.1 (normal)
	3.7 (high density)
New blown-in fiberglass	2.5 (open attics)
	3.1 (enclosed cavities)
Older blown-in fiberglass or rock wool	1.8
Vermiculite (loose fill)	2.2
Cellulose (loose fill, open blown)	3.7
Cellulose (dense pack, spray or cavity fill)	3.5
Polyisocyanurate (foil-faced rigid foam)	6.0
Closed cell spray foam (high density)	6.0
Open cell spray foam (low density)	3.6
Extruded rigid foam (XPS: blue, green, or pink)	5.0
Expanded rigid foam (EPS: white “bead” board)	4.0

Insulation Grades. Auditors should use other areas of the house to estimate the grade for unobservable areas, employing their best judgment. HERS standards require that assemblies that cannot be viewed should be given an insulation grade of III (the worst grade), but for well-constructed homes, we generally assume Grade II for these wall assemblies based on our judgment of the installation quality elsewhere in the home.

3.3.2.5 Windows

Window Size. Window area is the area of the rough opening, not just the visible frame dimensions. If desired, you can use these rules of thumb (from NMR's HERS provider) to measure the visible frame and speed up measurement:

- Wood frame windows: add 2" to visible frame width and 3" to height
- Vinyl or Fiberglass: add 1" to visible frame width, 2" to height
- Metal: usually do not need to add anything

Window U-Values. Record model numbers to look up rated U-values on the National Fenestration Rating Council's (NFRC) certified products directory: <http://search.nfrc.org/search/searchDefault.aspx>. If auditors are not able to find model-specific U-values on a window, they may use REM/Rate default U-values for that given window type. Any single-pane windows with a storm window or any double-pane non-lo-e window should be modeled with a U-value of 0.50, absent client objections.

3.3.2.6 Doors

In the absence of a rated U- or R-value on a door, auditors should use the following default R-values. Doors comprise a relatively small amount of a home's shell, and using the following values are sufficiently precise.

Table 3-2: Default Door R-Values

Insulation Material	R-Value
1-3/4" insulated steel door	4.4
2-1/4" solid core wood door	2.8
1-3/4" solid core wood door	2.1
1-3/8" solid core wood door	1.7
1-3/8" hollow core wood door	1.3
1-3/4" wood panel wood door	1.3
1-3/8" wood panel wood door	0.9
Fiberglass insulated door	5.0

3.3.2.7 Heating, Cooling, and Water Heating

In the field, auditors should take photos of all mechanical equipment and their specification labels. Auditors should be sure that these photos clearly capture the following information, whenever possible:

- Make
- Model number
- Serial number
- Energy input
- Energy output/capacity
- Efficiency, if present
- EnergyGuide label, if present
- Date of manufacture, if present

Once back in the office, confirm the equipment's capacity and efficiency data via the following online databases, in this order of preference:

- 1) Air Conditioning, Heating, and Refrigeration (AHRI) Directory of Certified Product Performance: <https://www.ahridirectory.org/ahridirectory/pages/home.aspx>
- 2) Manufacturer's website or documentation
- 3) Call or email manufacturer (they are usually quite helpful)
- 4) NMR's 2012 Vermont SFH database (includes data for selected old HVAC systems based on old GAMA manuals): available on NMR's Sharepoint site.

If the date of manufacture is not printed on the unit, use the following online lookup tools to determine the system's age using the system's model and serial numbers. It is important to verify ages because occupants' self-reports on system age may not be reliable.

- Building Intelligence Center
 - <http://www.buildingcenter.org/content/hvac-production-dateage>
- Appliance 411
 - <http://www.appliance411.com/service/date-code.php>.
 - This is for appliances, but includes room air conditioners.

NMR auditors may use age-based default values provided in HERS manuals in the absence of other model information.

3.3.2.7.1 Room Air Conditioners

Model all room air conditioners (RACs) in REM/Rate.

RACs usually have their specifications printed on a label on the side of the unit. In some cases, the label may be located inside the unit, behind the directional air flow grill. If the unit or label is inaccessible or illegible, default capacities and efficiencies from Table 3-3 may be used.

Table 3-3: Default Room AC Size and Efficiency

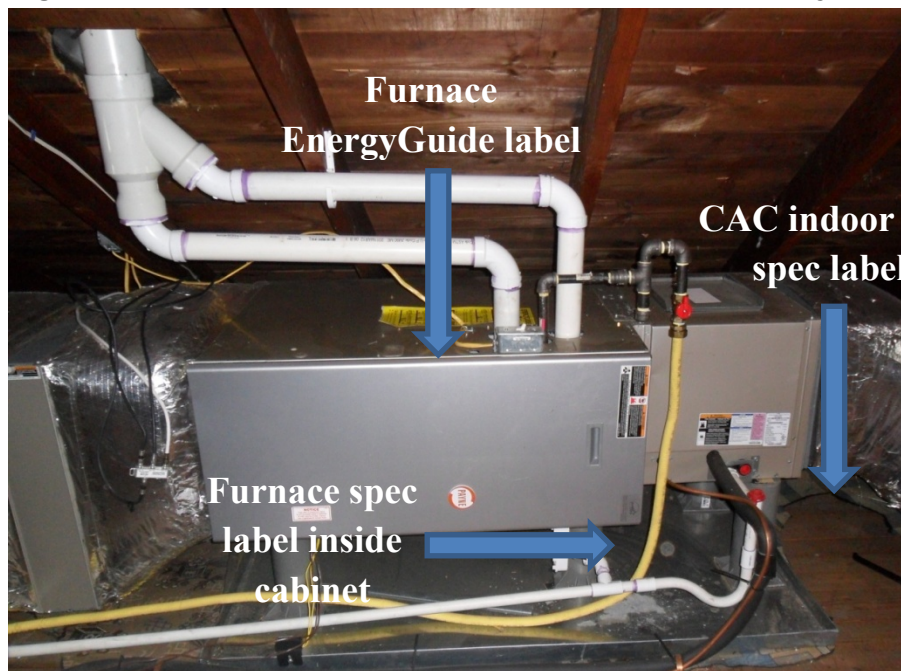
RAC Unit Size	Capacity (BTU)	EER
Small	5,000	9.7
Medium	10,000	9.7
Large	15,000	9.7

3.3.2.7.2 HVAC

The specification labels for most heating systems can be found on the outside of the unit, but in some instances—particularly furnaces—this information may be printed inside the blower cabinet.

Central AC units have indoor and outdoor units, and auditors should photograph the specification labels on both units, as the pairing determines the efficiency and capacity of the cooling system. The specification label for the outside unit will typically be on the back of the outdoor unit. As shown in Figure 3-2, the label for the indoor AC coil is often located near the top of the air handler cabinet and is separate from the label for the furnace component of the HVAC system.

Figure 3-2: Furnace and CAC Specification Labels (Attic System)



3.3.2.7.3 Electric Baseboard and Electric In-Wall Heaters

Record the number, length, and output of electric baseboard heating units. Electric baseboard heating units typically have their wattage printed on a metal label on the lower part of the front of the unit, either on the left or right side. It may only be visible from floor level (and is often dirty).

Figure 3-3: Where to Find Output Info for Electric Baseboard



If that label is missing or illegible (labels have often been painted over), auditors may estimate the output of these units as follows:

Table 3-4: Electric Baseboard Heat Output

Baseboard Length (inches)	Watts	BTUh (3.41*Watts)
24	350	1,194
30	500	1,705
36	750	2,558
48	1,000	3,410
72	1,500	5,115
Other lengths longer than 3 feet	250 Watts/ft.	3.41*Watts

You may also encounter in-wall electric heaters (often rectangular units located in bathrooms). If you can't find any information on the unit itself, chose one of the above values that seems most size appropriate, or use the size of the room to estimate the wattage of the heater:

Table 3-5: Approximate Electric Baseboard Heat Output Based on Room Size

Room Size	Watts	BTUh (3.41*Watts)
Small (about 150 sq ft.)	1,500	5,118
Medium (150-300 sq. ft.)	2,000	6,824
Large (300+ sq. ft.)	3,000	10,236

3.3.2.7.4 Fireplaces/Stoves

Be advised that some clients may ask us to treat fireplaces and stoves differently than suggested in the HERS standards, either to account for or discount occupant behavior. Absent any direction otherwise, our standard approach for handling fireplaces and stoves includes the following:

- **In the field:** Take photos of the fireplace or stove, including any stickers/labels on the unit that contain information about the unit's make, model number, serial number, date of

manufacture, and capacity. (For free-standing stoves, this information is often printed on a metal label on the back of the unit.)

- **In REM/Rate:**
 - DO model all gas fireplaces/stoves and space heaters (including wall-mounted ductless furnaces).
 - Use the % load verified onsite, and manually enter that into REM/Rate.
 - In the absence of legible labels, use the following size and efficiency defaults:

Table 3-6: Default Gas Fireplace and Insert Size and Efficiency

Unit Size	Capacity (BTUh)	Efficiency
Small	20,000	56%
Medium	30,000	56%
Large	40,000	56%

- DO NOT model any portable space heaters or wood-burning fireplaces.
- DO model wood-burning stoves if they are a significant heat source.
 - For wood stoves, consult *Table 303.8.1(2) Default Solid Fuel Combustion Seasonal Efficiencies for Space* of the RESNET Standards for efficiency assumptions. It refers you to the EPA's listing of certified wood stoves. The link in the standards is incorrect. The correct listing is here: <http://www.epa.gov/compliance/resources/publications/monitoring/caa/woodstoves/certifiedwood.pdf>

3.3.2.7.5 Tankless Coil Domestic Hot Water

When auditors find boilers with internal tankless coils providing the domestic hot water, they should use Table 3-7 to determine the energy factor of that DHW system. These defaults should be used for all internal tankless coil DHW systems.

Table 3-7: Default Energy Factor of Tankless Coil DHW

Occupants (Bedrooms + 1)	EF
3	0.45
4	0.50
5	0.55
6	0.60
7	0.65

3.3.2.8 Appliances

Like with mechanical equipment, auditors should take photos of all relevant appliances and their specification labels. Most appliances tend to have only one relevant specification label, which

simplifies the process, though some may have an EnergyGuide label as well. Auditors should be sure that these photos clearly capture the appliance’s specification label, including the following information whenever possible:

- Make
- Model number
- Serial number
- Size (refrigerators and freezers only)
- Date of manufacture, if present
- EnergyGuide label, if present

Look for the specification label for appliances in the following common locations:

Table 3-8: Common Locations for Appliance Spec Labels

Appliance	Location
Refrigerator	Interior side wall
Freezer	Interior side wall
Dishwasher	Inside, on rim or side of door
Range/oven	N/A: looking for convection fan and heating type only
Washer or dryer	Top load: beneath lid, on tub rim; Front load: on rim of tub or side of door

Determining the energy consumption or other necessary pieces of appliance-related information usually involves checking multiple databases, as there are gaps in some of these databases, and not every database contains every piece of needed information on a given appliance—for example, some might have efficiency, but not size.

Use the following electronic resources, in this order of preference:

- 1) NMR’s ENERGY STAR/California Energy Commission combined database, available on Sharepoint
- 2) Tie between:
 - ENERGY STAR product finder databases: <http://www.energystar.gov/productfinder/>
 - California Energy Commission appliance databases:
 - For newer products: <http://www.appliances.energy.ca.gov/AdvancedSearch.aspx>
 - For older products: http://www.energy.ca.gov/appliances/database/historical_excel_files/
- 3) ENERGY STAR Refrigerator Retirement Savings Calculator, for refrigerators and freezers: <http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator&>
- 4) Kouba-Cavallo database, for refrigerators and freezers: <http://www.kouba-cavallo.com/refmods.htm>

If the date of manufacture is not printed on the unit's label, use the following online lookup tool to determine the unit's age using the model and serial numbers. It is important to verify ages because occupants' self-reports on system age may not be reliable.

- Appliance 411: <http://www.appliance411.com/service/date-code.php>.

3.3.2.9 Infrared Imaging

Some projects involve using NMR's infrared (IR) cameras to obtain photos of good and performing areas in homes. These cameras can be useful to show hidden problem areas in homes and can help auditors more accurately describe an existing home's insulation.

If a project involves IR imaging, auditors should:

- Take photos of good and poor performance
- Take interior and exterior photos
- Take photos during blower door test to try and capture air leakage on the camera
- Good photo opportunities include:
 - Exterior walls (settling of insulation or missing insulation)
 - Attic and/or vaulted ceiling insulation
 - Attic hatches
 - Conditioned to garage walls (are they insulated?)
 - Attic kneewalls
 - Fireplaces
 - Doors
 - Windows
 - Plumbing, mechanical, or electrical penetrations
 - Stairwells to unconditioned spaces

3.3.2.10 Lighting

Auditors should follow HERS guidance on recording lighting information.

Note that in REM/Rate, incandescent fixtures on a motion sensor or timer (common for exterior lights) should be counted as high-efficiency lighting. These should still be counted as incandescents on a timer/sensor in our data collection forms.

Auditor Tip:

- In some cases, you can shine a flashlight into a light fixture to create a shadow of the bulb, allowing you to identify the type of light bulb without removing the fixture cover.

3.4 Diagnostics: Blower Door Test

The blower door test is the first diagnostic test to be conducted.

1. Prepare the homeowner:

- Courteously explain the process to the homeowner.
 - Tell them about the fan, turning off equipment, that you will open/close windows, etc.
 - Use layman's terms, not "CFM" or "ACH," which are meaningless to non-specialists.
 - Creative analogies can be helpful. Describe the house as a bicycle tire, where the fan essentially inflates it so that you can "hear" the leaks, or as a beach ball with a hole in it, where the fan helps you find and identify the size of the hole, and so forth.

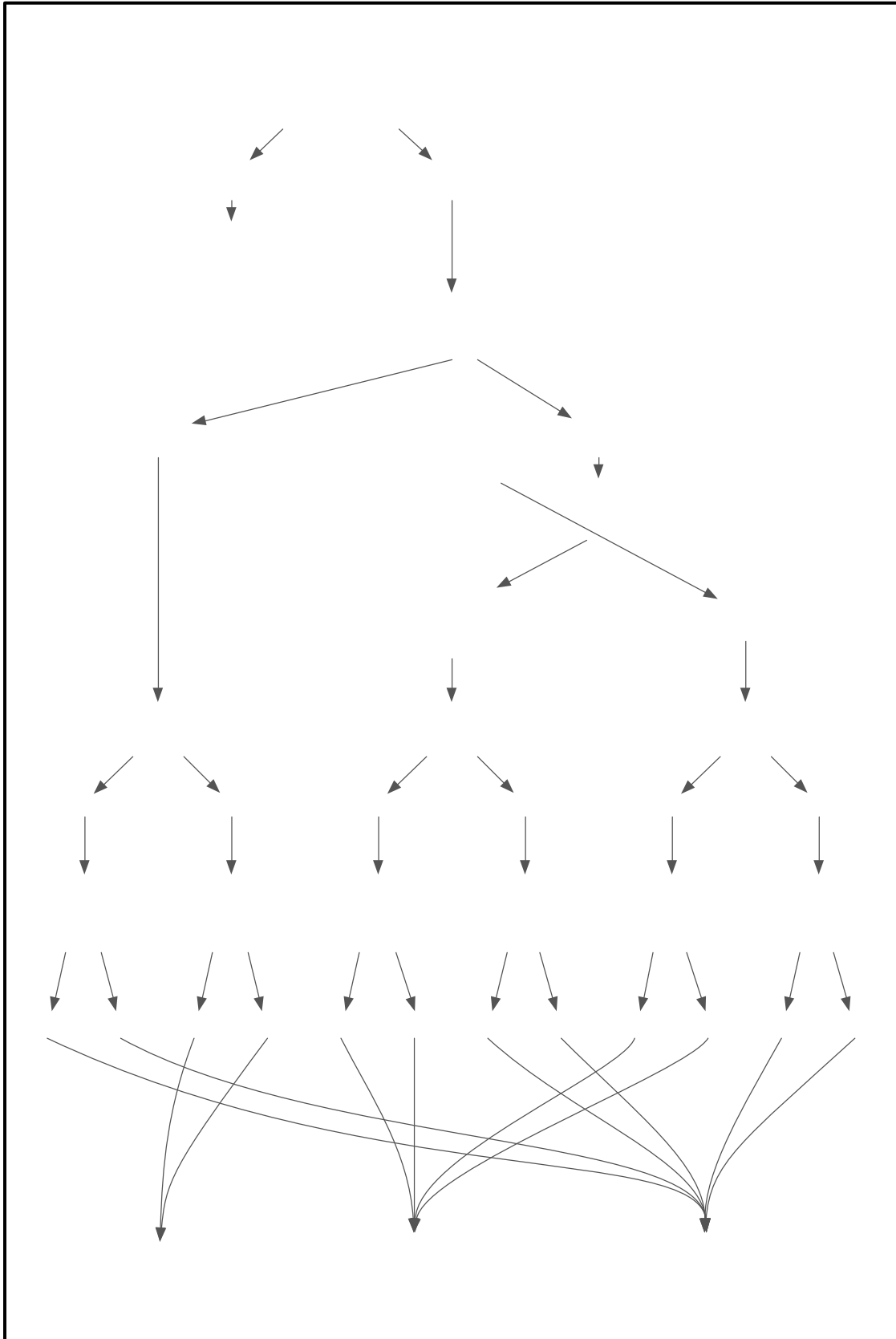
2. Make a judgment on the location of the thermal boundary, and make notes on your decisions.

- If there is a doubt about where the boundary is, err on the side of caution and run the diagnostics (blower door and duct leakage to outside) both ways, treating the space as conditioned volume (CV) and then unconditioned.
- Essentially, we follow the following methods:
 - If the boundary is unambiguous, only run tests in the one appropriate way.
 - If the boundary is ambiguous, run both ways.
- Figure 3-4 provides auditors with a clear decision tree on deciding how to handle basements or basement areas.

- For attics:
 - Vented attics are never conditioned space.
 - Attics with fully foamed roof rafters are conditioned space *if* attic is not vented.
- For attic spaces behind kneewalls:
 - Typically exclude from blower door tests, unless foamed at rafters.
- Never include garages in the conditioned area or blower door test.¹

¹ Per RESNET CFA standard: Unfinished, heated garages shall not be included in the CFA. A heated garage is not currently defined as a "rated feature" in the standards, and thus is not modeled as conditioned space nor included in the CFA.

Figure 3-4: Basement Diagnostics Decision Tree

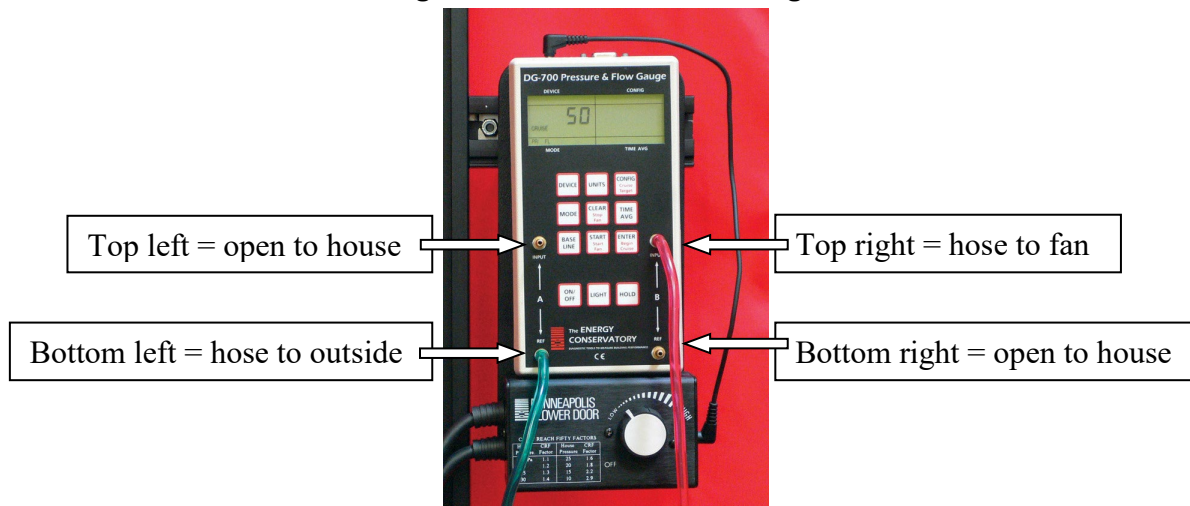


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3. Set up blower door:

- Watch for pets!
- Watch for kids!
- Run long hose outside.
 - Leave one end near the door where you will set up the fan, and put the other end at least 5 ft. to the *side* of the door.
 - Protect far end of hose from wind (via plants, boxes, etc.).
 - If windy outside, use “T” splitter to attach an extra hose and run to opposite side of building.
- Install frame and red panel in **exterior** doorway.
 - Avoid using door to garage. If you have to use it, open big garage door.
 - Avoid setting up right in front of stairs (creates turbulence on gauge).
 - Be gentle with the frame.
- Install fan in red panel, ring side in; make sure all hoses are connected, and leave fan closed (don’t remove the rings).
- Install fan control, gauge, and hoses, including cruise control cable, as seen below. As a memory device, remember that you are testing the pressure of the house (A-Input tap) with respect to the outdoors (A-Reference tap).

Figure 3-5: Blower Door Gauge



4. Prepare home for blower door:

- Close and lock all exterior doors and windows in house, basement, garage, and unvented, insulated attic.
- Open all interior doors.
- Turn off combustion appliances (furnace, water heater, boiler, etc.).
 - Don’t extinguish pilot lights! Furnaces and boilers can be turned off with a switch on the unit, and water heaters can be put in vacation mode or turned off at breaker panel.
 - For breaker panel: typically, switch pushed in = ON. Out = OFF.
- Close chimney dampers.

- Close fireplaces and wood stove doors to prevent scattering of ashes.
 - Don't run fan if fireplace was on that same day – hot ashes!
- Turn off exhaust fans, vented dryers, and room air conditioners.
- Fully tape up window AC units, unless they remain in place all year and are not sealed in the winter.
- Turn off **and seal** any continuous ventilation fans, from the outside if possible. This would include any ERV or HRV—these can typically be sealed from the outside of the house.
- Close attic door/hatch unless attic is part of conditioned volume (foamed rafters, usually).
- If there are drop ceilings in the house, pop up one panel so air can move freely.

5. Conducting the Blower Door Test (One-Point Test).

- Record Baseline Pa:
 - Leave fan rings/cover closed.
 - Device type = BD 3.
 - Mode = PR/FL@50.
 - Press BASELINE, then START, let run for 10-30 seconds (the windier it is, the longer it should run), then hit ENTER to record.
 - Channel A will now show ADJ icon (Pa adjusted for baseline.)
 - Remove fan cover plate/rings except for largest (A) ring (good starting point).
 - Tighter/smaller home = smaller ring.
 - Bigger/leaky home = bigger or no ring.
 - Press CONFIG to select chosen ring (OPEN, A1, B2, or C3).
- Turning on blower door fan:
 - Decide whether to use CRUISE CONTROL or not.²
 - If using CRUISE CONTROL:
 - Fan control knob = clicked to “just on” position.
 - Press BEGIN CRUISE.
 - Press CRUISE TARGET until “50” is displayed.
 - Press START FAN once “50” is displayed.
 - If fan ramps up way too high, check for open windows.
 - If using MANUAL CONTROL:
 - Manually adjust knob until fan reaches 50 Pa (or close, +/- 5 Pa).
 - Once at 50 Pa—*not before*³—press TIME AVG until LONG appears. Leave fan running until CFM stabilizes.
 - Record Adjusted CFM50 and fan configuration.
- Walk through house, record areas of high leakage, point out to homeowner if he/she is interested.
- Turn off fan manually, or press “STOP FAN” if using CRUISE.
- Troubleshooting gauge error messages:
 - If “----“ is displayed on Channel B, fan pressure is low (house is leaky). Check that windows are closed and/or remove rings.
 - If “LO” is displayed on Channel B, flow is too low (house is tight)—add a smaller ring.
 - Check that Device type = BD 3, Mode = PR/FL@50, and CONFIG matches fan flow rings in use.
- Be sure to run test with basement or other similar buffer zones (excluding garages) both ways if thermal boundary is ambiguous, or in accordance with Figure 3-4.
- If you have any reason to believe your first number is questionable, then do a walk-through to make sure everything is set up properly, and then re-run the test. If the first and second test results are significantly different, then run it a third time.

² Use your judgment. Cruise Control ramps up quickly. If you suspect that a sudden change to -50 Pa might cause air to come rushing in that might knock things off shelves or window ledges, pull in ashes, or otherwise damage the inhabitants or property, use the manual control, and ramp up to 50 Pa slowly and cautiously. You could always manually ramp up to 25 Pa, make sure everything is going smoothly, and then engage Cruise Control.

³ If the fan starts while LONG is selected, your readings will include averages from before the fan was fully up to speed, giving you inaccurately low numbers.

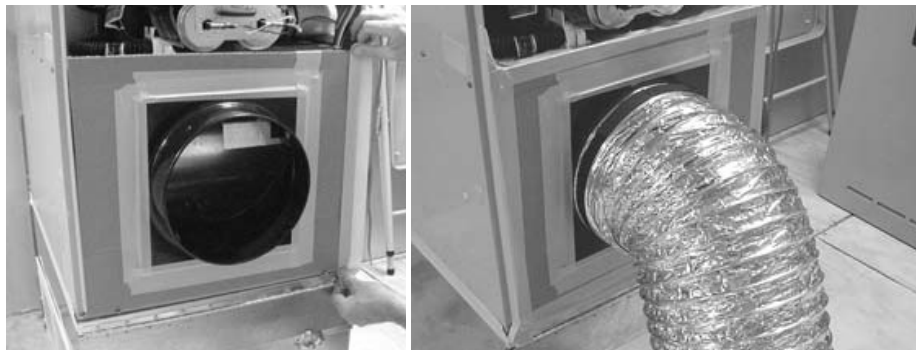
3.5 Diagnostics: Duct Blaster – Total Leakage

After conducting the blower door test, the first duct blaster test is the total leakage test. This measures the total leakage of the duct system, regardless of where the leaks are. The key thing to remember for this test is that the ducts are being treated as if they are in ambient conditions, so a window or door needs to be open in the house and the basement, and the basement should be open to the rest of the house.

1. Prepare home for Duct Blaster (duct pressurization).

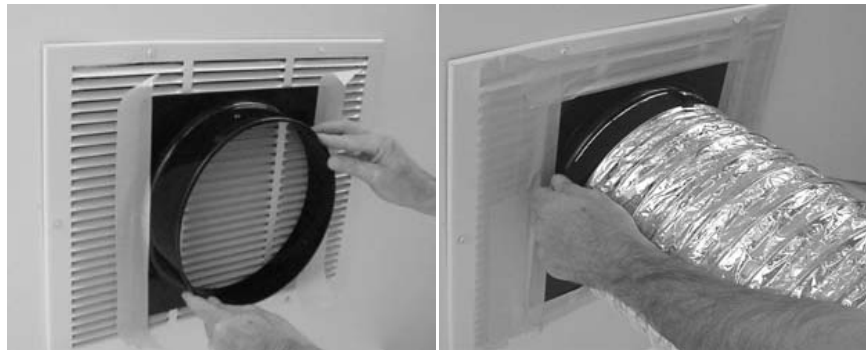
- Leave all home mechanical equipment turned off (HVAC, room AC, dryers, etc.).
- Remove air handler filter(s); close filter slot if possible.
- Make sure duct dampers are open—may need to turn system back on briefly to confirm. Look for green lights on auto damper switches.
- Seal all HVAC vents with special tape (except the return where you hook up the fan).
 - Ask the homeowner for help finding all the vents.
 - Confirm you can access every vent *before* sealing up all the vents.
 - Don't forget hard-to-reach ones, like under kitchen sink cabinets.
 - Remove the grill on the cabinet and install tape over the vent cut in the floor under the cabinet—this is tricky!⁴
 - For vents on walls or ceilings, put tape only on the metal vent itself, not the surrounding paint! The tape can peel paint.
- Attach fan to ducts:
 - Fan should be set to blow *into* the ducts.
 - Use a large return grill close to air handler, or hook up to air handler directly if return grills are much smaller than fan.
 - Use the silver flex hose if the return is on the wall, if there are obstructions within 6" of the face of the fan, or if grill is a bit smaller than fan; obstructions throw off readings via turbulence.

Figure 3-6: Transition piece taped to air handler blower cabinet



⁴ Sealing the vent cut into the cabinet kickplate is usually not sufficient; air will be able to blow into the cabinet, giving inaccurately high blower door numbers. Seal the actual hole in the floor.

Figure 3-7: Transition piece taped to central wall-mounted return



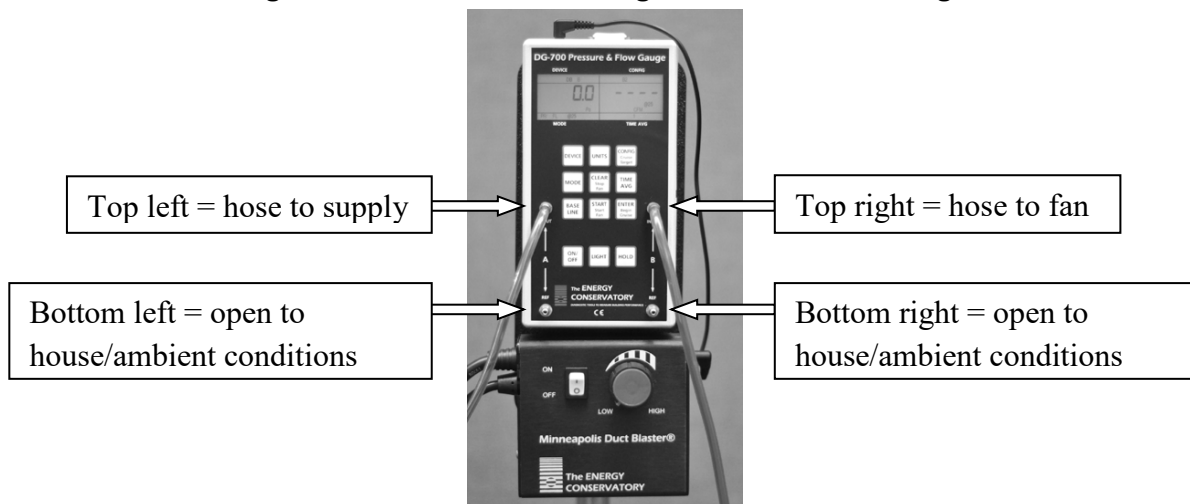
- Use black connecting trim to attach exhaust side of fan to silver flex hose, **and also** use it to connect any flow rings on the inlet side of fan.

Figure 3-8: Transition piece holding flow ring onto fan



- Install fan control, gauge, and hoses as seen below. Remember that you are pressurizing the ducts (A-Input tap) with respect to the ambient conditions (A-Reference tap).

Figure 3-9: Duct Blaster Gauge – Total Duct Leakage



- Attach other end of top left hose to metal probe, and insert into closest supply vent (or supply trunk, if hooking up at the blower). Make sure all zone dampers are open. Turn on system quickly and check for green lights on auto dampers, or other indication that they are open.

2. Conducting Total Leakage Duct Blaster Test, regardless of basement configuration:

- Open doors between house and basement, and between house and attic if attic isn't vented.
- Expose ducts to ambient conditions:
 - Open a window wherever there are ducts: house, basement, garage, and attic if not vented.
- Configure Gauge:
 - Device type = DB B.
 - Mode = PR/FL@25.
 - No need to record baseline unless pressure is $>+/-1$ Pa when fan is off *and sealed*. Record one baseline measurement if $>+/-1$ Pa, but make sure fan inlet is covered.
 - If measuring Baseline:
 - Press: BASELINE-START (wait 10-30 seconds)-ENTER.
 - Channel A will now show ADJ icon (Pa adjusted for baseline).
 - Remove fan cover plate/rings except for largest (1) ring (good starting point).
 - Tighter ducts = smaller ring.
 - Leaky ducts = bigger or no ring.
 - Press CONFIG to select chosen ring (OPEN, A1, B2, or C3).
- Turning on duct blaster fan:
 - If using CRUISE CONTROL:
 - Fan control knob = clicked to “just on” position.
 - Press BEGIN CRUISE.
 - Press CRUISE TARGET until “25” is displayed.
 - Press START FAN once “25” is displayed.
 - If fan ramps up way too high, check for unsealed vents.
 - If using MANUAL CONTROL:
 - Manually adjust knob until fan reaches 25 Pa ($+/-0.5$ Pa).
 - Once at 25 Pa—*not before*⁵—press TIME AVG until LONG appears. Leave fan running until CFM stabilizes.

⁵ If the fan starts while LONG is selected, your readings will include averages from before the fan was fully up to speed, giving you inaccurately low numbers.

- Check that Device type = DB B, Mode = PR/FL@25, and CONFIG matches fan flow rings in use.
- Record Adjusted CFM25 and fan configuration.
- Walk through house, record duct areas with high leakage, point out to homeowner if interested.
- Turn off fan manually, or press “STOP FAN” if using CRUISE.
- Troubleshooting gauge error messages:
 - If you can't get to CFM25 or fan is blowing very hard, check for open/hidden vents. If you're positive you sealed them all, record the CFM25 you get at the highest Pa you can reach.⁶
 - If “----” is displayed on Channel B, fan pressure is low (ducts are leaky). Check that vents are sealed and/or remove rings.
 - If “LO” is displayed on Channel B, flow is too low (ducts are tight)—add a smaller ring.
 - Always check that DEVICE and CONFIG are set correctly.

⁶ Just record what you get at PR/FL 25 with the fan as high as it will go—the gauge is automatically applying a “Can't Reach Pressure” factor. You should not multiply this number by any CRP factor!

3.6 Diagnostics: Duct Blaster – Leakage to Outside

The second duct blaster test is the leakage to outside test (LTO). The total duct leakage test quantifies all duct leakage, but LTO quantifies a subset of that—only the leakage that is happening outside the envelope. The LTO number will never be greater than the total leakage number. This is a key number to obtain for HERS ratings.

1. Conducting Leakage to Outside Duct Blaster Test:

- Return building to conditions for original blower door test:
 - Close any windows you opened in conditioned space,
 - Make sure all interior doors are still open, and
 - Close all doors between conditioned and unconditioned space.
- EXCEPT: open a window in any unconditioned spaces (unconditioned basement, garage, etc.). You will need to run the test twice if there are buffer zone areas that need to be tested in two configurations, based on Figure 3-4.
- Configure blower door gauge:
 - Device type = BD 3.
 - Mode = PR/FL@25.
 - Re-record BASELINE on blower door fan if BD gauge has turned off and ADJ is no longer displayed on BD gauge. *This requires re-sealing the blower door and duct blaster fans.*
- Unseal blower door fan, put back same flow ring used when conducting blower door test, and flip fan around so it will blow into the house.
 - Do not change any hose configurations.
 - Don't pinch any hoses when flipping the fan.
 - Press CONFIG to select chosen ring (OPEN, A1, B2, or C3).
- Configure duct blaster equipment:
 - Remember, you are testing the ducts relative to the pressurized house, so the top left tap (A-Input) needs to remain connected to the supply duct, and the bottom left tap (A-Reference) needs to be connected to the conditioned space.
 - Leave hoses as you had them for the total leakage test if you are conducting the test from within the conditioned space.
 - If the duct blaster fan and gauge are in unconditioned space, you need to add a second length of tubing to the bottom left tap (A-Reference), and run the other end up into the conditioned space. Running it up and under the door to the basement works well if doing this from the unconditioned basement.
 - Leave B-Input connected to fan and B-Reference open.
 - Device type = DB B.
 - Mode = PR/FL (*not* PR/FL@25).
 - Don't measure a baseline.
 - Add to the duct blaster fan the next smallest ring from what you used on the total leakage test.
 - Use ring 3 if you think duct system is tight.
 - Press CONFIG to select chosen ring (OPEN, A1, B2, or C3).

- Turning on blower door fan:
 - Use CRUISE CONTROL:
 - Fan control knob = clicked to “just on” position.
 - Press BEGIN CRUISE.
 - Press CRUISE TARGET until “25” is displayed.
 - Press START FAN once “25” is displayed.
 - If fan ramps up way too high, check for open windows.
 - While blower door fan is running, turn on duct blaster fan:
 - You can use MANUAL CONTROL to reach (+/- 0.5 Pa), but CRUISE CONTROL is easier:
 - Fan control knob = clicked to “just on” position.
 - Press BEGIN CRUISE.
 - Press CRUISE TARGET until “0” is displayed.
 - Press START FAN once “0” is displayed.
 - Once at 0 Pa—*not before*⁷—press TIME AVG until LONG appears. Leave fan running until CFM stabilizes.
- Check that Device type = DB B, Mode = PR/FL, and CONFIG matches fan flow rings in use.
- Record CFM and fan configuration.
- Turn off duct blaster fan manually, or press “STOP FAN” if using CRUISE, and turn off the blower door fan, too.
- Troubleshooting gauge error messages:
 - If “LO” is displayed on Channel B, flow is too low (ducts are tight)—add a smaller ring.
 - Always check that DEVICE and CONFIG are set correctly.

⁷ If the fan starts while LONG is selected, your readings will include averages from before the fan was fully up to speed, giving you inaccurately low numbers.

3.7 Wrap-up

More information is provided in each subsection below, but the basic steps involved in concluding a site visit are:

1. Restore initial site conditions

- Turn equipment back on
- Restore thermostat settings
- Open/close windows
- Gather up work materials (double-check!)
- Gather trash

2. Discuss findings with customer

3. Pay customer and have him/her sign inceptive receipt

4. Make sure customer has your business card

5. Thank the customer, and leave!

3.7.1 Return site to pre-visit conditions

As auditors, we must make sure that we return a home to the same condition in which we found it. This means not only cleaning up after ourselves, but also making sure that we restore any building components to their initial state, such as turning mechanical equipment back on or closing windows we might have opened.

3.7.1.1 Turn equipment back on

Never leave a home without making sure all the mechanical equipment is turned back on. Always double check that you did this. Many customers do not know how to turn this equipment back on and can be understandably upset if their HVAC or hot water does not work after you leave.

If you have left a home and then realize that you did not turn their mechanical systems back on (or get a phone call from the homeowner to this effect), you will need to call the homeowner and either a) go back and turn it on, or b) explain over the phone how to do it. Use your best judgment on which of these options to pursue, but it is best to avoid inconveniencing the homeowner. If you are close to the home, returning is likely the best option. If you are far away from the site and think the homeowner will be able to turn the system back on easily, politely and apologetically explain over the phone how to turn it back on. Do everything you can to ensure that the homeowner is inconvenienced as minimally as possible.

Auditor Tip:

- Give the customer your business card! That way he or she calls *you* to fix the problem, rather than calling the client, who is not in a position to help immediately.
- When doing audits alone, some auditors leave their car keys on top of the water heater so they literally cannot leave without returning to the mechanical room. Note that this practice **does not work if there is more than one auditor at the home! Only consider doing this if you are the sole auditor.**

3.7.1.2 Restore thermostat settings

If you turned off mechanical equipment via the thermostat or made changes to the thermostat set points, ensure that you restore those to the customer's settings.

3.7.1.3 Open/close windows

Blower door and duct blaster tests involve opening and closing windows and doors. Restore those windows to the state at which you found them, as appropriate.

3.7.1.4 Gather up all work materials and trash

Break down all diagnostic equipment and pack up all tools and trash. With this long list of items and tools to bring, it is easy to accidentally leave something at a customer's home. Being as neat as possible and double checking that you have all your tools is crucial. This is another reason why it is good to give the customer your business card: he or she can call you about anything you left behind.

NMR auditors should not dispose of waste materials at the customer's home. Bring any debris and trash with you when you leave for disposal later.

3.7.2 Discuss findings with customer

At the end of your visit, most customers will want to discuss your findings. Feel free to provide helpful feedback as appropriate, but do not criticize the work of previous contractors or the homeowner. Remember that NMR's job is typically data collection, not implementation of repairs or upgrades. If there are upgrades or changes that can be made, emphasize these as positive opportunities, but above all, keep a positive tone, and do not leave customers with a resoundingly negative view of their homes, particularly if you are not offering them immediate or easy solutions. If you think that a customer might benefit from participating in a local energy efficiency retrofit, make sure that the customer is clearly aware that we are in no way affiliated with such programs.

3.7.3 Pay the Customer and Obtain Signed Incentive Receipt Form

At the conclusion of the site visit, pay the homeowner the stated incentive, and ask him or her to complete and sign the incentive receipt form, found in Appendix A.3. It does not matter which of the residents signs the incentive form as long as the person is over 18, but it is necessary for auditing purposes to ensure that we have signed records of this transaction. If customers have any concerns, assure them that the form does not sign them up for any mailing lists, their information will not be sold, and that it is only for accounting purposes.

3.7.4 Leave Business Cards

Double check that the customer has your business card so he or she can call you with questions or to let you know if you left something behind.

3.7.5 Thank the Customer

Thank the customer for participating in our research, and try to ensure that you leave him or her satisfied with the experience.

4 Safety

Safety is the highest priority. Ensuring the safety of our employees and customers is critical. NMR is committed to encouraging and strengthening a culture of safety to achieve an injury-free workplace.

For this purpose, NMR's safety principles include:

- Leaving the workplace unhurt; anything less is unacceptable.
- Following work practices that uncompromisingly protect everyone's safety.
- Stopping work anytime unsafe conditions or behaviors are observed, until the work can be completed safely. NMR employees maintain the right and responsibility to discontinue any site visit where they believe their safety is in jeopardy.
- Participating in a project-specific safety orientation at the start of any field-based project.
- Immediately reporting any safety-related incidents to the designated NMR representative.

4.1 Hazardous Substances

At NMR, we train our auditors to follow OSHA guidelines for dealing with hazardous substances, and we err on the side of caution when dealing with these materials so as to protect the safety of our auditors and customers. Common hazardous materials that NMR auditors encounter in the field include asbestos-like materials (ALMs), mold, lead, and carbon dioxide. The guidelines below are general in nature, and not exhaustive.

4.1.1 Asbestos-Like Materials (ALMs)

In the past, asbestos was a common building material, as it has excellent insulating and heat-resistant properties while also being lightweight. However, it can become friable, meaning that small particles of it can break off and easily become airborne, and these small particles can be inhaled, causing serious lung damage. Many existing buildings may contain asbestos materials (e.g., insulation, roofing materials, gaskets, thermal system insulation, gypsum wallboard and joint compound, ceiling tiles, exterior stucco, pipes, window glaze, floor coverings including mastic, fireproofing, cable, cable wrap, transite panels, transite ducts, wire insulation).

NMR auditors must all participate in asbestos safety training before conducting on-site audits.

Asbestos is not always labeled, so auditors must learn to identify it in the field by sight. Materials that look like asbestos, but cannot be positively identified as such, are called asbestos-like materials (ALMs) and should all be treated as if they do contain asbestos.

If you find ALMs:

- **The best thing for auditors to do with ALMs that they find in a home is to leave them alone!**
- **Check for this in the initial walkthrough, and ask occupants if they are aware of any asbestos.**
- **If ALMs are present, do not do any diagnostic testing.**
- **Do not touch or disturb any such materials.** NMR auditors are not certified to remove or disturb ALMs.
- Document the presence of any asbestos-like materials.
- Use a respirator around any such materials.
- Inform the resident of the presence of these materials, and instruct that the materials should not be touched.
- Make it clear to the occupant that NMR auditors are not certified asbestos experts, but trained to err on the side of caution. Recommend that they obtain professional advisement from certified experts on how to deal with these materials.
- Asbestos shall be handled in accordance with EPA regulations 40 CFR Part 763—which is to say, **not by NMR auditors.**

ALMs can be found commonly in:

- Steam pipe insulation
 - From the outside, this white pipe insulation looks like old plaster casts used to set healing broken bones. Sometimes the interior is visible at edges and seams, and you may notice that the material is corrugated on the inside, resembling layers of cardboard. See Figure 4-1 for an example.
 - Note that newer—and safe—fiberglass pipe insulation is also typically white on the outside, but this is just a paper jacket covering the yellow fiberglass interior that is often visible at edges and seams, as shown in Figure 4-2. Learning to identify the difference between this and ALM pipe insulation is important.

Figure 4-1: Asbestos Pipe Insulation - Dangerous

Source: Inspectapedia.com: http://inspectapedia.com/hazmat/Asbestos_Pipe_Insulation.htm

Figure 4-2: Fiberglass Pipe Insulation - Safe

Source: Frost King:

<http://www.frostking.com/pre-slit-tubular-fiberglass-pipe-cover-with-self-sealing-jackets/>

- Duct insulation
 - Asbestos was sometimes used to insulate duct work. It can look similar to steam pipe insulation—a textured, white material that resembles plaster.
 - In Figure 4-3 below (from an actual NMR site visit), you can see a thin layer of textured ALM insulation over a run of metal duct work. The thin sheet of white insulation is friable and is breaking off in pieces.

Figure 4-3: Asbestos Duct Insulation in Basement Ceiling



- Vermiculite - attic and wall insulation
 - This insulation material can look like small multi-colored pebbles.

Figure 4-4: Vermiculite Insulation between Attic Rafters



Source: http://www.atsdr.cdc.gov/asbestos/more_about_asbestos/asbestos_photos/

4.1.2 Mold

Similar to when you find asbestos-like materials, document the presence of mold—but if there appears to be an ongoing mold problem in the house, do not conduct blower door tests that could draw these materials into the home.

4.1.3 Lead

Older homes may have lead paint, but because NMR auditors are not disturbing paint or engaging in any construction or renovation activities, auditors should not expect to have exposure to lead. If there is a concern about lots of lead dust, such as from homeowner report, auditors should wear their respirators and not conduct any diagnostic tests.

4.1.4 Chemicals

NMR auditors shall not use any toxic chemicals while on-site, and shall not touch any such chemicals that they may find on-site. Auditors should avoid such materials and wear all necessary protective gear to avoid contact or inhalation of such materials.

4.1.5 Broken CFLs

If a Compact Fluorescent Light (CFL) bulb is broken during the site visit, auditors should follow the EPA's Cleanup and Disposal Guidelines for Compact Fluorescent Light Bulbs, found in Appendix A.7.

4.2 Personal Protective Equipment (PPE)

NMR auditors must always wear appropriate PPE, including:

- Gloves
 - Utility gloves
 - Cold-weather gloves
 - Latex gloves (for broken CFL bulb cleanup)
- Safety glasses meeting ANSI Z87 specifications
 - Wear these at all appropriate times while in the customer's home.
- Hardhats or helmets
 - When working in attics or wherever there may be exposure to sharp or injurious objects (exposed beams, nails, etc.)
- Protective outer garments
 - Long sleeves and pants made out of sturdy materials are recommended in all weather to protect the skin during audits. Fiberglass fibers, for example, can be irritating to bare skin!
- Respirator with HEPA filter
 - Auditors are encouraged to wear these in any dusty environment, including attics.
- Closed-toe shoes, preferably rated safety shoes or work boots
 - Field technicians must wear closed-toe shoes at all times when doing work, and must wear shoe coverings when indoors to minimize any mess. If the homeowner requests that you take off your shoes, it is only acceptable to do so during the initial discussion with the homeowner about what the visit will entail. Politely explain that safety regulations require shoes to be worn when conducting work, but that you will wear shoe coverings and work to prevent any mess.
- If taking electrical measurements, auditors must also wear:
 - Rated electrical gloves
 - Helmet with arc-resistant face shield
 - Arc-resistant jacket

4.3 Fire Protection and Prevention

- Call 9-1-1 in the event of any fire.
- Auditors must participate in basic fire training.
- Have a fire extinguisher in the vehicle at all times.

- Auditors must park their vehicles such that emergency vehicles' access to roadways is not impeded.
- Auditors may not smoke in NMR work vehicles or on customer property.

4.4 Tool and Equipment Safety

- **General principles.** Auditors shall ensure that all specialized tools or equipment are operated and maintained in accordance with the manufacturer's specifications and as required by applicable regulations.
- **Tripping hazards.** Auditors should keep their workspace clean and minimize tripping hazards from tools or cables.
- **Combustion equipment.** Auditors must turn off all combustion equipment for blower door and duct blaster testing, as described in the diagnostics testing section.
- **Ladder safety.** Vendors and technicians must follow OSHA 3124-12R-2003 whenever ladders are used. HES Program policy allows the use of ladders (including step ladders) with a spotter. Appropriate safety precautions per OSHA 3124-12R-2003 must always be followed.

4.5 Electrical Safety

- Ensure that all power cords for any electrical equipment are in good condition and working properly. Do not use equipment with damaged electrical cords or plugs, or attempt field repair with unapproved materials, such as tape.
- When working, try to minimize tripping hazards with electrical cords.
- Do not pull or lift equipment by their electrical cords.
- Personal protective equipment such as arc and flame resistant outerwear, rated electrical gloves, and headgear (head, face, and eye protection) shall be worn whenever auditors are working with live or exposed electrical systems.
- Follow all OSHA guidelines relating to electrical safety, and never touch bare electrical wires. Specific projects involving electrical work will contain additional instructions on electrical safety.

4.6 Driving Safety

4.6.1 General Principles

- Obey all rules of the road, including speed limits and any other safety regulations, such as always wearing seat belts.
- Always practice defensive driving habits, and remember that, on the road, we are still representing NMR and our clients.
- As mentioned in Section 4.3, auditors should ensure to park at customers' homes in a way that does not restrict emergency vehicles from accessing roadways.
- Do not drive in unsafe weather conditions.

4.6.2 Car Accidents

Following are instructions for what to do in the event of a car accident. Auditors should familiarize themselves with the Auto Accident Report form, found in Appendix A.6, which provides much of this guidance and shows auditors what information to collect at the scene of a car accident.

Immediately following an accident:

- **Remain calm.**
- **Check yourself for injuries.**
 - If you are injured, call 9-1-1, or ask someone else to do so, and ask for an ambulance.
 - If you or someone else thinks you are seriously injured, do not move, and wait for emergency personnel to arrive.
- **If you are not hurt, check on other passengers.**
 - If other passengers appear to be injured, call 9-1-1, or ask someone else to do so, and ask for an ambulance.
 - If other passengers are seriously injured, make sure that they do not move, and wait with them for emergency personnel to arrive.
- **If the accident is minor, move the car to a safe place.**
 - Turn off the car's engine and turn on the car's hazard lights.
 - Set up cones, a safety triangle, or safety flares to alert traffic of your presence.
- **Call 9-1-1, or ask someone else to call if you cannot.**
 - Even if you do not believe you are injured, calling the police is necessary for insurance purposes.
- **Fill out Auto Accident Report Form**, found in Appendix A.6.
 - This form describes all the information you should collect, including information about witnesses, the other driver, the circumstances of the accident, and so forth.

Once the police officer arrives on scene:

- Have the officer gather the other driver's contact information, driver's license information, and insurance information for you.
- Inquire about when you will be able to gain access to the incident report.
- Record the officer's badge number.

Important Tips:

- **Do NOT say:**
 - "It's all my fault," even if you think it may have been.
 - "My insurance will pay for everything."
- Be polite to all involved parties.
- Collect as much information requested in the Auto Accident Report Form as you can, including:

- Take notes regarding what happened at the accident, the time of day, and the weather conditions.
- Take pictures of the vehicle and accident scene.
- If witnesses are present, gather their contact information.
- Limit your contact with the other driver and have the officer act as an intermediary.
- Do not leave the scene until the police and other driver do.
- **Notify NMR of the incident by calling the designated NMR representative. Unless otherwise specified, that is any of the people below:**
 - 1) Rachel Hoefgen-Harvey at 617-284-6230 x7 or
 - 2) Erin Coates at 617-284-6230 x19, or
 - 3) Lynn Hoefgen at 617-284-6230 x6.

4.7 Personal Injuries

- Use your best judgment or the following instructions in the event of personal injury. Remember to prioritize safety above all other project priorities!
- Determine if the injury is serious and/or potentially life threatening; if it is, call 9-1-1 or have someone else call 9-1-1.
- If the injury can be tended to at the job site, stop what you are doing and tend to it.
- If the injury cannot be tended to at the job site, but does not require the assistance associated with 9-1-1, seek additional medical attention at the nearest hospital emergency room.
- **Notify NMR of the incident by calling the designated NMR representative when able. Unless otherwise specified, that is any of the people below:**
 - 1) Rachel Hoefgen-Harvey at 617-284-6230 x7 or
 - 2) Erin Coates at 617-284-6230 x19, or
 - 3) Lynn Hoefgen at 617-284-6230 x6.
- Fill out the Onsite Incident/Injury Form when able, and submit to NMR representative.
 - Appendix A.4

4.8 Waste Management

Do not dispose of trash or waste materials at the customer's home. Collect any waste (used shoe coverings, used duct register tape, etc.) and bring it back with you for disposal at NMR or another appropriate facility. NMR auditors should take all precautions to ensure that they leave a site at least as clean as they found it, using drop cloths and shoe coverings to protect the occupant's home and belongings.

5 Customer Service

5.1 General Principles

NMR recognizes that good customer service is the key to leaving a customer satisfied with participation in our research activities. It also reflects positively on NMR's clients.

Because we are working in customers' living spaces, we must adhere to the highest standards of professionalism and customer service, always demonstrating respect for customers and their homes. Allowing strangers to spend time in every room of their homes—often without direct supervision—requires a great deal of trust, and auditors must be mindful of this. We should be as polite, friendly, and neat as possible. Demonstrating that we are competent, professional, and friendly helps make customers feel at ease with us being in their homes for several hours.

Customer satisfaction requires that we take strides to leave a home in at least as good a condition as we found it, cleaning up after ourselves and avoiding messiness.

Clear communication with customers is essential to ensure that they have accurate expectations of the results of participating in an NMR study. This is particularly important since NMR's focus is on collecting data, rather than fixing problems in homes. It is important to be objective, professional, and tactful when dealing with customers, particularly when we are the bearers of "bad news" in informing the customer of a problematic finding (e.g., damaged insulation, mechanical equipment in need of repair). Customers may appreciate helpful feedback on their homes, but remain mindful that being critical of a customer's home can leave that person frustrated, particularly if we are unable to provide an easy solution. Discussing any such issues as positive opportunities can be much more helpful to homeowners than framing them as difficult challenges.

Do not criticize any previous work on the home, as this can both frustrate the homeowner and potentially create a liability concern for NMR or its clients.

5.2 Customer Service Issues in the Field

NMR always endeavors to maintain a high quality work product. With on-site work, we take special precautions to ensure the quality of data collected and avoid jeopardizing the relationship our clients have with their customers. To that end, we take a number of steps to ensure that onsite technicians perform quality work that reflects well on NMR as well as on our clients. Following are specific customer issues that have arisen in on-site visits, along with guidance on how to deal with them should they arise for you.

- **Auditor feels unsafe**

Always prioritize safety. If you ever sense immediate danger, leave immediately! If you feel like your safety is compromised at any particular site visit, or around any particular home occupant, trust your judgment and know that it is acceptable to politely cancel the audit and leave. If you have already started the audit, politely tell the occupant that the home either does not qualify for the study, or that you have collected all the information that you need, pay the person, and leave. If you have not yet started the site visit but feel unsafe upon arrival, it is acceptable to leave and immediately call the NMR scheduler who can call the occupant and cancel the site visit.

- **Scheduled homeowner not present**

If no one is home, try calling the customer at the number provided. If that doesn't work, call the NMR scheduler and wait a reasonable amount of time (about 20 minutes). The NMR scheduler will reschedule the appointment or replace it.

If someone else is present who is 18+ years old, see if you can conduct the visit with him/her and leave the incentive for the main occupant.

- **Restricting access to rooms**

Explain to customer that access to all rooms is critical, but be polite and accommodating as possible. Measuring windows, counting lights, covering registers, etc., needs to be done in every room. The homeowner may be willing to help if there are unusual circumstances preventing you from entering a room.

- **Requesting payment first**

Provide customer with the check and then do the inspection. If the customer then kicks you out of the house, call NMR scheduler and NMR can cancel payment on the check (if payment is by check).

- **Customer in a hurry**

Let the customer know how long the visit typically takes, and that the study requires you to be thorough. Mention the incentive

Auditor Tip:

- Encourage homeowners not to leave during visits. If they must, ensure that you have an immediate means of contacting them.
- Do not criticize previous work on the home!

again to remind the person of the benefit of participating in the study. If customer needs to terminate the visit in the middle, we can try and re-schedule the appointment for a later date. Be sure to provide him/her with the check before you leave (even if you have to terminate mid-way). Call NMR scheduler and we'll contact the customer to determine the best solution.

- **Auditor breaks something**

Be apologetic, and assure the occupant that NMR will pay to replace or repair the item. Fill out the Onsite Incident Form found in Appendix A.4.

- **Talkative homeowners**

Some homeowners may be particularly talkative and eager to participate in the audit. Be friendly and courteous to these customers, but make sure that you remain focused on your work and safety as much as possible. It is reasonable to politely explain when you need to focus on something (“All right, this part is tricky, so now I need to focus on some calculations/ measurements/etc. I can let you know what I find once I finish this.”).

- **Overly helpful or pushy**

If a customer is trying to be helpful or pushy and tells you what kind of bulb is in the fixture before you've asked or had a chance to look, say, “Thanks, that's very helpful. I'm really supposed to examine it firsthand as well so I can get some pictures.” Say this the first time, but if the customer is agitated, you can take the person at his/her word and move on.

6 Expenses

6.1 General Guidance

Auditors will be provided with budget guidance at the beginning of each project regarding limits on amounts to spend on food and lodging. Follow adherence to these standards to the extent practicable.

Keep all receipts for food, lodging, gas, and other expenses, and submit them to NMR staff on a weekly basis, if possible.

6.2 Food, Lodging, and Travel

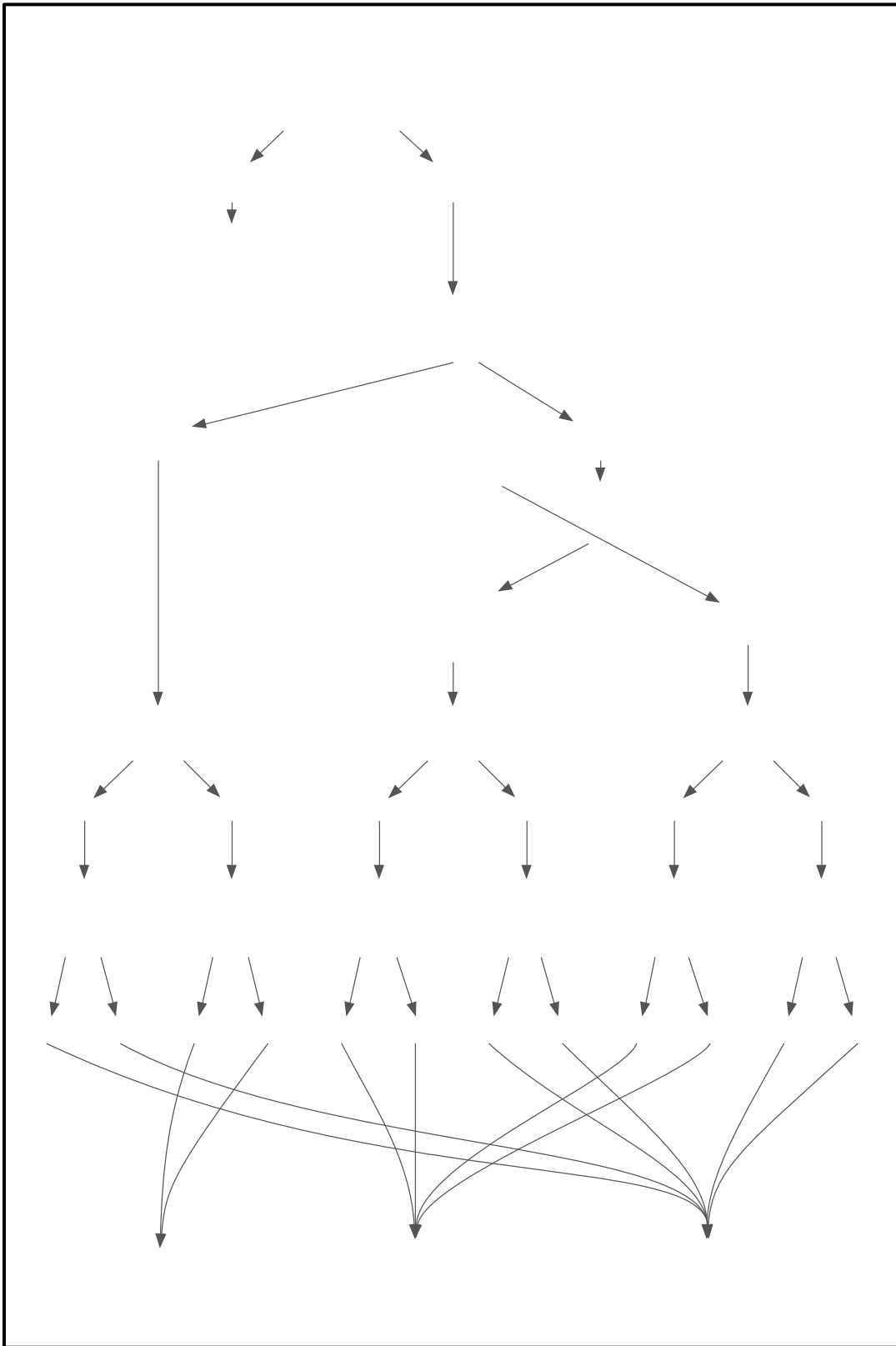
- **Food**
 - NMR auditors will be provided with budget guidance at the beginning of a project by NMR senior managers, and they should attempt to adhere to those limits.
- **Lodging**
 - Auditors can book their own hotels following budget guidance provided at the beginning of project by NMR senior managers.
 - NMR schedulers develop auditors' day-to-day schedules and are helpful resources in offering suggestions for areas to stay during an extended trip.
- **Travel**
 - Use approved vehicles, usually rentals obtained by NMR administrators.
 - Track mileage on trips.
 - See Appendix A.5 for mileage tracking form.
 - Specific guidance will be given at the beginning of a project in the event that auditors need to make air travel arrangements rather than driving.

Appendix A Forms

This appendix contains the various forms that auditors should bring with them to any onsite visit. They include the following:

- A.1. Basement Diagnostics Decision Tree
- A.2. Information Sheet for Occupant
- A.3. Incentive Receipt Form
- A.4. Onsite Incident/Injury Form
- A.5. Mileage Tracking Form
- A.6. Auto Accident Report Form
- A.7. EPA Cleanup and Disposal Guidelines for CFLs

A.1 Basement Diagnostics Decision Tree



A.2 Information Sheet for Occupant

The following page contains a template for a background information sheet describing the study that can be provided to homeowners upon arrival at the site.

Dear Homeowner:

Thank you for agreeing to a visit to your home as part of the [PROJECT NAME] study. [CLIENT] is conducting an important study of single-family homes in [STATE/REGION]. We are offering occupants of single-family homes and townhouses an incentive of \$___, as well as free energy efficiency measures, for taking part in the study. All participants will also be entered into a drawing to win [OPTIONAL ADDITIONAL INCENTIVE].

The study will include visits to [NUMBER] single-family homes in [STATE/REGION] from [STARTING MONTH] through [ENDING MONTH and YEAR] to examine their energy efficiency. The study involves measuring the efficiency in a wide range homes across the state, so we will not visit everyone who has agreed to participate. However, if your home is selected to be among those visited, we will contact you to set up a convenient time for our technicians to conduct the assessment. To handle the assessments for this study, [CLIENT] has hired NMR Group, a national firm that specializes in measuring energy efficiency in homes.

The inspectors will need to be at your home for about three to four hours. During the assessment, the inspectors will examine all features of your home that affect energy consumption; these features include, but are not limited to, insulation levels, appliance and mechanical equipment efficiencies, air leaks, and duct leaks. In order to identify air and duct leaks, the inspectors will need to conduct diagnostic tests on the both the home and any duct systems. Visits will be scheduled at your convenience. **All information collected for this project will be combined with information from all other customers for reporting; information specific to your home will not be shared with anyone, including the [CLIENT].**

Please note that this study is limited to standalone houses or townhouses that have a wall running from the basement through the attic that separates units. If we contact you for this study, please verify that your home is a standalone house or townhouse and not an ineligible two-to-four family structure.

If you have any questions about this study, please contact [CLIENT CONTACT NAME and TITLE], by email at _____ or by phone at _____.

Please do not call this number to schedule an appointment. The firms conducting the visits will call to set up appointments. Homes will be selected to represent the wide range of single-family residences in the state; some people receiving this letter will not be contacted at all if the quota for visits in their area has been reached.

We do hope you will agree to participate in this important study if you are called.

Thank you for your consideration,

[CLIENT NAME and CONTACT INFORMATION]

A.3 Incentive Receipt Form

The following page contains a template for an incentive receipt form that auditors should have customers sign to confirm that they have received payment for participation in the on-site visit.



Incentive Receipt Form

Thank you for your participation in this [PROJECT NAME] visit. Please sign the document below stating that you received the incentive. This form does not sign you up for any mailing lists, and your information will not be sold. This is a receipt for accounting purposes.

My signature below is provided only to verify that I did receive \$[INSERT AMOUNT], in the form of:

Circle one:	Cash	Check
-------------	-------------	--------------

from the visiting contractor, as previously agreed upon, on the date indicated.

Name: _____

Address: _____

Signature: _____ Date: _____

Provided by: NMR Group, Inc. Employee Name: _____

A.4 Onsite Incident/Injury Form

The following page contains a form that auditors should use in the event of any on-site incident, such as damage to customer property or auditor injury.



[PROJECT NAME] Onsite Incident/Injury Form

Homeowner Name: _____

NMR Auditor: _____

Vendor Company [if any]: _____

Vendor Employee Name [if any]: _____

Date: _____

Location of Incident: _____

In the box below, please describe the onsite incident, including any injuries.

If something was broken and needs to be replaced or if the homeowner is seeking reimbursement for other damages, please indicate the name of the liable company below.

Company Name: _____

Please sign here to verify that all parties are in agreement on the information specified above.

Homeowner Signature [not necessary if reporting auditor injury]: _____

NMR Auditor Signature: _____

Vendor Signature: _____

A.5 Mileage Tracking Form

This page contains a form that auditors should use to record their daily mileage. NMR tracks its mileage for reporting to the client and offsetting its carbon emissions.

Mileage Log			
Auditor:			
Date	Origination	Destination	Distance (miles)
TOTAL:			

A.6 Automobile Accident Report Form

The following two pages contain a form that auditors should use in the event of a car accident.

Auto Accident Report Form

Keep In Your Glove Box

When an accident occurs:

First Steps	Do Not Say	While Still At the Scene
<ul style="list-style-type: none"> • Remain calm • Get to a safe place • Check for injuries • Administer First Aid • Call police/EMT 	<ul style="list-style-type: none"> • It's all my fault, (even if it is). • My insurance will pay for everything. • It's OK, I have full coverage. 	<ul style="list-style-type: none"> • Get as much information as possible on this report. • Take Pictures • When the police come, cooperate and tell them what you know.

Accident Details

Day/Date/Time AM/PM	
Weather/Road Conditions	
Location of Accident	
Accident Details	

Damage Descriptions

Your Vehicle	Other Vehicle
Towing Company Name & Phone	Towing Company Name & Phone

Other Driver/Vehicle Information

Owner's Name:	
Owner's Address:	
Owner's Phone:	
Vehicle Make:	
Vehicle Model & Year:	
Vehicle Color:	
License Plate Number	
Insurance Company:	
Agent Name & Phone:	
Other Drivers Name:	
Other Drivers Address:	
Other Drivers Phone:	

Passengers/Injuries:	
Your Vehicle	Other Vehicle
# Passengers:	# Passengers:

Police Information	
Officer Name:	
Department:	
Phone:	
Badge Number:	
Other Info:	

Witness Information			
Name:		Name:	
Address:		Address:	
Home Phone:		Home Phone:	
Work Phone:		Work Phone:	

Sketch The Accident Scene:

A.7 EPA Cleanup and Disposal Guidelines for CFLs

The following guidance is taken from the EPA's Cleanup and Disposal Guidelines for Compact Fluorescent Light Bulbs from June 2008.

What precautions should I take when using CFLs in my home?

CFLs are made of glass and can break if dropped or roughly handled. Be careful when removing the bulb from its packaging, installing it, or replacing it. Always screw and unscrew the light bulb by its base (not the glass), and never forcefully twist the CFL into a light socket. If a CFL breaks in your home, follow the cleanup recommendations below. Used CFLs should be disposed of properly (see below).

What should I do with a CFL when it burns out?

EPA recommends that consumers take advantage of available local recycling options for compact fluorescent light bulbs. EPA is working with CFL manufacturers and major U.S. retailers to expand recycling and disposal options. Consumers can contact their local municipal solid waste agency directly, or go to www.epa.gov/bulbrecycling or www.earth911.org to identify local recycling options.

If your state or local environmental regulatory agency permits you to put used or broken CFLs in the garbage, seal the bulb in two plastic bags and put it into the outside trash, or other protected outside location, for the next normal trash collection. Never send a fluorescent light bulb or any other mercury-containing product to an incinerator.

If your ENERGY STAR-qualified CFL product burns out before it should, look at the CFL base to find the manufacturer's name. Visit the manufacturer's website to find the customer service contact information to inquire about a refund or replacement. Manufacturers producing ENERGY STAR-qualified CFLs are required to offer at least a two-year limited warranty (covering manufacturer defects) for CFLs used at home. In the future, save your receipts to document the date of purchase.

How should I clean up a broken fluorescent bulb?

Because CFLs contain a small amount of mercury, EPA recommends the following cleanup and disposal guidelines:

1. Before Cleanup: Air Out the Room

- Have people and pets leave the room, and don't let anyone walk through the breakage area on their way out.
- Open a window and leave the room for 15 minutes or more.
- Shut off the central forced-air heating/air conditioning system, if you have one.

2. Cleanup Steps for Hard Surfaces

- Carefully scoop up glass fragments and powder using stiff paper or cardboard and place them in a glass jar with metal lid (such as a canning jar) or in a sealed plastic bag.
- Use sticky tape, such as duct tape, to pick up remaining small glass pieces and powder.

- Wipe the area clean with damp paper towels or disposable wet wipes. Place towels in the glass jar or plastic bag.
- Do not use a vacuum or broom to clean up the broken bulb on hard surfaces.

3. Cleanup Steps for Carpeting or Rug:

- Carefully pick up glass fragments and place them in a glass jar with metal lid (such as a canning jar) or in a sealed plastic bag.
- Use sticky tape, such as duct tape, to pick up small glass fragments and powder.
- If vacuuming is needed after all visible materials are removed, vacuum the area where the bulb was broken.
- Remove the vacuum bag (or empty and wipe the canister), and put the bag or vacuum debris in a sealed plastic bag.

4. Cleanup Steps for Clothing, Bedding, etc.:

- If clothing or bedding materials come in direct contact with broken glass or mercury-containing powder from inside the bulb that may stick to the fabric, the clothing or bedding should be thrown away. Do not wash such clothing or bedding because mercury fragments in the clothing may contaminate the machine and/or pollute sewage.
- You can, however, wash clothing or other materials that have been exposed to the mercury vapor from a broken CFL, such as the clothing you are wearing when you cleaned up the broken CFL, as long as that clothing has not come into direct contact with the materials from the broken bulb.
- If shoes come into direct contact with broken glass or mercury-containing powder from the bulb, wipe them off with damp paper towels or disposable wet wipes. Place the towels or wipes in a glass jar or plastic bag for disposal.

5. Disposal of Cleanup Materials

- Immediately place all cleanup materials outdoors in a trash container or protected area for the next normal trash pickup.
- Wash your hands after disposing of the jars or plastic bags containing clean-up materials.
- Check with your local or state government about disposal requirements in your specific area. Some states do not allow such trash disposal. Instead, they require that broken and unbroken mercury-containing bulbs be taken to a local recycling center.

6. Future Cleaning of Carpeting or Rug: Air Out the Room During and After Vacuuming

- The next several times you vacuum, shut off the central forced-air heating/air conditioning system and open a window before vacuuming.
- Keep the central heating/air conditioning system shut off and the window open for at least 15 minutes after vacuuming is completed.
- For more information about compact fluorescent bulbs, visit <http://www.energystar.gov/cfls>.

For more information about compact fluorescent bulbs and mercury, visit <http://www.energystar.gov/mercury> EPA is continually reviewing its cleanup and disposal recommendations for CFLs to ensure that the Agency presents the most up-to-date information for consumers and businesses.