RBSA FIELD PROTOCOLS

Training and Reference Manual

Table of Contents

NEEA RBSA Communication and Customer Contact: Protocols for Field Technicians

This document outlines the communications, customer contact and field protocols for field technicians as approved at the start of the RBSA data collection phase. Very few changes to field protocols were made during the data collection phase, and these changes may not be reflected in this document.

Importance of Customer Interaction

Cadmus recognizes the importance of developing and adhering to well-defined protocols governing homeowner contact and interaction. Homeowner satisfaction is critical to the overall success of the RBSA and a top priority to Cadmus. The intent of this protocol is to outline all touchpoints involving field technician's interaction with utility customers and describe how they will handle foreseen and unforeseen interactions during the data collection process.

All field technicians will receive thorough training on Cadmus' customer contact and interaction best practices.

Site Visit Preparation and Initial Impressions

Before Site Visit

Field technicians will begin preparing for each site visit 24 to 48 hours in advance of their scheduled on-site appointment. The technicians will ensure they have all the information necessary to make the appointment, including:

- Customer's full name and the name of the person they will meet on the site
- The customer's full address, including any apartment numbers
- The customer's phone number, including area code
- Scheduled site visit time

If the technician identifies that any of these pieces of information are missing, they will immediately reach out to the scheduling firm, copying the project manager on any communication.

Once the field technicians locate all the needed information, they will call the customer, taking care to be professional and courteous on the phone. Field technicians will not make reminder phone calls from a loud or

distracting environment, or after 8:30 p.m. in the customer's local time. The purpose of the phone call is fourfold:

- Reminds the homeowner that the technician will be coming to their home. Technicians will confirm the date and time of the on-site appointment.
- Provides an opportunity to cancel or reschedule the visit if necessary. If the homeowner does need to cancel or reschedule, field technicians will reach out to the scheduling team immediately.
- Builds trust between the technician and the customer. Rather than having a first encounter at their front door, the homeowner learns who the technician is and a bit about what to expect during their site visit.
- Notifies the homeowner that the technician will call ahead if they are running early or late. Technicians will do their utmost to arrive on the site at the scheduled time.

During these reminder phone calls, the homeowner may have questions. Technicians will do their best to answer these questions while on the phone, but may have to call the homeowner back after researching some of the requested information.

Site Visit Equipment

Technicians will ensure they have adequate equipment and gear for the site visit. Such equipment will include an ID badge, an iPad and hardcopy data collection forms (as a backup), shoe covers, and ladders and tools necessary for the home inspection. Technicians will also verify that they have a leave behind letter and gift card for the customer.

Technicians will arrive at each site prepared to conduct all necessary work with their own tools. They will not rely on the resident to provide tools or equipment.[1]

Appearance

While in the field, Cadmus technicians are representatives of Cadmus, NEEA, and the utilities NEEA represents. As such, these staff will maintain a professional appearance and demeanor at all times, including courteous interactions with the utility customers.

All technicians will wear collared shirts, tucked in, with the Cadmus logo. Polo shirts and full button-down shirts are both acceptable. Field technicians will wear jeans, khakis, or work pants without holes, tears, or obvious stains. In extenuating circumstances, it may be permissible for technicians to wear shorts (if they check with the project manager first).

Before approaching the home, technicians will make sure they are presentable and that their affiliation with Cadmus and the RBSA are clearly visible. To this end, technicians will remove hats and sunglasses and ensure their ID badge is visible before approaching the residence.

[1] In some instances, the homeowner may have a special ladder or tool for hard-to-reach areas of their home. In these instances, the field technician may use the homeowner's equipment.

Arriving On-Site

Field technicians should not park in the driveway unless there is no practical alternative. Parking on the street in front of the home is usually the best choice, though care should be taken not to block drive-up access to any road-side mailbox.

Once the technicians arrive on the site, they should approach the residence with minimal gear. Field technicians will clearly communicate who they are to the homeowner, as well as who they work for and why they are at the home. Field technicians should confirm that it is okay to park where they parked, especially if they parked in the driveway. It may be helpful for field technicians to remind homeowners they called the day before to confirm the site visit. Field technicians will ensure their badge is clearly displayed, and will wear shoe covers while inside the home.

Field technicians will **NOT** enter the home unless the homeowner appears comfortable and they confirmed there is an adult (at least 18 years old) on the site.

Once inside the home, field technicians will provide the resident with a business card and a letter explaining the work. Field technicians will also provide the homeowner with their $100 gift card, helping to build trust and good will between the technician and the homeowner. Before beginning the home inspection, field technicians will ask the homeowner if they have any questions or concerns, and let them know that they may accompany the technicians during the on-site work.

On-Site Protocols

General Best Practices

It may be necessary during the course of the site visit for the technicians to move or shift furniture or other equipment, turn lights on and off, and access remote areas of the home such as attics, basements, or crawlspaces. The technicians will leave everything as they found it: turning lights back off, replacing furniture that was moved, and closing opened doors. The technicians will use their own equipment, such as ladders, and will wear shoe covers to protect the home, even if the homeowner says it is not necessary.

Before entering any attic or crawlspace, field technicians will lay a canvas on the floor where they will step out of the space, to catch any insulation or dirt. Field technicians should remove their shoe covers on the canvas, before entering the attic or crawlspace. Field technicians should follow all safety protocols, including putting on clean coveralls before entering a crawlspace from within the conditioned space of a home.

Homeowner Interactions

Throughout the site visit process, field technicians will be courteous. If the homeowner joins the site visit or otherwise engages field technicians in conversation, the technicians will avoid controversial topics while answering any questions the homeowner may have to the best of their ability. Weather, geography, travels, and personal (non-sensitive) history are typically good topics.

The technicians will not comment on the size or quality of construction of the home or the quality of any items in the home, and will not provide advice regarding building equipment or material. Field technicians should avoid conversation with one another in the home that is not directly related to the tasks at hand. Field technicians should assume that the customer can hear all comments.

If the resident has questions about energy efficiency or seeks recommendations based on field work findings, field technicians will arrange to have them put in touch with a utility representative who can help answer their questions (see the Utility Customer Acceleration Protocol below).

Cadmus will not provide reports or findings to homeowners on an individual basis. When encountering homeowners who want the results for their home, field technicians will let the homeowners know they are there to gather the data, but that the results will be interpreted at a later date and will available in anonymous form on NEEA's website. If the homeowner has further questions about the study or wants advice or a report on their home, the technicians will follow the Utility Customer Acceleration Protocol to connect the homeowner with the proper project manager or utility representative.

Site Damage

In the event that damage occurs to the property during the course of the home visit, the technicians will notify the homeowner of the damage and offer a couple of options for compensation. If the damage is small, such as a broken light bulb or a ding in the paint, technicians may offer the homeowner an extra gift card. If the damage is large, it may be necessary for field technician to offer to find a contractor to repair the damage. In either scenario, the technicians will be proactive and will notify the project manager as soon as possible. Field technicians will **NOT** leave the home without taking steps to resolve the issue.

On-Site Etiquette

While on the site, field technicians will avoid the following actions:

- Using the bathroom while in the home. If using the bathroom cannot be avoided, ALWAYS ask first.
- Using a cell phone for personal calls (cell phones are for critical business work only)
- Listening to music or wearing headphones
- Going to a site while sick—instead, field technicians will call the project manager, then will call the scheduling firm to reschedule or cancel the site visit
- Leaving the site when there are unresolved damage issues
- Leaving on the floor any dirt, insulation, or ash introduced during the site visit
- Walking inside the home without shoe covers

Completing the Site Visit

At the end of each site visit, field technicians will collect all of their tools and equipment, ensuring that everything in the home is how they found it. Field technicians will ask the homeowner if they have any additional questions and thank them for their participation in the study. Technicians will remind the homeowner that they can call the number in the leave behind letter if they have additional questions or issues arise.

Utility Customer Acceleration Protocol

As the RBSA work is associated with local utilities, homeowners may use this opportunity to provide field technicians with information that should be communicated to their utility. Cadmus worked with NEEA and NEEA stakeholders to develop a set of steps for field technicians to follow when it is necessary to communicate customer comments or concerns to the utility. This protocol provides information about when

field technicians will gather homeowner comments, the types of comments they should gather, and how and when they will communicate comments to the utility.

Cadmus recognizes that field technicians may capture this data at one or more of the following customer touchpoints during the RBSA scheduling and site visit process:

- During or after the phone survey
- During or after the web survey
- Left as a message on the inbound toll-free line
- During or after the scheduling call
- During or after the site visit

Cadmus proposes that Nexant take responsibility for tracking all customer acceleration incidents, including those that occur while field technicians are on site. For an on-site acceleration incident, the technician will record the relevant customer information and—if urgent—will pass the information to the scheduling team before resuming data collection activities (field technicians will pass non-urgent information to the scheduling team following the visit). From that point, Nexant will adhere to the acceleration protocol outlined below.

When: Nexant will gather customer comments from homeowners who meet the following conditions:

- Has questions or concerns about their energy bills
- Has questions about utility programs, such as energy efficiency programs, online bill payments, or other utility sponsored programs
- Has complaints about the utility
- Wishes to have their comments passed to the utility
- Provides details affecting their satisfaction with their utility

What: Nexant will gather the following information for each customer comment:

- Customer name (verify spelling)
- Customer utility (both natural gas and electric, but indicating which utility the comment is directed to)
- Customer mailing address
- Customer phone number (where they wish to be contacted)
- Customer e-mail address (if possible)
- Customer comment(s)
- Indication of whether the customer requested follow up from the utility
- Date of contact

How: Nexant will e-mail the comment information directly to the utility within 24 business hours, copying the NEEA project manager and Kristie Rupper at Cadmus. Nexant will compile the information from all individual e-mail messages into a tracking spreadsheet, which they send to Cadmus weekly.

NEEA RBSA Lighting Inventory: Protocols for Field Technicians

This document describes the protocol for field technicians of what to collect and the proper methods for collecting lighting data as part of the NEEA RBSA home surveys. The primary data points to be collected are outlined below.

Data Collected for Installed and Stored Lamps

Category	Datapoint	Collected for Installed Lamps	Collected for Stored Lamps
Lighting	Control Type	X	
	Fixture Type	X	
	Fixture Quantity	X	
	Base/Socket Type	X	X
	Lamp Type	X	X
	Lamp Style	X	X
	Lamp length (feet)	X	X
	Lamp Wattage	X	X
	Lamp Quantity	X	
	Wi-Fi connected	X	
	Notes	X	X

Data Collection

The Cadmus iPad data collection tool allows field technicians to record the control type, fixture type, fixture quantity, socket type, lamp type, lamp style, lamp length, lamp wattage, and number of lamps per fixture for each room or space. Field technicians will collect this data for lighting both inside and outside the residence, including for lamps stored for future use.

Where necessary and reasonable, technicians will remove lampshades or fixture covers in order to identify the lamp characteristics. Technicians will not remove lampshades or fixture covers in instances where the fixture seems unstable or otherwise susceptible to breaking.

In the event that a given data point cannot be positively identified by visual inspection, field technicians will note that they gathered this information from some other source (asked the homeowner, assumed based on similar equipment in the home, or unable to identify). Possible scenarios in which this could occur include:

- Fixtures located on high ceilings or suspended fixtures that are out of the reach;
- Hardwired fixtures or fixtures that cannot be quickly taken apart; and
- Fixtures that look susceptible to breaking or unsafe to take apart.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

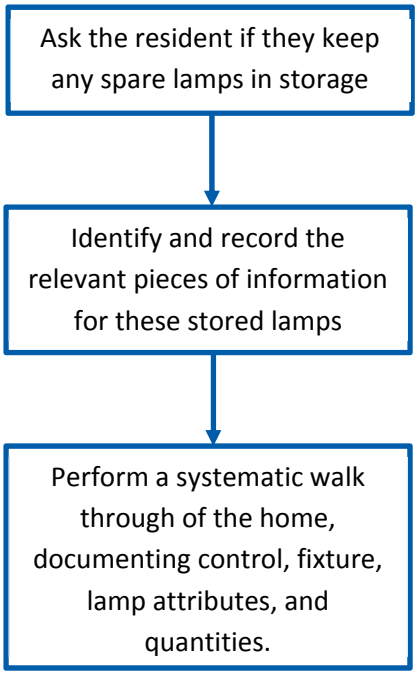
- Data point cannot be safely determined (such as needing to climb over furniture to assess, or when equipment is off the ground and cannot easily be assessed with a stepstool)
- Fixtures that are not easily taken apart or are susceptible to breakage
- Equipment is in a locked room or a room the homeowners asked field technicians not to enter
- Unusual specification and field technicians cannot determine

Notes

Technicians will note any additional information that may prove useful during the data analysis phase, such as: the resident refused access to certain rooms or fixtures; fixture type, lamp type, lamp style, or socket type could not be determined because the lighting fixture cover could not be removed; or irregularities in the home layout (such as bare wires where a fixture used to be).

Lighting Inventory Overview

Lighting data collection is a highly involved process, encompassing lighting both inside and outside the residence, as well as equipment kept in storage or used in the common areas of multifamily buildings. To ensure that all relevant data is collected in a complete and efficient manner, Cadmus has outlined the following process for data collection:



Note that the schematic above reflects the theoretical best practice. Because the actual configuration is highly variable, it may be appropriate for field technicians to deviate from this approach in order to complete the home visit in the most efficient and least intrusive manner.

Though there is some flexibility in the walk through of the residence, the type of data collected for each control-fixture-lamp grouping is fixed and will be consistent across all sites. Field technicians will record the attributes of each control fixture lamp grouping using Cadmus' proprietary iPad data collection software.

Lighting Data Collection

Control Type

Field technicians will collect the control type of each light fixture. To identify which lamps and fixtures are connected to each control point, field technicians will manually test each control. For instances where the control cannot be physically tested (timers, motion sensors, daylight sensors, etc.), field technicians will ask the homeowner how they control the lamp or fixture and which other fixtures are on the same control point. For lamps and fixtures with multiple controls points – such as a fixture that is controlled by both a wall mounted switch and a remote control – field staff will record the more complex control point.

Typical control types are shown in the table below, and include an on-off switch, a dimmable control, a low-medium-high switch for three light outputs, and a motion/photo sensor control. If technicians encounter control types not included in the list or otherwise unfamiliar, they will enter these as "Unknown" and include a description.

Lighting Control Types

Control Types
Three-Way (Low-Medium-High)
Dimmer fixture mounted
Dimmer wall mounted
Motion
On/Off Fixture Mounted
On/Off Wall Mounted
Photo
Photo/Motion
Remote Control
Timer
Other
N/A
Unknown

Fixture Type

Field technicians will identify fixture types based on a visual inspection. Typical possibilities include floor lamp, recessed, and track mounted. The table below shows these and other possible fixture types.

Lighting Fixture Types

Fixture Types
Ceiling Fan
Ceiling Mount Fixture
Hanging (Chandelier or Pendant)
Exit

Fixture Types
Exterior (Flood or Security)
Floor Lamp
Garage Door Opener
High Bay
Landscape
Low Bay
Recessed - Other
Recessed - Can
Table
Torchiere
Track
Wall Mount
Other
N/A
Unknown

Number of Fixtures

Field technicians will identify and collect the quantity of each fixture that is connected to a power source during the time of the inspection.

Base/Socket Type

Field technicians will identify socket types through a visual inspection. In some cases, it may be necessary for technicians to remove the lamp from the fixture. Possible socket types are shown in the table below, and include medium screw base and small screw base.

Most fixtures only have one socket type; however, some fixtures have more than one socket type. For instance, large chandelier fixtures may have a medium screw base globe or incandescent lamps in the center, with small screw base (candelabra) lamps around the perimeter. In these instances, the technicians will identify that a particular fixture has more than one socket type.

Lighting Socket Types

Socket Types
Medium Screw Base (Standard)
Small Screw Base (Candelabra)
Large Screw Base (Mogule)
Pin Base
Integral Fixture
Other
N/A
Unknown

Field staff will also record the socket (base) type for all lamps in storage.

Number of Lamps and Sockets

Field technicians will identify and collect the quantity of each lamp and socket type on a given fixture or in storage. In the event that there is no lamp (i.e., an empty socket), field technicians will record the socket type and indicate that it is empty.

Lamp Type

Field technicians will collect the lamp type through visual inspection of the lamp and fixture. If technicians encounter lamp types not included in the list or otherwise unfamiliar, they will code these as "Unknown" and include a description. Where necessary and reasonable, technicians will remove lampshades or fixture covers in order to identify the lamp type. The table below shows the typical lamp types.

Lamp Types

Lamp Types
Incandescent
Compact Fluorescent
Halogen
Linear Fluorescent
Light Emitting Diode
Halide
Induction
High Intensity Discharge
Incandescent / Halogen
Empty Socket
Other
Unknown

Lamp Style

Field technicians will collect lamp style through visual inspection of the lamp and fixture. The table below lists the various descriptions of lamp shapes field technicians will include in on-site audits. Except for empty sockets, field technicians will describe the shape of every lamp in the audit. Where necessary and reasonable, technicians will remove lampshades or fixture covers in order to identify the lamp style.

Lamp Styles

Lamp Style
Standard A Lamp
Decorative
Globe
Reflector / Flood
Heat Lamp
Colored
Twist
Circline (Screw Base)
Straight Tube
T-4

Lamp Style
T-5
T-8
T-12
N/A
Unknown

Lamp Length

For a subset of lamp types, specifically linear fluorescent lamps, lamp length is also an important attribute. Field technicians will measure lamp length to the nearest half foot, recording the length, in feet, of each linear fluorescent fixture. Where necessary and reasonable, technicians will remove lampshades or fixture covers in order to identify the lamp length.

Lamp Wattage

Due to the changing lighting efficiency standards, the accurate collection of lamp wattage is important. Lamp shape is not a reliable indicator of lamp technology due to residential customer preference for lamps that mimic the shape and feel of traditional technologies (namely, A-lamp incandescents). As a result, the only known and accurate method to properly identify wattage is to physically view the lamp and identify its rated wattage. Typically, the rated wattage can be found:

- Printed on the lamp glass,
- Printed on the lamp ballast, or
- Engraved on or near the metal lamp threading.

Where necessary and reasonable, technicians will remove lampshades or fixture covers in order to identify the lamp wattage. They may also ask homeowners for wattage information.

Wi-Fi Connected

Field technicians will identify whether the home has lamps that are Wi-Fi connected through consultation with the homeowner. Some homes may have hubs that indicate the presence of Wi-Fi connected lamps. In other instances, the Wi-Fi capability is built into the lamp itself and does not require a special hub. Field technicians will flag lamps that are Wi-Fi connected in the data collection tool.

NEEA RBSA Electronics Inventory: Protocols for Field Technicians

This document describes the protocols for field technicians of what to collect and the proper methods for collecting electronics data as part of the NEEA RBSA home surveys. The primary data points to be collected are outlined below.

Importance of Data Collection

The thorough collection of electronics equipment data is a very important task of the upcoming RBSA effort. Electronics are one of the few technologies that all utility customers use on a daily basis. Additionally, because of the many new product and technology types available, the consumer electronics market is constantly in flux.

As the consumer electronics market has changed significantly in recent years, capturing detailed information on the types and quantities of this equipment in residences across the Northwest provides unique insight into the current market trends.

Data Collection Overview

Inventory

Consumer electronics data collection has the potential to be a very time consuming process. To ensure that all relevant data is collected in a complete and efficient manner, Cadmus has the following restrictions for electronics data collection:

- Field technicians will only collect data for pieces of equipment that are actually plugged in at the time of the inspection. For instance, a TV in storage will not be captured.
- Field technicians will try to get equipment model numbers in all scenarios, except when it is not reasonable because of site conditions (TV mounted within a wall, unable to move furniture, etc.). In these scenarios, field technicians will collect as much qualitative data as possible.

Though there is some flexibility in the walk-through of the residence, the type of data collected for each piece of equipment is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data collection software.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

- Data point cannot be safely determined (such as needing to climb over furniture to assess, or when equipment is off the ground and cannot easily be assessed with a stepstool)
- Label is old and information is unrecognizable or label has been removed
- Equipment is in a locked room or a room the homeowners asked field technicians not to enter
- Unusual specification and field technicians cannot determine

Notes

Technicians will note additional information that may prove useful during the data analysis phase, such as: the resident refused access to certain rooms or areas of the home, data collection is limited because the television is recessed or wall mounted, or it was impossible to measure television wattage because the power cord was inaccessible.

Data Collection by Category

Television

Field technicians will collect all of the data points outlined below for each television plugged in at the time of the site visit.

Brand and Model Number

Technicians will collect the unit model number from the equipment nameplate. For televisions, this information is typically either on the back or side of the unit. Some units may have this information on the front cabinet surrounding the screen.

Manufacture Date

Technicians will collect the manufacture date from the equipment nameplate. In some instances, this may be on a sticker near the nameplate, rather than the nameplate itself. If the manufacture date is not listed, field technicians will attempt to look it up using the brand and model information.

Screen Type

Technicians will collect the unit screen type based on a visual inspection. There are three types of television boxes (flat, curved, and tube) that indicate the screen and cabinet shape, and a fourth response to indicate that the unit is a projector, not a television set (see table below).

Flat screen televisions are the new “normal;” they are typical of most units available on sales floors and have a very narrow profile. Curved televisions are a new technology where the screen is curved concave towards the viewer, and is more rare. Tube, internal projection, and rear projection televisions are typically quite large and heavy, to allow space for the internal projection. These larger devices are typically cubic or rectangular, whereas flat and curved LCD devices are more panel shaped and have a very narrow depth.

Screen Types

Response Types
Flat
Curved
Tube (CRT and internal or rear projector)
Projector (non-CRT)

Display Resolution

The display resolution refers to the number of pixels that can be displayed. Field technicians will collect this information from the nameplate, or may ask the homeowner. The response options are shown in the table below.

Display Resolution Types

Response Types
Standard Definition
High Definition (720p)
FHD (1080p)
UHD (4080p)
XUHD (8096p)
Other
N/A
Unknown

Size

Field technicians will measure the size of the television in diagonal inches, to reflect the actual screen size, not the cabinet size. To take this measurement, field technicians will measure from one upper corner diagonally to the opposite lower corner of the screen, rounding to the nearest half inch.

Primary TV Status (Yes/No)

In order to gauge television usage, field technicians will ask homeowners which two units in the home are the primary units (and are used the most). The table below shows the response options.

Primary or Secondary Response Types

Response Types
Primary
Secondary
Both used about the same
Unknown
N/A

Wattage

Field technicians will physically measure the television wattage whenever possible, using a plug through power meter. In order to accomplish this, field technicians will unplug the television from the outlet or power strip, plug in the power meter, then plug the television into the power meter. Once plugged in, the technicians will turn on the TV, wait for the metered value to stabilize, and record the measured power.

When measurement is complete, field technicians will plug the television back in to the outlet or power strip and ensure that it is functioning.

Auxiliary Devices Plugged Into Single Power Strip (Yes/No)

Field technicians will record, as a yes/no response, whether all of the auxiliary items identified are plugged into the same power strip or directly into the TV.

Number of Auxiliary Items

If auxiliary devices are present, field technicians will record the number of auxiliary items associated with the TV that are actually plugged in at the time of inspection. This does not necessarily mean that each device is directly connected to the TV, but rather that it is plugged into a power source and is in working condition at the time of inspection. Auxiliary equipment does not include any of the electronics outlined in this protocol, because these items are being recorded in a more detailed fashion. Auxiliary equipment may include:

- VCRs
- DVDs
- Streaming devices (Roku, Apple TV, etc.)

Internet Enabled (Yes/No)

Field technicians will record as a yes/no response whether each television is internet enabled, meaning it is factory designed to connect to the internet and display content. Televisions that require the assistance of another device (Apple TV, Roku, etc.) to connect to the internet do not qualify under this category. Field technicians will ask the homeowner if any of the TVs are internet enabled.

Set Top Box

Set top boxes convert digital television signal to analogue for viewing on a conventional television set, or they enable cable or satellite television to be viewed. These devices come in a couple of sizes, typically either full size (similar to a DVD player or VCR) or small size (similar to a paperback book). Field technicians will collect the data points outlined below for all set top boxes.

Year Issued

The year the unit was produced provides some insight into its typical power draw. To determine this information, field technicians will locate this information from on or near the equipment nameplate. If field technicians are unable to identify the year of manufacture, they will enter it as “Unknown.”

Size of Device

Field technicians will determine whether the set top box is full size or small size through visual inspection. Full size devices are roughly the same size as a VCR or DVD player, while small devices are roughly the size of a typical paperback book. If field technicians are unsure of the set top box size, they will record the model number in the notes section and select “Unknown” as the response option. The full list of response options is shown in the table below.

Full Size or Small Size Response Options

Response Types
Full
Small
Unknown
N/A

Cable/Satellite Provider

Field technicians will ask homeowners what company provides their television service, and will enter that information into the iPad tool.

Show Recording (Yes/No)

Field technicians will ask homeowners whether they record shows on their set top box, recorded as a yes/no response.

Computer

For the RBSA, a computer is defined as a computing device that is not charged via a USB connector. For desktop and integrated computers, there is usually only a single power cord that connects the power outlet to the computer itself. In some cases, there may also be a power adapter similar to that described below for laptops. Typical laptop chargers consist of three main components:

1. **A laptop tip**, or the portion of power cord that actually plugs into the laptop. The laptop tip is a non-USB power transfer device.
2. **A power adapter**, which is typically on the same cord as the laptop tip, and is usually a larger, blocky device.
3. **Power cord**, or the actual cord that plugs into a power outlet. The opposite end of the power cord attaches to the power adapter.

These definitions will help field technicians identify equipment types, and exclude tablets and other mobile devices from being included as computers.

Type

There are three primary categories of computers: desktops, notebooks (or laptops), and integrated computers (also known as all-in-one computers). Field technicians will select “other” for computing equipment that does not appear to fall into one of the three primary categories.

Computer Type

Computer Type
Desktop
Notebook
Integrated
Other

Desktop computers are easily recognized by their form and components. Desktops typically have either upright (vertical) towers or are horizontal, and include external monitors (displays) and a separate

keyboard/mouse. A desktop is not portable; it is stationary and must be plugged into a power outlet to operate.

Notebook computers are portable with a clamshell form. These devices combine the components of a desktop system into a single device, including the computer, display, speakers, keyboard, and pointing device (such as a touchpad or trackpad). Typically these devices are powered by a rechargeable battery, so they can be used without an external power source for extended periods of time. A laptop is differentiated from a tablet by its power cord: tablets are charged via a USB connector, while laptops are not charged via USB.

Integrated or all-in-one computers fall between desktop and laptop computers. Like a laptop, integrated computers combine the various components of a desktop computing setup into a single machine. Unlike a laptop, integrated computers are not powered by a rechargeable battery: they must remain connected a power outlet in order to function.

The "other" response option indicates that a computer does not fall into one of the above categories. If a field technicians identifies such a computing setup, they will select "other" and take pictures of the setup. Cadmus will then review this documentation for quality control via desk review.

Year of Manufacture

The year the unit was produced provides some insight into its typical power draw. To determine the year the unit was produced, field technicians will locate this information on the equipment nameplate. If technicians are unable to identify the year of manufacture, they will enter it as "unknown."

Number of Screens

Field technicians will document the number of displays connected to the computer that are plugged in and operational at the time of the site visit.

Size of Screens

Field technicians will measure the size of the computer in diagonal inches to reflect the actual screen size, not the cabinet size. To take this measurement, field technicians will measure from one upper corner diagonally to the opposite lower corner of the screen, rounding to the nearest half inch.

Primary Monitor External

Field technicians will identify if the primary computer monitor is external to the computer itself, identifying the primary by asking the homeowner which monitor they use the most. In some cases, this may mean that the primary monitor for a laptop or integrated computer is actually an external display. If the homeowner has multiple monitors they use equally, field technicians will consider the primary monitor as the largest of the monitors in the set-up.

Primary Monitor Size

Field technicians will measure the size of the computer display to reflect the actual screen size, not the size of the cabinet. To take this measurement (in inches, rounded to the nearest half inch), field technicians will measure from one upper corner diagonally to the opposite lower corner.

Primary Monitor Type

In addition to identifying whether the primary monitor is an external component, field technicians will identify the type of display technology: liquid crystal display (LCD) or cathode ray tube (CRT). CRTs are an older technology and can be identified as cubic or rectangular in appearance, with a significant level of depth. LCDs are the more typical of monitors currently available on store shelves. These displays are thinner, and are often referred to as "flatscreen," with more of a panel shape and very narrow depth.

Primary Monitor Type

Primary Monitor Type
LCD
CRT (tube)
N/A

Secondary Monitor External

Field technicians will identify whether secondary computer monitors are external to the computer itself, identifying secondary monitors by asking homeowners which monitors they use the second most. In some cases, the secondary monitor for a laptop or integrated computer will be an external display. If the resident has a multiple monitors they use equally, the field technicians will consider secondary monitors as the second-largest monitors in the set-up.

Secondary Monitor Type

In addition to identifying whether the secondary monitor is an external component, field technicians will identify the type of display technology: LCD or CRT (as detailed above).

Secondary Monitor Type

Secondary Monitor Type
LCD
CRT (tube)
N/A

Secondary Monitor Size

Field technicians will measure the size of the secondary monitor display to reflect the actual screen size, not the size of the cabinet. To take this measurement, field technicians will measure from one upper corner diagonally to the opposite lower corner, collecting this information in inches and rounding to the nearest half-inch.

Auxiliary Computer Items

Field technicians will record the number of auxiliary items associated with computer that are actually plugged in at the time of inspection. Auxiliary equipment does not include any of the electronics outlined in this protocol, because these items are being recorded in a more detailed fashion. Auxiliary equipment may include:

- Printers
- External drives

Auxiliary Devices' Power Strip (Yes/No)

Field technicians will record whether all of the auxiliary items identified are plugged into the same power strip.

Printer (Yes/No)

Field technicians will note whether there is a printer present, operable, and plugged in at the time of the site visit.

External Drive (Yes/No)

Field technicians will note whether there is an external drive present, operable, and plugged in at the time of the site visit.

Modem/Router Quantity

Field technicians will identify how many modems and routers are in the home. Typically, a modem is physically connected to the cable company's coaxial cable or the phone company's DSL phone line. A modem establishes and maintains a connection with the internet service provider's service and converts signals from and to the router. If a homeowner has satellite internet service, they will have a satellite modem.

Routers must be physically wired to the modem. The purpose of a router is to forward data along networks, either by physical wiring or through a wireless network (if the router and associated devices have wireless capabilities).

Uninterruptible Power Supply (Yes/No)

Field technicians will document whether the homeowner uses an uninterruptible power supply (UPS). A UPS is an electrical apparatus that provides emergency power to a load when the input power source fails, such as in a power outage. The on-battery runtime of most UPSs is relatively short (only a few minutes), but is sufficient to start a standby power source or properly shut down the protected equipment. A UPS is typically used to protect hardware such as computers, data centers, telecommunication equipment, or other electrical equipment where an unexpected power disruption

Other Accessory (Yes/No)

Field technicians will identify the presence of any other accessory devices related to the computer.

Other Accessory Type

Field staff will identify the type of each accessory device, asking the homeowner if necessary. As a last resort, field technicians may select this value as "unknown."

Notes

Technicians will provide any additional information that may prove useful during the data analysis phase.

Game System

A game console outputs a video signal to display video games. These devices are designed for video games, but are unique from arcade machines or home computers. Many modern game consoles also function as DVD players, web browsers, and streaming devices.

Brand

Field technicians will collect the brand and model of video game consoles (referring to pictorial examples from training if necessary).

Brand Type

Brand Type
Playstation2
Playstation3
Playstation4
Xbox 360
Xbox One
Nintendo Game Cube
Nintendo Wii
Other
N/A
Unknown

Release

Field technicians will collect the specific release type of the game system, corresponding to the actual configuration of the game system itself. This data point is important because most game systems will have lower power consumption units as a later release.

Release Type

Release Type
Original
Slim
N/A
Unknown

DVDs or Blu-Ray (Yes/No)

Field technicians will ask homeowners if they use their game system to play DVDs or blu-ray movies.

Internet Access (Yes/No)

Field technicians will ask homeowners if they use their game system to access the internet (for e-mail, Netflix, video chat, etc.).

Notes

Technicians will provide any additional information that may prove useful during the data analysis phase.

Audio Equipment

Field technicians will collect the following information about audio equipment within the home.

Number of Pieces

Field technicians will identify the number of pieces of audio equipment, including speakers, subwoofers, and a receiver.

Subwoofer (Yes/No)

Field technicians will record whether audio equipment includes a subwoofer.

Subwoofer Indicator Light (Yes/No)

Field technicians will record whether the subwoofer has an indicator light or was warm to the touch.

Notes

Technicians will provide any additional information that may prove useful during the data analysis phase.

NEEA RBSA Building Configuration: Protocols for Field Technicians

This document describes the protocol that field staff will adhere to while collecting information about the configuration of residential buildings as part of the NEEA RBSA home surveys. The primary data points to be collected are described below.

Data Collection Overview

Inventory

Building configuration data collection can be very time consuming. To ensure that all relevant data are collected in a complete and efficient manner, Cadmus has these restrictions for building configuration data collection:

- Field technicians will collect building configuration data only for the primary structure and any attached additions. Outbuildings or other separate structures will be noted but otherwise will not be included.
- Field technicians will not enter areas where access is blocked by objects that cannot be easily and safely moved by one person in one minute or less.
- Field technicians will not attempt to enter areas with standing water or where access is not safe.

Although there is some flexibility in the walk-through process, the type of data collected is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data-collection software.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

- The data cannot be determined because of any condition noted under Inventory (listed above).
- Determining the data point would require entry into a locked room or a room or area of the structure that the occupant asked the field technicians not to enter.
- The field technicians cannot determine the data point with confidence because of unusual conditions, structure, or materials.
- Determining the data point involves significant risk to occupant property or technician.

Notes

Field technicians will provide any additional information that may prove useful during the data analysis phase, such as when the homeowner refuses access to certain rooms or areas of the home or when data collection is limited because data points are inaccessible.

Building Configuration Data Collection

The pages that follow provide building configuration protocols for these types of structures:

- Single-Family Homes
- Multifamily Homes: All Buildings
- Multifamily Homes: Buildings with Three or Fewer Floors
- Manufactured Homes

The data below will be collected for all housing types.

Year of Construction

Field technicians will enter the year of construction of the building, if known. For site-built structures, this date should be drawn from county tax assessor records where available. For manufactured homes, the date may be available on the U.S. Department of Housing and Urban Development (HUD) data label, as described in the Manufactured Homes section later in this document.

Solar Photovoltaic Systems

Field technicians will collect information on the solar photovoltaic (PV) systems encountered in the field. The data points of interest are outlined below.

Solar PV System Present (Yes/No)

Field technicians will note whether or not a solar PV system is installed on the property.

Solar PV System Rated Power (kW)

Field technicians will note the rated power of the solar PV system in kW.

Solar PV Financing

Field technicians will ask how the solar PV system was financed. This table shows acceptable options.

Solar PV Financing

Response Options
Power purchase agreement with third party
Solar leases
Clean renewable energy bonds
Bank loan
Purchased outright
Other
Unknown

Solar PV Battery Backup (Yes/No)

Field technicians will identify whether there is a battery backup for the solar PV system.

Solar PV Battery Backup Capacity (kW)

For sites with battery backup for the solar PV systems, field technicians will note the system's capacity.

Electric Vehicles and Charging Stations

Field technicians will collect information on the electric vehicles and electric vehicle charging stations encountered in the field. The data points of interest are described below.

Electric Vehicle Quantity

Field technicians will note the number of electric vehicles found on the site.

Electric Vehicle Type

For each electric vehicle on the site, field technicians will identify the vehicle type from the list below.

Electric Vehicle Type

Response Options
Tesla Model S
Tesla Model X
BMWi3
Nissan Leaf
Chevy Volt
Other

Electric Vehicle Charging Station Quantity

Field technicians will note the number of electric vehicle charging stations found on site.

Electric Vehicle Charging Station Type

For each electric vehicle on site, field technicians will identify the vehicle charging station type from the list below.

Electric Vehicle Charging Station Type

Response Options
Level 1 - 1.3kW - 110V (plugs in to standard wall socket)
Level 2 - 3.3kW (15A service)
Level 2 - 6.6kW (30A Service)
Level 2 - 9.6kW (Tesla only - 50A service)
Level 2 - 19.2kW (Tesla Only - 100A service)
Unknown

Home Electrical Panel

Field technicians will collect information on the electrical panel in each dwelling visited.

Electrical Panel Age

Field technicians will note the age of the electrical panel. If unable to identify this information, the technician will mark the age "Unknown."

Electrical Panel Brand

Field technicians will note the manufacturer of the electrical panel by choosing the appropriate value.

Electric Panel Brand

Response Options
General Electric
Federal Pacific
Federal Pacific Stab Lok
Square D
Siemens
Zinsco
Other
Unknown

Electrical Panel Capacity

Field technicians will determine the capacity of the electrical panel in amps by inspecting the label inside the panel door. If this label is illegible or is not found, the field technician will record "Unknown."

Electrical Panel Type

Field technicians will record whether the electrical panel is a fuse panel or a breaker panel. A breaker panel comprises a number of switches that may be tripped by an unsafe electrical surge. Breakers can simply be reset following a surge. A fuse panel will be filled with fuses, typically screwed in similar to a light bulb, and these fuses must be replaced following an unsafe electrical surge.

Room Information

Field technicians will collect information for each room they enter during the site visits. The key data collected for each room is described below.

Room Type

Field technicians will record the room type (such as bedroom, bathroom, kitchen) and will include a more detailed description as warranted. For instance, it may be appropriate to identify a bedroom and bathroom as the "master bedroom" and "master bathroom."

Room Area

Field technicians will record the square footage of each room they enter. Measurements will be taken with a laser measure.

Ceiling Height

Similar to room area, field technicians will also record the average ceiling height for each room. Measurements will be taken with a laser measure.

Utility Meter Information

Field technicians will collect information for all utility meters on site. For single-family and manufactured homes, there will typically be a single meter per resource.

For multifamily buildings, field technicians will need to identify all of the meters for the building and units of interest. At a minimum, field staff should know which meter(s) the audited unit(s) are on, what meter the building is on, and anything else on that building meter.

Utility Gas Meter Number

Field technicians will note the number from the gas meter(s), if present.

Utility Electric Meter Number

Field technicians will note the number from the electric meter(s), if present.

Meter Notes

Field technicians will enter any relevant notes, such as additional meter numbers or information about what portions of a home or building the meter serves.

Smart Home Information

Field technicians will collect information regarding "smart homes" and connected equipment. Information on smart thermostats will be collected under the HVAC Protocols instead.

NEST Smoke Detector

Field technicians will note the number of NEST smoke detectors installed on site, if any.

NEST Smoke Detectors

Response Options
None
1
2
3
4
5+
Unknown

Controller Type

Where multiple devices can be controlled, field technicians will indicate whether control is provided through a web app or software that runs on a personal computer or if the control operates as a stand-alone device with an integrated display.

Controller Type

Response Options
Controlled by web app
Controlled by computer software
Stand-alone device with integrated display
N/A
Unknown

Modules

Field technicians will indicate whether or not modules are installed for each of the following types:

- Door Lock (Yes/No)
- Energy Meter (Yes/No)
- Irrigation Controller/Plant Water (Yes/No)

- Lighting Controls (Yes/No)
- Motion Sensor (Yes/No)
- Other Sensors (Yes/No)
- Security Camera (Yes/No)
- Outlet Socket (Yes/No)

Survey Start Time

Field technicians will enter the arrival time at the home.

Survey Complete Time

Field technicians will enter the time leaving the home.

Single-Family Homes

Field technicians will collect the following data.

Type of Building

Field technicians will identify the type of building from the following list.

Field technicians will choose townhouse or rowhouse when a single-family home with its own structure abuts one or more buildings and sits on land owned by the owner of the home.

Type of Building

Response Options
Single-family, detached
Townhouse or rowhouse
Duplex, triplex, or fourplex
Unknown

Floors Above Grade

Field technicians will note the number of floors above grade.

For most homes with basements, field technicians will consider all of the basement below grade. They will count the basement as 0.5 floors if there is a framed cripple wall at the perimeter of the basement above grade.

For homes with daylight basements, where one wide wall of the home is completely above grade, field technicians will count the basement as 0.5 floors.

Field technicians will choose 1.5 or 2.5 floors for a two- or three-story home with the top floor built into the roof space so that knee-wall attics are present alongside top-floor living space.

Floors Above Grade

Response Options
1
1.5
2
2.5
3+
Unknown

Foundation Type

Field technicians will identify the foundation type.

Field technicians will consider any basement as conditioned unless it is clearly outside of the thermal and pressure boundary of the home. A basement should be considered unconditioned only if it is vented or has a dirt floor and does not contain HVAC equipment. The presence of insulation in the floor above a basement should not in itself define the basement as being unconditioned: homeowners and contractors sometimes insulate the floor above a basement even when the basement should be considered conditioned and without providing an adequate thermal and pressure boundary between the basement and the remainder of the house.

Foundation Type

Response Options
> 90% crawl
> 90% slab
Mixed crawl and slab
Mixed crawl and room over garage
> 90% unconditioned basement
> 90% conditioned basement
Mixed crawl and unconditioned basement
Mixed crawl and conditioned basement
Adiabatic space below
Unknown

Are Any Outbuildings >100 Sq. Ft. Conditioned? (Yes/No)

Field technicians will note whether or not there are any separate structures on the property with an area of conditioned space larger than 100 sq. ft., such as a finished garage or office.

Fuel Type of Outbuilding

Field technicians will identify the primary heating fuel type of the outbuilding.

Fuel Type of Outbuilding

Response Options
Electricity
Gas
Propane
Oil
Other
Unknown

Conditioned Floor Area of Home (Sq. Ft.)

Field technicians will enter the conditioned area of the home, including any basement space that is not clearly outside the thermal and pressure boundary of the home. Conditioned floor area will be calculated using exterior perimeter measurements where practical and interior measurement as necessary.

Multifamily Homes: All Buildings

Field technicians will collect the following data for all included multifamily buildings, regardless of the number of floors.

Building Construction Type

Field technicians will note construction type.

Building Construction Type

Response Options
Frame
Frame over concrete slab
Solid masonry
Rigid frame (concrete or steel)
Unknown

Type of Frame

Field technicians will choose the type of frame from the list of values.

Type of Frame

Response Options
Wood
Steel
Concrete
Masonry
Other
Unknown

Type of Building

Field technicians will identify the type of building.

Type of Building

Response Options
Townhouse or rowhouse
Flats/apartments
Unknown

Total Number Floors Above Ground

Field technicians will enter the number of floors above ground.

Total Number Residential Floors

Field technicians will enter the number of residential floors.

Multifamily Homes: Buildings with Three or Fewer Floors

For multifamily buildings with three or fewer floors, field technicians will collect the following data.

Number Nonresidential Floors

Field technicians will enter the number of nonresidential floors.

Number Parking Floors

Field technicians will enter the number of floors occupied by parking.

Number of Storage/Mechanical Floors

Field technicians will enter the number of floors dedicated to storage and mechanical systems.

Total Enclosed Building Floor Area (Sq. Ft.)

Field technicians will enter the total enclosed floor area of the building, including residential and commercial space but excluding parking.

Total Residential Floor Area (Sq. Ft.)

Field technicians will enter the total floor area of residential space in the building, including any common space in residential areas.

Residential Interior Common Floor Area (Sq. Ft.)

Field technicians will enter the area of common floor area in the residential portions of the building.

Commercial Space

Field technicians will collect the following data points regarding nonresidential commercial space in multifamily buildings.

Commercial Space Enclosed in Building Shell (Yes/ No)

Field technicians will note whether or not the building contains commercial space in addition to residential units.

Commercial Area (Sq. Ft.)

Field technicians will enter the total area of commercial space in the building.

Grocery Area (Sq. Ft.)

Field technicians will enter the area occupied by one more grocery stores.

Office Area (Sq. Ft.)

Field technicians will enter the area of office space in the building.

Retail Area (Sq. Ft.)

Field technicians will enter the area of retail space in the building.

Other Commercial Area (Sq. Ft.)

Field technicians will enter the area of other occupied commercial space in the building.

Vacant Commercial Area (Sq. Ft.)

Field technicians will enter the area of vacant commercial space in the building.

Parking

Field technicians will provide the following data for each type of parking provided on site.

Is Parking Provided In/At the Audited Building? (Yes/No)

Field technicians will indicate whether or not parking is provided at the audited building.

Parking Type

Field technicians will select the type of parking from this list.

Parking Type

Response Options
Carport
Open garage (under building)
Enclosed garage
Open lot (parking lot)
N/A

Parking Area (Sq. Ft.)

Field technicians will report the area of building parking of the identified type in square feet.

Parking Stalls

Field technicians will enter the number of parking spaces of each parking type.

Parking Illuminated (Yes/No)

Field technicians will indicate whether or not the parking of this type is directly illuminated.

Percentage of Parking for Nonresidential Use

For the identified type of parking, technicians will enter the percentage used for nonresidential parking.

Percentage Parking for Nonresidential Use

Response Options
0
10
20
30
40
50
60
70
80
90
100
N/A
Unknown

Parking Notes

Field technicians will note any significant additional or unusual conditions.

Pool/Hot Tubs

Field technicians will provide the following data on any pools or hot tubs.

Pool/Hot Tub Type

Field technicians will select the type of pool or hot tub.

Pool/Hot Tub Type

Response Options
Pool, heated
Pool, unheated
Hot tub
N/A
Unknown

Pool Location

Field technicians will indicate the location of the pool or hot tub.

Pool/Hot Tub Location

Response Options
Indoor
Outdoor
N/A
Unknown

Primary Fuel Type

Field technicians will determine the primary fuel type for the heat source of a heated pool or hot tub.

Pool/Hot Tub Fuel Type

Response Options
Gas
Propane
Electric
Fuel oil/kerosene
Gas/oil
Other
None
Unknown

Pool or Hot Tub Solar Assist

Field technicians will indicate whether or not solar PV equipment has been installed to reduce water heating energy usage.

Pool or Hot Tub Cover

Field technicians will indicate whether or not a pool or hot tub cover is available and regularly used.

Pool or Hot Tub Availability

Field technicians will enter the number of months each year that the pool or hot tub is typically available.

Pool or Hot Tub Notes

Field technicians will notes any significant or unusual conditions not accounted for in the predefined data points.

Laundry

Field technicians will collect data on laundry machines in common areas of multifamily buildings as documented in Appliance Protocols.

Manufactured Homes

Field technicians will collect the following data.

Age and Construction Standard

Field technicians will determine the age and construction standard of each manufactured home based on any relevant certifications, as described here.

Manufactured homes are built according to the U.S. Department of Housing and Urban Development (HUD) code. Any manufactured home built after 1976 should have a HUD data label in one of three locations—the electrical panel, the kitchen cabinet, or a bedroom closet. Field technicians will record the year of manufacture printed on the label. In the absence of a label, the home was probably built before 1976; in this case, field technicians will verify that the condition of the home is consistent with a 40-year-old manufactured home. If the home appears significantly newer and the year of manufacture cannot be determined, field technicians will select “unknown.”

Manufactured homes that comply to Super Good Cents (SGC) or Natural Choice standards will be labeled as such in a similar location as the HUD label. For these homes, field technicians will select "1990-1994, SGC, or Natural Choice."

Manufactured homes that comply with the ENERGY STAR manufactured home standard will be labeled as such in a similar location as the HUD label. For these homes, field technicians will select "NEEM 2000 to current ENERGY STAR."

Age and Construction Standard

Response Options
1975 and older, HUD
1976-1994, HUD
1990-1994, SGC or Natural Choice
1995 to current, HUD
1995 to current, NEEM 2000 to current, ENERGY STAR
N/A
Unknown

Type of Building

Field technicians will identify the type of manufactured home.

Type of Building

Response Options
Single-wide
Double-wide
Triple-wide
Modular/prefab
Other
Unknown

Is There a Site-Built Conditioned Addition? (Yes/No)

Field technicians will indicate whether or not site-built conditioned space has been added to the manufactured home.

Are There Any Outbuildings >100 Sq. Ft. That Are Conditioned? (Yes/No)

Field technicians will note whether or not there are any separate structures on the property with an area of conditioned space larger than 100 sq. ft., such as a finished garage or office.

Fuel Type of Outbuilding

Field technicians will identify the primary heating fuel type of the outbuilding.

Fuel Type of Outbuilding

Response Options
Electricity
Gas
Propane
Oil
Other
N/A
Unknown

Conditioned Floor Area of Home (Sq. Ft.)

Field technicians will enter the conditioned floor area of the home. Conditioned floor area will be calculated using exterior perimeter measurements where practical and interior measurement as necessary.

NEEA RBSA Building Shell: Protocols for Field Technicians

This document outlines the protocols of each data point to be collected and how to collect that data for field technicians performing building shell data collection as part of the NEEA RBSA home surveys. The primary data points to be collected are outlined below the table, which shows which data points are collected by building type.

Data Collection by Building Type

Data Point	Building Type		
	Single Family	Multifamily	Manufactured Homes
Floors			
Floor Type	◊	◊	
Rated Floor Insulation Level			◊
Evidence of Increased Floor Insulation (Yes/No)			◊
Floor Area			◊
Floor Insulation Type			◊
Floor Insulation Thickness			◊
Floor Insulation Condition			◊
Slab Floors			
Slab Floor Type	◊	◊	
Heated Slab (Yes/No)	◊	◊	
Insulated Slab (Yes/No)	◊	◊	
Slab Insulation Level	◊	◊	
Slab Insulation Position	◊	◊	
Slab Floor Area	◊	◊	
Slab Perimeter	◊	◊	
Crawlspaces			
Crawlspace Floor Type	◊	◊	
Vents (Yes/No)	◊	◊	
Blocked or Closed Vents (Yes/No)	◊	◊	
Crawlspace Floor Insulation	◊	◊	
Crawlspace Floor Insulation Thickness	◊	◊	
Crawlspace Floor Insulation Condition	◊	◊	
Crawlspace Floor Framing	◊	◊	
Crawlspace Joist Size	◊	◊	
Crawlspace Wall Insulation	◊	◊	

Data Point	Building Type		
	Single Family	Multifamily	Manufactured Homes
Crawlspace Wall Insulation Thickness	◊	◊	
Crawlspace Wall Insulation Condition	◊	◊	
Basement			
Basement Floor Type	◊	◊	
Basement Conditioned (Yes/No)	◊		
Floor Above Basement Insulation	◊	◊	
Floor Above Basement Insulation Thickness	◊	◊	
Floor Above Basement Insulation Condition	◊	◊	
Basement Slab Heated (Yes/No)	◊	◊	
Basement Slab Insulation	◊	◊	
Basement Slab Insulation Position	◊	◊	
Basement Slab Floor Area	◊	◊	
Basement Slab Perimeter	◊	◊	
Cantilever Area			
Cantilever Floor Type	◊	◊	
Cantilever Floor Insulation (Yes/No)	◊	◊	
Cantilever Floor Insulation Type	◊	◊	
Cantilever Floor Insulation Thickness	◊	◊	
Cantilever Floor Insulation Condition	◊	◊	
Other Areas			
Type of Floor Over Other Areas	◊	◊	
Area Below Heated (Yes/No)	◊	◊	
Type of Other Area	◊	◊	
Type of Floor Above Other Area	◊	◊	
Floor Over Other Area Insulation	◊	◊	
Floor Over Other Area Insulation Thickness	◊	◊	
Floor Over Other Area Insulation Condition	◊	◊	
Floor Area Over Other Area	◊	◊	
HVAC Ducts			
Ducts Present (Yes/No)	◊		◊
Type of Duct	◊		◊
Metal Ducting Insulation Type	◊		
Metal Ducting Insulation Thickness	◊		
Metal Ducting Insulation Condition	◊		
Flex Duct Insulation Level	◊		
Duct Board Duct Thickness	◊		
Cavity Used for Air Transport (Yes/No)	◊		
Return Ducting in Conditioned Space	◊		
Supply Ducting in Conditioned Space	◊		
Supply Ducting in Inaccessible Unconditioned Space	◊		
Evidence of Duct Sealing (Yes/No)	◊	◊	◊
Duct Crossover (Yes/No)			◊

Data Point	Building Type		
	Single Family	Multifamily	Manufactured Homes
Crossover Condition			◊
Walls			
Wall Area	◊	◊	◊
Wall Type	◊	◊	
Framing Size	◊	◊	
Framing Spacing	◊	◊	
Wall Cavity Insulation	◊	◊	
Wall Cavity Insulation Thickness	◊	◊	◊
Rigid Insulation Sheathing	◊	◊	
Alternative Wall Framing (Yes/No)	◊	◊	
Exterior Insulation (Yes/No)	◊	◊	
Exterior Insulation Type	◊	◊	
Exterior Insulation Thickness	◊	◊	
Masonry Type	◊	◊	
Block Filled with Insulation (Yes/No)	◊	◊	
Furred Wall (Yes/No)	◊	◊	
Furred Wall Framing Size	◊	◊	
Furred Wall Framing Spacing	◊	◊	
Furred Wall Insulation	◊	◊	
Furred Wall Insulation Thickness	◊	◊	
Basement Percent Above Grade	◊	◊	
ICF Type	◊	◊	
ICF Wall Thickness	◊	◊	
SIP Thickness	◊	◊	
Log Thickness	◊		
Other Wall Assembly	◊	◊	
Rated Wall Insulation Level			◊
Evidence of Increased Wall Insulation (Yes/No)			◊
Wall Insulation Type			◊
Adiabatic Walls			
Wall Type	◊	◊	
Wall Construction	◊	◊	
Infill Frame Type	◊	◊	
Wall Notes	◊	◊	
Doors			
Door Construction	◊	◊	
Door Size	◊	◊	
Door Type	◊	◊	
Door Window	◊	◊	
Windows			
Window Area	◊	◊	
Window Direction	◊	◊	

Data Point	Building Type		
	Single Family	Multifamily	Manufactured Homes
Window Framing Type	◊	◊	
Window Glazing Type	◊	◊	
Low-E Coating	◊	◊	
Window Opening	◊	◊	
Storm Window	◊	◊	
Ceilings			
Ceiling Type	◊	◊	
Ceiling Area	◊	◊	◊
Ceiling Height	◊	◊	◊
Ceiling Framing Size	◊	◊	
Ceiling Framing Spacing	◊	◊	
Ceiling Insulation (Yes/No)	◊	◊	
Ceiling Insulation Type	◊	◊	◊
Ceiling Insulation Thickness	◊	◊	◊
Ceiling Insulation Condition	◊	◊	
Evidence of Air Sealing (Yes/No)	◊		
Attic Vented (Yes/No)	◊		
Knee Wall Area	◊		
Knee Wall Insulation (Yes/No)	◊		
Knee Wall Framing Size	◊		
Knee Wall Framing Spacing	◊		
Knee Wall Insulation Type	◊		
Knee Wall Insulation Thickness	◊		
Type of Area Above Adiabatic Ceiling	◊	◊	
Ceiling Notes	◊	◊	
Rated Ceiling Insulation Level			◊
Evidence of Increased Ceiling Insulation (Yes/No)			◊
Foam Layer on Top of Roof			◊

Data Collection Overview

Inventory

Building shell data collection has the potential to be very time consuming. To ensure that all relevant data is collected in a complete and efficient manner, Cadmus has the following restrictions for building shell data collection:

- Field technicians will collect building shell data only for primary structure and any attached additions. Outbuildings or other separate structures will be noted but otherwise will not be included.
- In cases where one building comprises more than one living unit, field technicians will collect data only for the living unit or units that correspond to the specified address. For example, with a legal duplex with separate mailing addresses, data will be collected only on the unit indicated by the chosen address. For rented spaces within a single-family home where renters use the same mailing address as the owners, data will be collected for the entire structure and all living spaces if practical.

- Field technicians will base data collection in attics and crawlspaces on observations available from within 10 feet of the hatch.
- Field technicians will not enter areas where access requires creating access holes, freeing access hatches that have been sealed using caulk or other materials, or opening access panels that require removal of more than two screws.
- Field technicians will not enter areas where access is blocked by objects that cannot be easily and safely moved by one person in one minute or less.
- Field technicians will not attempt to enter areas with standing water or where access is not safe.

Though there is some flexibility in the walk-through process, the type of data collected is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data collection software.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

- The data cannot be determined because of any conditioned noted under Inventory above, such as with attics and crawlspaces that do not have access hatches or areas that cannot be safely entered or entered within a reasonable amount of time. .
- Determining the data point would require entry into a locked room or a room or area of the structure that the occupant asked the field technicians not to enter.
- The field technicians cannot determine the data point with confidence because of unusual conditions, structure, or materials.
- Determining the data point involves significant risk to occupant property or technician safety, such as with heavy or delicate light fixture shades or light fixtures that cannot be accessed safely from a step stool.
- The data point cannot be determined through observation without drilling holes or otherwise using destructive methods, which are prohibited.

Notes

Field technicians will provide any additional information that may prove useful during the data analysis phase, such as when the homeowner refuses access to certain rooms or areas of the home, or when data collection is limited due to data points being inaccessible.

Building Shell Data Collection, Single Family and Multifamily

During each site visit, field technicians will measure the size of the home or multifamily building and collect the data required to define the energy efficiency characteristics of the building shell.

For multifamily buildings, field technicians will collect shell information for buildings with three or fewer floors above ground level. Shell data will be collected only for the shell of the building taken as a whole—not for individual units.

Technicians will verify building shell characteristics visually by inspecting all accessible areas of the home or building. Technicians will enter attics and crawlspaces to determine insulation levels and construction types and to inspect duct systems.

Field technicians will collect the data outlined below. Where necessary to accurately characterize the shell, field technicians will define multiple segments of a given shell surface, such as floors, ceilings, or walls.

Floors

Field technicians will characterize all floor space at the thermal boundary of the building by providing the data points defined below for each type of floor. Technicians will enter details of different spaces of the same type separately if attributes such as insulation type or value are substantially different.

Floor Type

Field technicians will select each type of floor on the lowest living space of the building from the following options:

- **Slab** is any conditioned area of the building (except for the basement) that has a concrete floor in contact with the ground.
- **Crawlspace** is a floor suspended above the ground. Crawlspaces are generally shallow enough to prohibit standing in at least some areas and there may be sheets of plastic on the ground to serve as a moisture barrier.
- **Basement** is a lower floor with at least some walls that are at least partially below grade. Basements usually have concrete floors, but some have dirt floors.
- **Cantilever** is a floor that overhangs the foundation or exterior walls of the building.
- **Floor over other area** is a floor above unconditioned areas of a building, such as a garage or storage area, or a floor over any area of a separate dwelling or nonresidential space.

Floor Type

Floor Type
Slab
Crawlspace
Basement
Cantilever
Floor over other area

Slab Floors

Field technicians will collect the data outlined below for each slab floor area of the building.

Heated Slab (Yes/No)

Field technicians will note whether there is a heat source in the floor or slab designed to heat the slab and/or the space above.

Insulated Slab (Yes/No)

Field technicians will note whether slab insulation is installed. This can generally be determined only if building plans are available. If no building plans are available and the technicians cannot determine whether or not insulation existing through visual observation, then they must select "Unknown."

Slab Insulation

Slab Insulation
Yes
No
N/A
Unknown

Slab Insulation Level

Field technicians will measure the thickness of any observable slab insulation.

Slab Insulation Level

Slab Insulation Level
1 inch
2 inches
3 inches
N/A
Unknown

Slab Insulation Position

Field technicians will determine if there is insulation around the perimeter of the slab or both underneath the slab and at the perimeter ("Complete").

Slab Insulation Position

Slab Insulation Position
Perimeter
Complete
N/A
Unknown

Slab Floor Area

For the conditioned area of the building except for any basement, field technicians will calculate the floor area (square footage) in contact with the ground. This area will often be different than conditioned floor area.

Slab Perimeter

For the conditioned area of the building except for any basement, field technicians will measure the perimeter of floor area (linear feet) in contact with ground.

Crawlspaces

Field technicians will capture the applicable values for each crawlspace of the structure.

Crawlspace Floors

Field technicians will document the type of crawlspace floor.

Vents (Yes/No)

Field technicians will note whether vents are present at the exterior perimeter of the crawlspace, typically through the foundation.

Blocked or Closed Vents (Yes/No)

Field technicians will note whether most or all of the crawlspace vents are currently sealed, blocked, or closed.

Crawlspace Floor Insulation

Field technicians will determine what type of insulation is present at the subfloor above the crawlspace.

Crawlspace Floor Insulation Type

Insulation Type
None
Fiberglass batts, friction fit
Fiberglass batts with twine
Fiberglass batts with wood lath
Fiberglass batts with mesh
Blown cellulose with bib
Open-cell spray foam
Open-cell spray foam and fiberglass batts
Closed-cell spray foam
Closed-cell spray foam and fiberglass batts
N/A
Unknown

Crawlspace Floor Insulation Thickness

Field technicians will measure the thickness of floor insulation in each accessible crawlspace. When spray foam and fiberglass batts are installed, they will measure total thickness.

Floor Insulation Thickness

Floor Insulation Thickness
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
7 inches
8 inches
9 inches
10 inches
11 inches

Floor Insulation Thickness
12 inches
N/A
Unknown

Crawlspace Floor Insulation Condition

It is common for floor insulation to fall from place if it is not fastened to the floor or has been damaged by pests. Field technicians will estimate the percentage of insulation that is still in place in each accessible crawlspace.

Particularly with floors using a post-and-beam structure, significant sagging is common. Field technicians will disregard sagging unless it is severe enough that the insulation cannot function effectively, such as when they can view the subfloor and/or reach through without moving the insulation. If severe sagging is present, field technicians will consider the insulation as fallen, or not in place.

If the thermal envelope of the building extends below the floor into a conditioned crawlspace and the floor is not insulated, field technicians will choose the value as "N/A" (non-applicable).

Floor Insulation Condition

Floor Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Crawlspace Floor Framing

Field technicians will note the framing technique used to support the floor in each accessible crawlspace from the following options:

- ***Post and beam*** floors have regular posts supporting 4-inch or wider beams, which are usually spaced 48 inches apart or wider. The perimeter foundation also provides support.
- ***Joist*** floor framing comprises 2-inch-wide joists, usually spaced 16 or 24 inches apart. A few posts may be present as well as one or more supporting beams to reduce the span, but perimeter foundation walls carry more of the load than with a post-and-beam floor framing.

Crawlspace Floor Framing

Crawlspace Floor Framing
Post and Beam
Joist
N/A
Unknown

Crawlspace Joist Size

Field technicians will capture the depth (height) of the most common joists or beams.

Crawlspace Joist Size

Crawlspace Joist Size
2x6 or 4x6
2x8 or 4x8
2x10 or 4x10
2x12 or 4x12
N/A
Unknown

Crawlspace Wall Insulation

Field technicians will note the type of insulation along the exterior walls of the crawlspace.

Crawlspace Wall Insulation Type

Crawlspace Wall Insulation Type
None
Foil-faced polyisocyanurate foam board
Extruded Polystyrene foam board (pink or blue board)
Expanded Polystyrene foam board (white)
Fiberglass batts
Open-cell spray foam
Closed-cell spray foam
N/A
Unknown

Crawlspace Wall Insulation Thickness

Field technicians will measure the thickness of crawlspace insulation in each accessible crawlspace.

Crawlspace Wall Insulation Thickness

Crawlspace Wall Insulation Thickness
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
7 inches
8 inches
9 inches
10 inches

Crawlspace Wall Insulation Thickness
11 inches
12 inches
N/A
Unknown

Crawlspace Wall Insulation Condition

It is common for crawlspace wall insulation to fall away from the wall. Field technicians will estimate the percentage of insulation that is still in place in each accessible crawlspace.

Crawlspace Wall Insulation Condition

Crawlspace Wall Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Basement

Field technicians will capture the applicable values outlined below for each basement of the structure.

Basement Conditioned (Yes/No)

Field technicians will identify the basement as conditioned unless it is clearly outside of the thermal and pressure boundary of the building. They will consider a basement as unconditioned only if it is vented or has a dirt floor and does not contain HVAC equipment. The presence of insulation in the floor above a basement should not in itself define the basement as being unconditioned: homeowners and contractors sometimes insulate the floor above a basement even when the basement should be considered conditioned and without providing an adequate thermal and pressure boundary between the basement and the remainder of the house.

Floor Above Basement Insulation

Field technicians will note the type of insulation at the subfloor between the basement and the floor above it. If the basement ceiling is finished and field staff are not able to access the subfloor, they will choose “Unknown.”

Floor Above Basement Insulation Type

Floor Above Basement Insulation Type
None
Fiberglass batts, friction fit or compression pins
Fiberglass batts with twine
Fiberglass batts with wood lath
Fiberglass batts with mesh
Blown cellulose with bib
Open-cell spray foam
Open-cell spray foam and fiberglass batts
Closed-cell spray foam
Closed-cell spray foam and fiberglass batts
N/A
Unknown

Floor Above Basement Insulation Thickness

Field technicians will measure the thickness of insulation at the subfloor above the basement. Where spray foam and fiberglass batts are installed, they will measure the total thickness.

Floor Above Basement Insulation Thickness

Floor Above Basement Insulation Thickness
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
7 inches
8 inches
9 inches
10 inches
11 inches
12 inches
N/A
Unknown

Floor Above Basement Insulation Condition

Field technicians will estimate the percentage of the floor above the basement that is insulated.

Floor Above Basement Insulation Condition

Floor Above Basement Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Basement Slab Heated (Yes/No)

Field technicians will note whether there is a heat source on the basement floor or inside the basement slab designed to heat the floor and/or the basement.

Basement Slab Insulation

Field technicians will note whether slab insulation is installed. This can generally be determined only if building plans are available. If no building plans are available and the technicians cannot determine whether or not insulation existing through visual observation, then they must select "Unknown."

Basement Slab Insulation Level

Basement Slab Insulation Level
None
1 inch
2 inches
3 inches
N/A
Unknown

Basement Slab Insulation Position

Field technicians will determine if there is insulation around the perimeter of the slab or both underneath the slab and at the perimeter ("Complete").

Insulation Position

Insulation Position
Perimeter
Complete
N/A
Unknown

Basement Slab Floor Area

Slab floor area represents the square footage of the building that is contact with the ground and is not considered a basement. Field technicians will calculate this in real time from digital sketches of applicable internal rooms of the structure. This area is different than conditioned floor area.

Basement Slab Perimeter

Field technicians will determine the slab perimeter in linear feet.

Basement Percent Above Grade

Field technicians will indicate the percentage of basement walls above grade by measuring the typical above-grade height of the foundation walls.

Basement Percent Above Grade

Basement Percent Above Grade
< 5% (less than 6 inches)
5-10% (7-12 inches)
10-25% (13-24 inches)
25-50% (24-48 inches)
> 50% (> 48 inches)
N/A
Unknown

Cantilever Area

Field technicians will capture the applicable values outlined below for each cantilevered area of the structure.

Cantilever Floors

Field technicians will document the type of floor in each cantilever area.

Cantilever Floor Insulation (Yes/No)

Where practical, field technicians will determine whether insulation is present under the floor of each cantilevered area.

Cantilever Floor Insulation Type

Where practical, field technicians will determine and note the type of insulation under the floor of the cantilevered area.

Cantilever Floor Insulation Type

Cantilever Floor Insulation Type
Fiberglass batts
Cellulose (blown)
Fiberglass (blown)
Open-cell spray foam
Closed-cell spray foam
N/A
Unknown

Cantilever Floor Insulation Thickness

Where practical, field technicians will measure the thickness of insulation in the floor of the cantilevered area.

Cantilever Floor Insulation Thickness

Cantilever Floor Insulation Thickness
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
7 inches
8 inches
9 inches
10 inches
11 inches
12 inches
N/A
Unknown

Cantilever Floor Insulation Condition

Field technicians will estimate the percentage of insulation that is still in place in the floor of the cantilevered area.

Cantilever Floor Insulation Condition

Cantilever Floor Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Floor Over Other Areas

Field technicians will capture the applicable values for floors above unconditioned areas of a building, such as a garage or storage area, or for floors over any area of a separate dwelling or non-residential space.

Area Below Heated (Yes/No)

Field technicians will determine whether the other area is heated, whether by supply vents, portable heaters, or other heat sources.

Type of Other Area

Field technicians will specify the type of other area from the values shown in the table below.

Type of Other Area Below Cantilever

Type of Other Area
Garage
Parking
Storage
Nonresidential occupancy
Residential occupancy
Other
N/A
Unknown

Type of Floor Above Other Area

Field technicians will identify the type of floor above the other area.

Type of Floor Above Other Area

Type of Floor Above Other Area
Frame
Slab
Other
N/A
Unknown

Floor Over Other Area Joist Size

Field technicians will capture the depth (height) of the joists.

Floor Over Other Area Joist Size

Floor Over Other Area Joist Size
2x6 or 4x6
2x8 or 4x8
2x10 or 4x10
2x12 or 4x12
N/A
Unknown

Floor Over Other Area Insulation

Where practical, field technicians will determine what type of insulation is present in the floor assembly over the other area.

Insulation Type in Floor Over Other Area

Insulation Type in Floor Over Other Area
None
Fiberglass batts
Cellulose (blown)
Fiberglass (blown)
Open-cell spray foam
Closed-cell spray foam
N/A
Unknown

Floor Over Other Area Insulation Thickness

Where practical, field technicians will measure the thickness of insulation in the floor over the other area.

Insulation Thickness in Floor Over Other Area

Insulation Thickness in Floor Over Other Area
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
7 inches
8 inches
9 inches
10 inches
11 inches
12 inches
N/A
Unknown

Floor Over Other Area Insulation Condition

Where practical, field technicians will estimate the percentage of insulation that is still in place in the floor over the other area.

Other Area Floor Insulation Condition

Other Area Floor Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Floor Area Over Other Area

Field technicians will calculate the area (in square footage) of the floor over other areas.

Walls

Field technicians will define separate wall areas as necessary to account for multiple types of construction, framing depth, insulation, etc. They will characterize each wall segment with the relevant data points using the guidance outlined below.

Wall Area

Field technicians will determine the gross area (square footage) of each type of wall based on exterior perimeter and interior ceiling height measurements. Technician will define basement walls separately from above-grade walls, even in buildings with masonry walls above ground. Field technicians will enter different spaces of the same type separately if attributes such as insulation type or value are substantially different.

Wall Type

Field technicians will note each type of wall in the building, which will be defined by the materials and configuration that provide primary structural support. Wood-framed walls rank by far as the most common in houses. Field technicians will attempt to confirm the wall type through observation from within a garage or basement, from the attic, or by removing a faceplate from a light switch or electrical outlet.

Wall Type

Wall Type
Wood framed
Masonry
Masonry (basement)
Insulated concrete form
Structural insulated panels
Adiabatic
Structural steel
Infill frame
Log
Other
N/A
Unknown

Wood framed will be the correct choice for most single-family homes. The structure of the walls is provided by wood framing. A wall should be considered wood framed even when stucco is applied to the exterior of a wood-framed wall, as is usually the case with stucco exteriors.

Masonry is for walls that rely on brick, concrete block, poured concrete, or stone for structure support. **Masonry (basement)** applies only to basement walls.

Occupants of a home with **insulated concrete form (ICF)** walls can generally identify the wall type and may be able to provide building plans. In a multifamily building, the building manager or owner will likely know.

Property owners or managers of a building constructed with **structural insulated panels (SIPs)** will likely be able to identify the wall structure.

Adiabatic walls act as barriers between two thermal systems, such as two houses or units, primarily in a duplex or multifamily building with an insulated common wall.

Structural steel walls have steel framing that provides primary structural support.

Infill frame walls are rare in single family homes. They have relatively few large timbers, steel beams, or masonry components to support the structural loads. Sections of wall between the supports complete the shell but do not carry load.

Log walls will be relatively rare but obvious: Homeowners typically like to preserve the log aesthetic at least at the exterior of the walls.

Other walls have a construction type that does not fit within an identified category.

Framed Walls

Field technicians will collect the data points outlined below for each framed wall in the building.

Framing Size

Field technicians will note the size of framing for wood and steel framed walls, and, if applicable, for "Other" wall types. Field technicians will often determine the framing depth by measuring the jamb width of an exterior door: a 4.5-inch door jamb usually indicates 2x4 framing, while a 6.5-inch door jamb usually indicates 2x6 framing. To determine the thickness of framing, field technicians will measure the entire wall assembly, then subtract off the estimated thickness of the interior wall surface and exterior sheathing, insulation (if present), and cladding.

Size of Framing

Size of Framing
2x2
2x3
2x4
2x6
2x8
N/A
Unknown

Framing Spacing

Where practical, field technicians will determine the spacing of framing for wood and steel framed walls, and, if applicable, for "Other" wall types.

Spacing of Framing

Spacing of Framing
16” on center
24” on center
N/A
Unknown

Alternative Wall Framing (Yes/No)

Field technicians will note if there is known or observed alternative or advanced wall framing, which might comprise 2x4 staggered studs with a 2x6 top plate or double-wall construction. The goal of advanced framing is to reduce the framing factor in walls and to combat thermal bridging.

Wall Insulation

Field technicians will collect the data points outlined below for wall insulation in the building.

Wall Cavity Insulation

Field technicians will indicate whether each framed wall area is insulated and will make every reasonable effort to determine this through thermal infrared inspection or through observation, such as by probing around exterior wall electrical boxes. Field technicians will attempt to confirm conclusions reached through thermal infrared inspection by observation in at least one location. If wall insulation cannot practically be determined through nondestructive methods, then field technicians will choose “Unknown.” Where practical, field technicians will determine the type of cavity insulation in wood and metal framed walls, infill walls, and “Other” wall types.

Wall Cavity Insulation Type

Wall Cavity Insulation Type
None
Fiberglass batts
Mineral wool batts
Cellulose batts
Blown fiberglass
Blown mineral wool
Blown cellulose
Open-cell spray foam
Closed-cell spray foam
Vermiculite
N/A
Unknown

Wall Cavity Insulation Thickness

Where practical, field technicians will measure or estimate the thickness of cavity insulation. Estimating is permissible only when the insulation can be probed to determine air gap. Field technicians will select “Unknown” if direct observation or probing is not practical.

Cavity Insulation Thickness

Cavity Insulation Thickness
1 inch
2 inches
2.5 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
N/A
Unknown

Exterior Insulation (Yes/No)

For wall types other than ICF, field technicians will note whether insulation is observable or known to exist at the exterior of the structural wall, against the sheathing or masonry. Any available building plans may have this information. It may be possible to detect insulation under siding at the top of the foundation. Field technicians will not include the 1/2-inch or thinner layer of foam board that is often installed over pre-existing wood siding when vinyl or aluminum siding is added to a home

Exterior Insulation Type

Where practical, field technicians will determine the type of exterior insulation in all wall types other than ICF.

Exterior Insulation Type

Exterior Insulation Type
Foil-faced polyisocyanurate foam board
Extruded polystyrene foam board (pink or blue)
Expanded polystyrene foam board (white)
Open-cell spray foam
Closed-cell spray foam
N/A
Unknown

Exterior Insulation Thickness

Where practical, field technicians will determine the thickness of any known or observable exterior insulation in all wall types other than ICF. Technicians will not include the 1/2-inch layer of foam board often installed with vinyl or aluminum siding.

Exterior Insulation Thickness

Exterior Insulation Thickness
0.5 inches
0.75 inches
1 inch
2 inches
3 or more inches
N/A
Unknown

Masonry Walls

Field technicians will collect the data points outlined below for each masonry wall in the building.

Masonry Type

Field technicians will indicate the type of masonry wall where applicable. The most common type of masonry in basements is poured concrete. Stone masonry walls and foundations are rare in the Northwest.

Masonry Type

Masonry Type
Brick
Concrete block
Poured concrete
Stone
N/A
Unknown

Block Filled with Insulation (Yes/No)

Where practical, field technicians will note whether concrete blocks are filled with insulation. This value will most commonly be "Unknown," but field technicians will take the information from building plans if they are available.

Furred Walls

Field technicians will collect the data points outlined below for each furred wall in the building.

Furred Wall (Yes/No)

Field technicians will note whether there is a framed wall on the interior of the structural wall, as is common with masonry walls. This input also applies to basement walls and structural steel walls. With masonry walls, field technicians can easily determine the existence of a furred wall by knocking on the interior wall.

Furred Wall Framing Size

Where a furred wall is present, field technicians will determine the size of framing. Framing thickness can often be determined by measuring the wall cavity depth.

Furred Wall Framing Size

Furred Wall Framing Size
2x2
2x4
2x6
2x8
N/A
Unknown

Furred Wall Framing Spacing

Where practical, field technicians will determine the spacing of furred wall framing.

Furred Wall Framing Spacing

Furred Wall Framing Spacing
16 inches on center
24 inches on center
N/A
Unknown

Furred Wall Insulation

Field technicians will indicate the type of furred wall insulation. Where this cannot be determined by observation, such as by probing around exterior wall electrical boxes, field technicians will choose “Unknown.”

Furred Wall Insulation Type

Furred Wall Insulation Type
None
Fiberglass batts
Mineral wool batts
Cellulose batts
Blown fiberglass
Blown mineral wool
Blown cellulose
Foil-faced polyiscyanurate foam board
Extruded polystyrene foam board (pink or blue)
Expanded polystyrene foam board (white)
Open-cell spray foam
Closed-cell spray foam
Vermiculite
Perlite
N/A
Unknown

Furred Wall Insulation Thickness

Field technicians will measure or estimate the thickness of insulation in furred wall cavities. Estimating is permissible only when the insulation can be direction observed or probed to get some indication of air gap; otherwise, technicians will select "Unknown."

Furred Wall Insulation Depth

Furred Wall Insulation Depth
1 inch
2 inches
2.5 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
N/A
Unknown

ICF Type

Field technicians will determine the type of insulated form used in ICF construction. If available, a building plan should provide this information.

ICF Form Type

ICF Form Type
Expanded polystyrene foam board (white)
Urethane
Thickness, nominal R-value
N/A
Unknown

ICF Wall Thickness

Field technicians will determine wall thickness from building plans or by measuring at window or door frames.

ICF Wall Thickness

ICF Wall Thickness
6 inches
8 inches
12 inches
N/A
Unknown

SIP Thickness

Field technicians will determine the SIP thickness from building plans or by measuring at window or door frames and subtracting the estimated thickness of the interior wall finish and exterior cladding.

SIP Thickness

SIP Thickness
4 inches
6 inches
8 inches
10 inches
N/A
Unknown

Log Thickness

Field technicians will determine the log thickness from building plans or by measuring at window or door frames.

Log Thickness

Log Thickness
6-9 inches
10-14 inches
15 or more inches
N/A
Unknown

Adiabatic Walls

Field technicians will collect the data points outlined below for each adiabatic wall in the building.

Wall Type

Field technicians will specify whether adiabatic walls separate the dwelling from another living space, as with a condo or townhouse, or from a heated nonresidential space, such as an office or retail space.

Adiabatic Type

Adiabatic Type
Wall to other living space
Wall to heated nonresidential occupancy
Other
N/A
Unknown

Wall Construction

Field technicians will specify the type of construction of the adiabatic wall, which will typically be framed.

Adiabatic Wall Type

Adiabatic Wall Type
Framed
Masonry
SIPs
Other
N/A
Unknown

Infill Frame Type

Where practical, field technicians will specify the material of the structural members.

Infill Frame Type

Infill Frame Type
Wood
Metal
Reinforced concrete
N/A
Unknown

Wall Notes

Field technicians will log additional relevant information in the notes field for each wall type. Examples of additional information include:

- Conditions that prevented the desired data collection
- Significant water damage or other durability or safety issues
- Brick or stone foundations in buildings with a basement
- The presence and height of framed cripple walls in basement
- The source of wall assembly information if other than direct observation, such as building plans

Other Wall Assembly

Field technicians will describe the wall assembly as accurately as possible in the Notes field and document all relevant data. Field technicians will also take pictures and will document in the Notes field why the assembly does not fit another classification.

Ceilings

Field technicians will characterize each ceiling/attic space at the thermal boundary of the home by providing the data points defined below. Technicians will enter different spaces of the same type separately if attributes such as insulation type or value are substantially different.

Ceiling Type

Field technicians will determine the ceiling style type.

Ceiling Style Type

Ceiling Type
Attic
Attic (inaccessible)
Roof deck
Sloped/vaulted (no attic)
Knee wall
Adiabatic
Other

Attic is where there is accessible attic space above the ceiling, such as with most flat ceilings and some vaulted ceilings.

Roof decks should be chosen when the roof deck of an attic space has been insulated to create a conditioned attic space or when the roof assembly contains one or more layers of foam board. Field technicians will not select the roof deck type where somebody attempted to insulate by installing insulation on the roof deck but fell short of creating a conditioned boundary (such as when the attic space is ventilated or the insulation is incomplete, exterior attic walls remain uninsulated, and there has been no attempt to air-seal at the roof deck and eaves). In attics that have been brought inside the thermal boundary properly, the roof deck insulation is typically spray foam or rigid foam.

Sloped/vaulted (no attic) is for ceilings that attach to rafters, leaving no accessible attic. This includes cathedral ceilings over entire rooms, as well as the sloped portion of ceilings common in 1.5 story houses.

Knee walls are any wall or portion of a wall that separates the attic from living space.

Adiabatic ceilings serve as a boundary between another dwelling unit or conditioned nonresidential space.

For side attics, also known as knee-wall attics or rake attics, field technicians will select **Attic** to define the ceiling area that makes up the floor of the side attics, **sloped/vaulted (no attic)** to define the area of sloped ceiling between the side attic and upper attic, and **knee wall** to define the wall that separates the side attics from living space.

Ceiling Area

For each ceiling segment, field technicians will calculate the area in square feet. For sloped ceilings such as vaulted and cathedral ceilings, this will be the actual area of the ceiling surface, not the area of the living space beneath it.

Ceiling Height

For each ceiling segment (except knee walls), field technicians will enter the average ceiling height in feet. Then, field technicians will use this average to calculate the volume of living space, which is useful for calculating the building airflow standard, also called the building tightness limit and minimum ventilation level.

Where there is a cathedral or vaulted ceiling, field technicians will pick a point half-way up the pitch to use as the average ceiling height.

Ceiling Framing Size

Field technicians will determine the framing size as practical, either by measuring from within the attic space or by probing around a light fixture with a wood or plastic probe.

Ceiling Framing Size

Ceiling Framing Size
2x2
2x4
2x6
2x8
2x10
2x12
TJI
Open-web truss
N/A
Unknown

Ceiling Framing Spacing

Field technicians will determine the framing spacing where practical, either by measuring from within the attic space or by detecting rafters with a stud finder or by knocking.

Ceiling Framing Spacing

Ceiling Framing Spacing
16 inches on center
24 inches on center
30 inches on center
Other
N/A
Unknown

Ceiling Insulation (Yes/No)

Field technicians will indicate whether the area of ceiling is insulated. Where this cannot be determined from the attic space or by observation, such as by probing around ceiling light fixtures, field technicians will choose "Unknown."

Ceiling Insulation Type

Field technicians will determine the type of ceiling insulation, either by observation from within accessible attic space or by probing around a ceiling light fixture with a wood or plastic probe. Where this cannot be determined from the attic space or by observation, such as by probing around ceiling light fixtures, field technicians will choose "Unknown."

Ceiling Insulation Type

Ceiling Insulation Type
Mixed
Fiberglass batts
Mineral wool batts
Cellulose batts
Blown fiberglass
Blown mineral wool
Blown cellulose
Foil-faced polyiscyanurate foam board
Extruded polystyrene foam board (pink or blue)
Expanded polystyrene foam board (white)
Open-cell spray foam
Closed-cell spray foam
Vermiculite
Perlite
N/A
Unknown

Ceiling Insulation Thickness

Field technicians will determine the thickness of ceiling insulation, either by observation from within accessible attic space or by probing around a ceiling light fixture with a wood or plastic probe. Technicians will choose the closest value, only estimating when they can probe the insulation to determine thickness or air gap. Field technicians will choose "Unknown" if direction observation or probing is not possible.

Ceiling Insulation Depth

Ceiling Insulation Depth
1 inch
2 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
10 inches
12 inches
14 inches
16 inches
18 inches
20 or more inches
N/A
Unknown

Ceiling Insulation Condition

Field technicians will estimate the percentage of insulation installed in the area through direct observation or, where practical, infrared inspection.

Attic Insulation Condition

Attic Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Evidence of Air Sealing (Yes/No)

In accessible attic spaces, field technicians will note whether there are signs of air sealing in the ceiling or attic floor. For instance, from the attic, field technicians will look for indications of air sealing, such as a small spot of spray foam at electrical and plumbing penetrations or a strip of spray foam around openings along the top plates of walls.

Attic Vented (Yes/No)

Field technicians will note whether there are any observable roof, edge, soffit, or eave vents for the attic space.

Knee Wall Area

Field technicians will enter the knee wall area in square feet.

Knee Wall Insulation (Yes/No)

Field technicians will indicate whether the area of knee wall is insulated. Where this cannot be determined from the attic space or infrared inspection, field technicians will choose “Unknown.”

Knee Wall Framing Size

Field technicians will measure the framing size where practical.

Knee Wall Framing Size

Knee Wall Framing Size
2x2
2x4
2x6
Unknown

Knee Wall Framing Spacing

Field technicians will determine the framing spacing where practical, either by measuring from within the attic space or by detecting rafters with a stud finder or by knocking.

Knee Wall Framing Spacing

Knee Wall Framing Spacing
16 inches on center
24 inches on center
30 inches on center
Other
N/A
Unknown

Knee Wall Insulation Type

Field technicians will determine the type of ceiling insulation, either by observation from within accessible attic space or by probing around a ceiling light fixture with a wood or plastic probe. Where this cannot be determined from the attic space or by observation, such as by probing around ceiling light fixtures, field technicians will choose "Unknown."

Knee Wall Insulation Type

Knee Wall Insulation Type
Mixed
Fiberglass batts
Mineral wool batts
Cellulose batts
Blown fiberglass
Blown mineral wool
Blown cellulose
Foil-faced polyiscyanurate foam board
Extruded polystyrene foam board (pink or blue)
Expanded polystyrene foam board (white)
Open-cell spray foam
Closed-cell spray foam
Vermiculite
Perlite
N/A
Unknown

Knee Wall Insulation Thickness

Field technicians will determine the thickness of the knee-wall insulation, either by observation from within an accessible attic space or by probing around an electrical outlet box with a wood or plastic probe.

Knee Wall Insulation Thickness

Knee Wall Insulation Thickness
1 inch
2 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
Unknown

Type of Area Above Adiabatic Ceiling

Field technicians will record the ceiling construction type between the dwelling and the other conditioned space.

Area Type Above Adiabatic Ceiling

Area Type Above Adiabatic Ceiling
Nonresidential occupancy
Parking
Storage
Other
N/A
Unknown

Ceiling Notes

Field technicians will log additional relevant information in the notes field for each ceiling type. Examples of additional information include:

- Conditions that prevented the desired data collection
- Significant water damage or other durability or safety issues
- The source of assembly information if other than direct observation, such as building plans or infrared inspection

HVAC Ducts

Field technicians will capture the applicable data outlined below for HVAC ducting.

Ducts Present (Yes/No)

Field technicians will note whether HVAC system ducting is present, whether in a crawlspace, attic, or inside the thermal boundary of the building.

This data will not be applicable to buildings with no air handler, such as those that rely on a boiler with a radiator system or on electric baseboard heating.

Type of Duct

Field technicians will determine duct type through observation. Duct type can usually be determined by observation in the crawlspace, basement, and/or attic. Return air may be channeled through joist bays, often

called panned returns. In that case, field technicians will choose the duct-type value that most closely characterizes the supply air ducts.

- Flex duct, or ***flex***, consists of a flexible vinyl layer supported by a wire coil. An outer insulating layer comprises a layer of fiberglass with an outer shell, which is usually black plastic. The plastic outer shell of older flex duct may be light gray. Some flex duct has a foil outer shell.
- ***Duct board*** typically consists of one inch or more of semi-rigid fiberglass board with a foil facing on one side and a layer of fiberglass matting on the other. Duct board is sometimes used to create a low-cost plenum, trunkline, and other ducting but is often used in garages or other unconditioned spaces only to insulate a metal plenum or trunk. Field technicians will be careful to determine whether any duct board in the system is serving as the duct itself or only as insulation.

Type of Duct

Type of Duct
All metal
Metal plenum/trunk, flex runs
90% flex (spider system)
100% duct board
Duct board plenum, flex runs
N/A
Unknown

Evidence of Duct Sealing (Yes/No)

Field technicians will note whether there is evidence of duct sealing. Sealed ducts should have duct mastic or caulk around the register boots visible from inside. If ducting is visible in unconditioned areas, the joints of that ducting would be sealed with duct mastic, which is usually off-white or gray.

Evidence of Major Supply Duct Leakage (Yes/No)

Field technicians will indicate whether or not they observe duct disconnects or major holes in supply ducting in unconditioned areas. The correct choice will be “Unknown” when it is not possible to adequately observe duct condition from within 10 feet of the crawlspace or attic hatch.

Metal Ducting Insulation Type

Field technicians will identify the most common type of insulation on metal ducting in accessible unconditioned areas, such as the garage, crawlspace, and/or attic. They will collect this information for any metal ducting in unconditioned spaces whether the duct system is all metal or a mix of metal and some other material.

Metal ducting in attics and crawlspaces is often insulated with fiberglass batts wrapped around the ducts and secured with twine or wire. Metal ducting in garages often comprises foil-faced fiberglass, bubble-type wrap, duct board, or foam board.

Insulation Type for Metal Ducting

Metal Ducting Insulation Type
Fiberglas batts
Foil-faced fiberglass
Foil-faced bubble wrap
Duct board
Foam board
N/A
Unknown

Metal Ducting Insulation Thickness

Field technicians will note the thickness of insulation on metal ducting in accessible unconditioned areas, such as the garage, crawlspace, and/or attic. They will collect this information for any metal ducting in unconditioned spaces, whether the duct system is all metal or a mix of metal and some other material.

Insulation Thickness on Metal Ducting

Metal Ducting Insulation Thickness
1 inch
2 inches
3 inches
4 inches
5 inches
6 inches
N/A
Unknown

Metal Duct Insulation Condition

Field technicians will estimate the percentage of insulation that is still in place on the ducting in accessible unconditioned spaces. Particularly with older duct systems, thin fiberglass insulation may be missing or falling away over large areas of the duct system. They will collect this information for any metal ducting in unconditioned spaces, whether the duct system is all metal or a mix of metal and some other material.

Metal Duct Insulation Condition

Metal Duct Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Flex Duct Insulation Level

For HVAC duct systems that include flex ducting, field technicians will determine the most common insulation value from the label on the outer shell of the flex duct. Typical values are R-4, R-6, and R-8. Where R-value differs for the return and supply ducting, field technicians will choose the R-value for the supply ducts.

Flex Duct Insulation Value

Flex Duct Insulation Value
R-4
R-6
R-8
N/A
Unknown

Duct Board Duct Thickness

Field technicians will measure the thickness of duct board ducting when present in the system. They will record this value as "N/A" if duct board is used only as insulation on metal ducting.

Duct Board Duct Thickness

Duct Board Duct Thickness
1 inch
2 inches
N/A
Unknown

Cavity Used for Air Transport (Yes/No)

Field technicians will note whether the HVAC system uses building cavities for air transport. This is common even in relatively new homes for return air ducting. It is usually easy to identify whether or not return ducting uses building cavities by looking through or removing the return grilles. In older homes with crawlspaces, sheet metal is often used to close off the bottom of the cavity, leading to the term "panned returns."

Return Ducting in Conditioned Space

Field technicians will estimate the percentage of return ducting in condition areas of the building, which typically include the basement and living space.

Supply Ducting in Conditioned Space

Field technicians will estimate the percentage of supply ducting in conditioned areas of the building, which typically include the basement and living space.

Supply Ducting in Inaccessible Unconditioned Space

Where ducting runs through inaccessible unconditioned areas, such as inaccessible crawlspaces or attics, field technicians will estimate the percentage of supply ducting in such spaces.

Doors

Field technicians will collect the data outlined below for each exterior door in the dwelling.

Door Construction

Field technicians will note the construction of the door. A Dutch door comprises two vertical sections that can be opened separately.

Door Construction

Door Construction
Single
Double
Dutch

Door Size

Field technicians will enter the width and height of the door slab, in inches.

Door Type

Field technicians will specify the door type, being careful to remember that fiberglass doors often simulate the look and texture of wood doors.

Door Type

Door Type
Wood solid core
Wood hollow
Metal
Fiberglass
Other
Unknown

Door Window

Field technicians will specify the type of window in the door, if any.

Door Window

Door Window
None
Half window
Decorative window (arch, etc.)
French door
Other

Windows

Field technicians will collect the information outlined below for each window and skylight in the building.

Window Area

Field technicians will enter the width and height of each window or skylight opening in inches, measuring to approximate the size of the rough opening or total window assembly—not just the sash(es).

Window Direction

Field technicians will note the direction the window or skylight faces to the outside.

Window Direction

Window Direction
North
South
East
West
Northeast
Northwest
Southeast
Southwest

Window Frame Type

Field technicians will determine the construction of each window or skylight frame. Aluminum frames are typically dark brown or raw metal in color. Vinyl windows are almost always white. Fiberglass window frames may be any color. Clad windows come in a variety of types and may be difficult to distinguish. Homeowners and building managers may be able to provide information about the specific windows installed.

Window Frame Type

Window Frame Type
Aluminum
Vinyl
Wood
Wood, fiberglass clad
Wood, aluminum clad
Fiberglass
Fiberglass, interior wood clad

Window Glazing Type

Field technicians will determine whether the glazing (glass) comprises one, two, or three panes. With two or more panes of glass, the spacer between the two panes is visible along the edge. To distinguish between double and triple glazing, field technicians will try shining a light on the window and counting the reflections. For windows too high reach safely, field technicians will assume that the glazing matches that of lower windows if the windows appear to be of the same type.

Window Glazing Type

Window Glazing Type
Single pane
Double pane
Triple pane
N/A
Unknown

Window Opening

Field technicians will specify the style of operable sashes, including for fixed and operable skylights.

Window Opening

Window Opening
Single hung
Fixed (picture)
Slider
Casement
Awning
Skylight fixed
Skylight opening
Other

Storm Window

Field technicians will identify whether there is a storm window installed on the exterior or interior of the window.

Storm Window

Storm Window
None
Interior
Exterior

Building Shell Data Collection, Manufactured Homes

Field technicians will determine each of the data points below for manufactured homes.

Floors

Field technicians will collect the information outlined below for each floor in the manufactured home.

Floor Area

Field technicians will use perimeter measurements to calculate the floor area in square feet.

Rated Floor Insulation Level

Field technicians will record the original rated insulation level, which should be listed as a U-factor on the HUD label, present for any manufactured home built after 1976.

Evidence of Increased Floor Insulation (Yes/No)

Field technicians will note whether there is evidence of additional floor insulation by asking the occupant and checking for an insulation certificate near the electrical panel. If insulation was added under the home, there will likely be adhesive patches in the belly, spaced at regular intervals.

Floor Insulation Type

Where practical, field technicians will determine the type of floor insulation by looking for breaks or holes in the belly under the home.

Floor Insulation Type

Floor Insulation Type
Mixed
Fiberglass batts
Mineral wool batts
Blown fiberglass
Blown mineral wool
Blown cellulose
N/A
Unknown

Floor Insulation Thickness

Where practical, field technicians will determine the thickness of floor insulation by measuring the thickness through a break or hole in the belly under the home.

Floor Insulation Thickness

Wall Insulation Thickness
1 inch
2 inches
3.5 inches
5.5 inches
7.5 inches
10 inches
12 inches
N/A
Unknown

Floor Insulation Condition

Field technicians will estimate the percentage of the floor that is insulated. Insulation in the floors of manufactured homes is often partially missing because of damage over time.

Floor Insulation Condition

Floor Insulation Condition
100% in place
90% in place
75% in place
50% in place
25% in place
0% in place
N/A
Unknown

Walls

Field technicians will collect the information outlined below for each wall in the manufactured home.

Wall Area

Field technicians will calculate the exterior wall area in square feet.

Rated Wall Insulation Level

Field technicians will document the original rated insulation level listed as the U-factor recorded on the HUD label, present for any manufactured home built after 1976.

Evidence of Increased Wall Insulation (Yes/No)

Field technicians will note whether there is any evidence of increased wall insulation by asking the occupant and looking for an insulation certificate near the electrical panel.

Wall Insulation Type

Where practical, field technicians will determine the type of insulation in exterior walls. They may accomplish this by probing the insulation with wood or plastic after removing the faceplate from an exterior switch or outlet.

Wall Cavity Insulation Type

Wall Cavity Insulation Type
Mixed
Fiberglass batts
Mineral wool batts
Blown fiberglass
Blown mineral wool
Blown cellulose
N/A
Unknown

Wall Insulation Thickness

Where practical, field technicians will determine the thickness of insulation in the exterior walls. They may accomplish this by probing the insulation with wood or plastic after removing the faceplate from an exterior switch or outlet.

Wall Insulation Thickness

Wall Insulation Thickness
1 inch
2 inches
2.5 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
N/A
Unknown

Ceilings

Field technicians will collect the information outlined below for each ceiling in the manufactured home.

Ceiling Area

Field technicians will calculate the ceiling area in square feet.

Ceiling Height

Field technicians will measure the ceiling height in feet. Where there is a cathedral or vaulted ceiling, field technicians will pick a point half-way up the pitch to use as the average ceiling height.

Rated Ceiling Insulation Level

Field technicians will document the original rated insulation level, which should be recorded as the U-factor on the HUD label, present for any manufactured home built after 1976.

Evidence of Increased Ceiling Insulation (Yes/No)

Field technicians will note whether there is evidence of increased ceiling insulation by asking the homeowner, looking for an insulation certificate near the electrical panel, and looking for regular plastic plugs or patched

holes in the ceiling. Insulation can also be added by drilling hole through the metal roof or by adding foam board and a rubber layer on top of the existing roof.

Ceiling Insulation Type

If access to the area above the ceiling is practical, field technicians will determine the insulation type. Access to the attic space is rare in manufactured homes.

Ceiling Insulation Type

Ceiling Insulation Type
Mixed
Fiberglass batts
Mineral wool batts
Cellulose batts
Blown fiberglass
Blown mineral wool
Blown cellulose
N/A
Unknown

Ceiling Insulation Depth

If access to the area above the ceiling is practical, field technicians will measure the insulation depth. Access to the attic space is rare in manufactured homes.

Ceiling Insulation Depth

Ceiling Insulation Depth
1 inch
2 inches
3 inches
3.5 inches
5.5 inches
7.5 inches
N/A
Unknown

Foam Layer on Top of Roof

Field technicians will note the thickness of any foam layer added on top of the original metal roof a mobile home. The foam will be covered by a black layer of rubber, which will show folds at the corners.

Foam Layer on Top of Roof

Foam Layer on Top of Roof
1 inch
2 inches
2.5 inches
3 inches
3.5 inches
N/A
Unknown

HVAC Ducts

Field technicians will collect the information outlined below for all ducts in the manufactured home.

Ducts Present (Yes/No)

Field technicians will note whether ducting is present in the manufactured home, which will almost always be indicated by registers in the floor.

Duct Material

Field technicians will determine the duct material through visual observation of the ducting through the register boots or under the manufactured home. Supply ducting may be encapsulated by the belly and may not be visible from below.

Duct Material

Duct Material
Metal
Flex Duct (vinyl)
Duct board
Panned joist
N/A
Unknown

Evidence of Duct Sealing (Yes/No)

Field technicians will note whether there is evidence of duct sealing. Sealed ducts show duct mastic or caulk around the register boots from inside, and there is a hand-cut foam block inside the ducting that is visible by looking into the boots the farthest towards the front and back of the home. If ducting is visible underneath the home, the joints of that ducting should be sealed with duct mastic, which is usually off-white or gray.

Duct Crossover Present (Yes/No)

Field technicians will indicate via visual observation from under the home whether a crossover duct is present, as is usually the case with double-wide homes or others that comprise more than one segment. A crossover duct generally runs under a beam and back up to connect the ducting of two segments of a home.

Crossover Condition

Field technicians will note the condition of the crossover via visual observation from below the home.

Crossover Condition

Crossover Condition
Connected
Partially connected
Disconnected
N/A
Unknown

Connected crossover duct is intact and appears tightly connected at each end.

Partially connected crossover duct is connected loosely and likely leaks a significant volume of air.

Disconnected crossover ducts have one or both ends partially or fully disconnected.

N/A In a single wide a crossover wouldn't exist. In a double- or triple-wide, N/A means the technician verified by visual inspection that the home is not designed to use a crossover duct.

Windows

Field technicians will collect the information outlined below for each window in the manufactured home.

Window Area

Field technicians will enter the width and height of each window or skylight opening in inches, measuring to approximate the size of the rough opening or total window assembly—not just the sash(es).

Window Direction

Field technicians will note the direction the window or skylight faces to the outside.

Window Direction

Window Direction
North
South
East
West
Northeast
Northwest
Southeast
Southwest

Window Frame Type

Field technicians will determine the construction of each window or skylight frame. Aluminum frames are typically dark brown or raw metal in color. Vinyl windows are almost always white. Fiberglass window frames may be any color. Clad windows come in a variety of types and may be difficult to distinguish. Homeowners and building managers may be able to provide information about the specific windows installed.

Window Frame Type

Window Frame Type
Aluminum
Vinyl
Wood
Wood, fiberglass clad
Wood, aluminum clad
Fiberglass
Fiberglass, interior wood clad

Window Glazing Type

Field technicians will determine whether the glazing (glass) comprises one, two, or three panes. With two or more panes of glass, the spacer between the two panes is visible along the edge. To distinguish between double and triple glazing, field technicians will try shining a light on the window and counting the reflections. For windows too high reach safely, field technicians will assume that the glazing matches that of lower windows if the windows appear to be of the same type.

Window Glazing Type

Window Glazing Type
Single pane
Double pane
Triple pane
N/A
Unknown

Window Opening

Field technicians will specify the style of operable sashes, including for fixed and operable skylights.

Window Opening

Window Opening
Single hung
Fixed (picture)
Slider
Casement
Awning
Skylight fixed
Skylight opening
Other

Storm Window

Field technicians will identify whether there is a storm window installed on the exterior or interior of the window.

Storm Window

Storm Window
None
Interior
Exterior

NEEA RBSA HVAC Inventory: Protocols for Field Technicians

This document describes the protocol that field staff will adhere to while performing HVAC data collection as part of the NEEA RBSA home surveys. The primary data points to be collected are listed below along with the proper method for collecting these data.

Importance of the HVAC Data Collection

The thorough collection of HVAC equipment data is a very important task of the upcoming RBSA effort. When coupled with utility billing analysis and building shell information, this information can provide a clear picture of the energy consumption of various HVAC system types and help utility and program planners determine the potential savings for HVAC retrofit or installation measures.

Residential HVAC Equipment Inventory

HVAC and Ventilation System Data Collection

Though there is some flexibility in the walk-through process, the type of data collected for each piece of equipment is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data collection software.

The Cadmus iPad tool uses two basic data collection methods for HVAC systems:

- Select the room and record information for the HVAC equipment in the room.
- Select the central HVAC system option and record all information for the HVAC equipment associated with the system including the spaces that system serves.

Technicians generally use the first method to collect data for unitary HVAC equipment (e.g., window air conditioning, packaged terminal air conditioning [PTAC], packaged terminal heat pump [PTHP], ductless mini-split, fireplace) or to collect HVAC ventilation information (e.g., kitchen vent, bathroom vent). Technicians use the second method to collect information for HVAC systems that serve the whole house or large zones in the home (e.g., central system, upstairs system, or whole-house fan). The following section presents the data collection protocols for every expected equipment type.

Primary Heating System Identification

Field technicians will collect information for every heating system in the home. If multiple systems are present, the field technician will ask the homeowner which system is used most frequently during the winter months and will designate that equipment the "primary" heating system.

Primary Cooling System Identification

Field technicians will collect information for every cooling system in the home. If multiple systems are present, the field technician will ask the homeowner which system is used most frequently during the summer and will designate that equipment the "primary" cooling system.

Unknown Designation

In the following circumstances, a data point will not be determinable and field technicians will record the data as unknown and enter a brief note of explanation:

- Data point cannot be safely determined (such as needing to climb over equipment to assess it or the equipment is off the ground and cannot easily be assessed with a stepstool).
- Label is old and information is unrecognizable or label has been removed.
- Equipment is in a locked room or a room the homeowner asked field technicians not to enter.
- The specification is unusual and the field technician cannot determine it.

Notes

Field technicians will briefly note any additional information that may prove useful during the data analysis phase, such as if the resident refuses access to certain rooms or areas of the home or the data collection is limited due to equipment being inaccessible.

Data Collection of Zonal HVAC Equipment: Equipment Parameters

Zonal HVAC equipment typically provides heating and/or cooling to one or more zones but not to the entire home. This section lists all common zonal HVAC equipment and the parameters or responses for all data collection points for each type of equipment.

Electric Resistance Baseboard Heat

Electric resistance baseboard heaters are zonal heaters, typically installed along a portion of the perimeter of a room and controlled by thermostats located in the room. Field technicians will collect the following information for electric resistance baseboard heaters.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, “Master Bedroom” rather than “Bedroom”). The room name should tie back to the room information such as square footage and window presence.

Length

This is the physical length of the unit. Field technicians will record the physical length of the unit in feet.

Capacity

If available, field technicians will record the rated capacity of the baseboard unit in kW.

Controls

The field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Device Use Response Options

Response Options
Seldom (1-2 times per month)
A little (1-2 times per week)
All the time (daily / almost daily)

Vertical Wall Heater

Vertical wall heaters are small heaters, similar to a Cadet heater, located in the wall of a room or building. These units primarily heat the space they are located in and typically do not have ducting to other parts of the home. Field technicians will document the location of the equipment and any information regarding the unit's operation and use. The next section describes each data point and response option.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, "Master Bedroom" rather than "Bedroom"). The room name should tie back to the room information such as square footage and window presence.

Controls

The field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer

Fuel Type

Field technicians will record the fuel type for the equipment. The two fuel type options are gas and electric. If the heating element is visible while the unit is in operation, differentiating between the two units is fairly straightforward. Gas units typically have a blue flame (more decorative units may look like a fireplace and have orange flames) whereas the heating coils in electric units glow orange during operation. Gas units may also have a visible gas line. In the event that the equipment's fuel type is difficult to identify, the field technicians will ask the homeowner.

Ignition

If the equipment fuel type is gas, field technicians will record the ignition type. The two options available are standing pilot and intermittent ignition. If the unit has a standing pilot, field technicians may be able to visually identify that the pilot light is on.

Intermittent ignition devices use electricity to spark the burner. When the unit is activated, gas flows to the pilot where a spark ignites the fuel; once the fuel is ignited, gas is allowed to flow into the main burner and the unit is turned on. Intermittent units typically emit a clicking sound during unit startup. Similar to a gas stove, this clicking sound is caused by the electrical spark that will ignite the unit.

Heat Capacity

Field technicians will record the heat capacity of the unit. If the unit is electric, field technicians will record the unit's kW output. If the unit is gas-powered, field technicians will record the input and output Btuh (both, if available). This information is typically available on the equipment nameplate but may need to be looked up using the equipment model number.

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Device Usage Response Options

Response Options
Seldom (1-2 times per month)
A little (1-2 times per week)
All the time (daily / almost daily)

Unit Heater

Unit heaters are often in the shape of a box and located near the ceiling, typically in semi-conditioned space such as a garage, workshop, or basement. Unit heaters are permanently installed in a space and fueled by electricity or natural gas. To record information about unit heaters, the field technicians will follow the data collection protocol for vertical wall heaters.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, "Master Bedroom" rather than "Bedroom"). The room name should tie back to the room information such as square footage and window presence.

Controls

The field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Non-Programmable Thermostat
Timer
None
On/off

Fuel Type

Field technicians will record how the equipment is fueled. This information will be gathered from consultation with the homeowner.

Fuel Response Options

Response Options
Wood (cord)
Wood (pellets)
Natural Gas
Propane
Oil
Electric
Other

Heat Capacity

Field technicians will record the heat capacity of the unit. If the unit is electric, field staff will record the unit's kW output. If the unit is gas-powered, field staff will record the input and output Btuh (both, if available). This information is typically available on the equipment nameplate or may need to be looked up using the equipment model number.

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Electric Plug-In Heater

Electric plug-in heaters are portable zonal (space) heaters and are easy to move from room to room as needed. Field technicians will collect the following information for electric plug-in heaters.

Location

This is the location of the unit. Field staff will record the room in which the unit is located and will include a description as necessary (for instance, "Master Bedroom" rather than "Bedroom"). The room name should tie back to the room information such as square footage and window presence.

Controls

The field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Temperature Setpoint on System
Timer
On/Off

Heat Capacity

Field technicians will record the rated capacity of the unit in kW. This information is available on the device nameplate.

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Device Usage Response Options

Response Options
Seldom (1-2 times per month)
A little (1-2 times per week)
All the time (daily / almost daily)

Mini-Split Heat Pump

Mini-split heat pump systems have the same basic components as a central heat pump system. The system comprises a compressor/condenser outside and air handling unit(s) inside. Most commonly, mini-split heat pumps are ductless. The condenser and the air handling unit(s) are typically connected by refrigerant lines that run through small holes in the exterior wall.

A mini-split heat pump system is defined by the outdoor compressor/condenser unit, and each outdoor unit can have several indoor heads. Field technicians will collect the following data for mini-split heat pump systems.

Distribution

Field technicians will identify how the mini-split heat pump system distributes the conditioned air in the space or throughout the home.

Distribution Response Options

Response Options
Zonal (ductless)
Ducted

Brand

Field technicians will collect the brand from the unit nameplate by selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Number of Indoor Heads

Field technicians will record the number of heads in each system. Currently, mini-split heat pump systems can have up to five indoor heads connected to each condenser.

Location

For ductless systems, this is the location of the indoor head(s). Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, "Master Bedroom" rather than "Bedroom"). The room name should tie back to the room information such as square footage and window presence. This information will be collected for each indoor head. For ducted mini-split systems, field technicians will record the zone(s) served by the system by recording the thermostat location(s) for the thermostat(s) associated with the system.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate and will manually enter it into the iPad collection tool. This information will be collected for each indoor head.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options. This information will be collected for each indoor head.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Mini-Split Air Conditioner

Mini-split air conditioning systems have the same basic components as a central air conditioning system. The system comprises a compressor/condenser outside and air handling unit(s) inside. Most commonly, mini-split air conditioners are ductless. The condenser and the air handling unit(s) are typically connected by refrigerant lines that run through small holes in the exterior wall.

A mini-split air conditioning system is defined by the outdoor compressor/condenser unit, and each outdoor unit can have several indoor heads. Field technicians will collect the following data for mini-split AC systems.

Distribution

The field technician will identify how the mini-split air conditioning system distributes the conditioned air in the space or throughout the home.

Distribution Response Options

Response Options
Zonal (ductless)
Ducted

Brand

Field technicians will collect the brand from the unit nameplate by selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Number of Indoor Heads

Field technicians will record the number of heads in each system. Currently, mini-split air conditioning systems can have up to five indoor heads connected to each condenser. If a home has multiple outdoor units, field technicians will consult with the homeowner and trace the refrigerant conduits to identify which indoor heads are on which system.

Location

For ductless systems, this is the location of the indoor head(s). Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, “Master Bedroom” rather than “Bedroom”). The room name should tie back to the room information such as square footage and window presence. This information will be collected for each indoor head. For ducted mini-split systems, the technician will record the zone(s) served by the system by recording the thermostat location(s) for the thermostat(s) associated with the system.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool. This information will be collected for each indoor head.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options. This information will be collected for each indoor head.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Unitary Refrigerant-Based HVAC Systems

Unitary air conditioner or heat pump systems include any system wherein all components—compressor/condenser, heating/cooling coils, the air handling unit, and oftentimes auxiliary heat—are packaged into a single cabinet. Field technicians will collect the following data for this type of system.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, “Master Bedroom” rather than “Bedroom”). The room name should tie back to the room information such as square footage and window presence.

Equipment Type

Field technicians will record the type of packaged system observed. PTAC and PTHP units are common in hotel rooms and multifamily buildings but less common in homes. These are generally installed through the wall beneath a window. Wall-mounted PTAC and PTHP units are elongated packaged units mounted above the ground on the outside of a building.

Through-wall PTAC/PTHP units, though similar in appearance to window air conditioning units, are installed permanently in a cutout of an exterior wall of a home. Removable window air conditioner and heat pump units, common in homes, are installed temporarily in windows and plug into standard 120V outlets. Portable air conditioner and heat pump units also plug into a 120V outlet but stand on the floor and use a large (approximately 6-inch) hose to reject air to or absorb air from the outside through a window.

Equipment Type Options

Response Options
PTAC
PTHP
Wall-Mounted PTAC
Wall-Mounted PTHP
Through-Wall Air Conditioner
Through-Wall Heat Pump
Window Air Conditioner
Window Heat Pump
Portable Air Conditioner
Portable Heat Pump
Other

Brand

Field technicians will collect the brand from the unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Capacity

Field technicians will collect the unit's heating AND cooling capacities from the equipment nameplate. This information will be recorded in Btuh.

Controls

The field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Additional Heat

Some packaged units, in addition to their heat pump capabilities, can also provide heat through electric resistance strips or coils or through a gas furnace included as part of the system. Field technicians will record

the fuel type of the supplemental heating system (gas or electric). If the unit has electric heat, field technicians will record the heating capacity in kW; otherwise, the heating capacity will be recorded in Btuh.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

ENERGY STAR Label (Yes/No)

Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Fireplace

Residential fireplaces typically function either as purely decorative or as a mix of decoration and heat production.

Used for Heat or Decoration

Field technicians will record how the equipment is used. This information will be gathered from consultation with the homeowner.

Usage Response Options

Response Options
Decorative
Used for heat

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Device Use Response Options

Response Options
Seldom (1-2 times per month)
A little (1-2 times per week)
All the time (daily / almost daily)

Fuel Type

Field technicians will record how the equipment is fueled. This information will be gathered from consultation with the homeowner and visual inspection.

Fuel Response Options

Response Options
Wood (cord)
Wood (pellets)
Natural Gas
Propane
Oil
Other

Equipment Type

Field technicians will record the type of fireplace(s) observed in the home.

- **Open hearth** fireplaces have no permanent barrier between the fireplace and the space it heats.
- **Glass door over open hearth** fireplaces have glass pane(s) separating the fireplace from the space. These panes typically extend to the edge of the hearth.
- **Factory-built inserts** are made to fit inside preexisting hearths. These inserts are typically constructed from glass and metal, with a metal border extending from the edge of the glass to the edge of the hearth.

Equipment Response Options

Response Options
Open Hearth
Glass Door Over Open Hearth
Factory-Built Insert

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and include a description as necessary (for instance, "Master Bedroom" rather than "Bedroom"). The room name should tie back to the room information such as square footage and window presence.

Ignition

If the equipment is gas-powered, the field technicians will record the unit's ignition type. The three options available are manual, standing pilot, and automatic ignition.

Manual ignition devices require the resident to manually turn the stove on, either through igniting the fuel with a match or lighter, or pressing a button on the stove.

If the unit has a standing pilot, field technicians may be able to visually confirm that the pilot light is on.

Intermittent ignition devices use electricity to spark the burner. When the unit is activated, gas flows to the pilot where a spark ignites the fuel; once the fuel is ignited, gas is allowed to flow into the main burner and the unit is turned on. Intermittent units typically emit a clicking sound during unit startup. Similar to a gas stove, this clicking sound is caused by the electrical spark that will ignite the unit.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Space Heating Stove

Space heating stoves are similar to fireplaces but are more often used for space heating than as pure decoration.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, “Master Bedroom” rather than “Bedroom”). The room name should tie back to the room information such as square footage and window presence.

Use

Field technicians will record how often the equipment is used. This information will be gathered from consultation with the homeowner.

Device Usage Response Options

Response Options
Seldom (1-2 times per month)
A little (1-2 times per week)
All the time (daily / almost daily)

Heat Transfer

Field technicians will record how the equipment transfers heat to the space. Some space heating stoves have a built-in fan system that turns on once the unit reaches a certain temperature. These units transfer heat through convection. More traditional units do not have a fan system, and the heat radiates out from the body of the unit.

Fuel Type

Field technicians will record how the equipment is fueled. This information will be gathered from consultation with the homeowner and visual inspection.

Fuel Response Options

Response Options
Wood (cord)
Wood (pellets)
Natural Gas
Propane
Oil
Coal
Electric
Other

Ignition

If the equipment is gas-powered, the field technicians will record the unit's ignition type. The three options available are manual, standing pilot, and automatic ignition.

Manual ignition devices require the resident to manually turn the stove on, either through igniting the fuel with a match or lighter, or pressing a button on the stove.

If the unit has a standing pilot, field technicians may be able to visually confirm that the pilot light is on.

Intermittent ignition devices use electricity to spark the burner. When the unit is activated, gas flows to the pilot where a spark ignites the fuel; once the fuel is ignited, gas is allowed to flow into the main burner and the unit is turned on. Intermittent units typically emit a clicking sound during unit startup. Similar to a gas stove, this clicking sound is caused by the electrical spark that will ignite the unit.

Heat Capacity

Field technicians will collect the unit's input AND output capacities from the equipment nameplate. This information will be recorded in Btuh.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Evaporative Cooler

Evaporative coolers cool air through the evaporation of water. Field technicians may encounter these systems in the field, typically in hotter and dryer climates.

Evaporative Scale

Field technicians will identify to what degree these devices function to cool the home. Some homes may have a central system, whereas others may have a zonal system in which each zone has a separate cooler. The table lists all response options.

Control Response Options

Response Options
Zonal
Central
Both

Bathroom Exhaust Fan

A bathroom exhaust fan is a mechanical ventilation device which, when ducted to the exterior of the house, draws out stale or humid air, thereby improving the quality of indoor air.

Location

This is the location of the unit. Field technicians will record the room in which the unit is located and will include a description as necessary (for instance, “Master Bathroom” rather than “Bathroom”). The room name should tie back to the room information such as square footage and window presence.

Working (Yes/No)

Field technicians will indicate if the exhaust fan is in working condition at the time of the site visit.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Manual Switch
Continuous
Humidity Control Switch
Timer

Hours per Day

Field technicians will ask the homeowner how many hours per day the exhaust fan is used.

Kitchen Vent

An exhaust hood, extractor hood, or range hood is a device containing a mechanical fan that hangs above the stove or cooktop in the kitchen. It removes airborne grease, combustion products, fumes, smoke, odors, heat, and steam from the air by evacuation of the air and filtration.

Equipment Type

Field technicians will indicate what type of kitchen exhaust vent is installed in each home.

- **High capacity exhaust** range hoods are common for homes with large cooktops. These systems typically have a make-up air vent damper installed that replaces the air lost through exhaust.
- **Small capacity exhaust** range hoods pull air from the kitchen and exhaust the air to the outdoors. Small capacity systems typically do not need a make-up air damper.
- **Recirculating** kitchen vents circulate air within the home and do not exhaust to the outdoors.

Equipment Response Options

Response Options
High Capacity Exhaust Range Hood
Small Capacity Exhaust
Recirculating Only

Data Collection of Central HVAC Equipment

A central HVAC system provides heating, cooling, or ventilation to the whole interior of a building (or portion of a building) from one central location, unlike a unitary system that provides heating, cooling, or conditioned air to the space in which it is located.

Packaged AC/HP

Packaged air conditioners and heat pump units are referred to as RTUs (rooftop units) and are most commonly found on commercial rooftops but are also installed in some homes. These units have a duct distribution system. Field technicians will collect the following data for this type of system.

Zones Served

Field technicians will note the space(s) served by the packaged unit. The table lists the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Brand

Field technicians will collect the brand from the unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Capacity

Field technicians will collect the unit's heating AND cooling capacities from the equipment nameplate. This information will be recorded in Btuh.

Additional Heat

Some packaged units, in addition to their heat pump capabilities, can also provide heat through electric resistance or gas furnace included as part of the system. Field technicians will record the heating fuel type (gas or electric). If the unit has electric heat, technicians will record the heating capacity in kW.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Central Air Conditioner

Central air conditioner systems are composed of an outdoor compressor unit, an indoor evaporator coil, and an air handler unit. Typically, the same air handler is used for both the central heating system (such as a furnace or heat pump) and the central air conditioner.

Zones served

Field technicians will note the space(s) served by the central unit. The table shows the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the outdoor unit nameplate and manually enter it into the iPad collection tool.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool. This information will be collected for each indoor head.

Cooling Capacity

Field technicians will collect the unit's cooling capacities from the equipment nameplate. This information will be recorded in Btuh.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Dehumidifier (Yes/ No)

Field technicians will record whether there is a dehumidifier incorporated into the central system.

Fan Type

Field technicians will record what type of motor the central system fan is equipped with. This information will be gathered via visual inspection wherever possible, and via equipment model lookup wherever it is not. The table lists the response options.

Fan Response Options

Response Options
ECM
PSC

Filter Type

Field technicians will record what type of filter the central system is equipped with. The response options are shown in the table below.

- **Electrostatic air filter:** An electrically charged filter attracts particles in the air using electro-forces. This type of filter has electrostatic fibers as well as mechanical fibers.
- **Electronic air cleaner:** This type of filter does not use any mechanical filtration. A high voltage electrode arrangement of plates charges particles in the air that are attracted to a ground electrode.
- **Disposable thin filter.** This type of filter is typically one inch thick and requires frequent replacement (once every few months).
- **Disposable thick pleated.** This type of filter is usually about four inches thick with one-inch pleats.
- **Other.** There are many types of air filters. Field technicians will record the filter type if known.
- **None.** No air filter is present.

Filter Response Options

Response Options
Electrostatic Air Filter
Electronic Air Cleaner
Disposable Thin
Disposable Thick Pleated
Other
None

Central Air Source Heat Pump

An air source heat pump uses a refrigerant system involving a compressor and a condenser to absorb heat from the air at one place and release it at another. A central air source heat pump is able to provide either warm or cold air to the space and usually includes electric resistance backup heat (strip heat) to provide additional heating capacity when needed.

Zones Served

Field technicians will note the space(s) served by the central unit. The table shows the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the outdoor unit nameplate, manually entering it into the iPad collection tool.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate, manually entering the model number into the iPad collection tool. This information will be collected for each indoor head.

Cooling Capacity

Field technicians will collect the unit's cooling capacity from the equipment nameplate. This information will be recorded in Btuh.

Heating Capacity

Field technicians will collect the unit's heating capacity from the equipment nameplate. This information will be recorded in Btuh.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Dehumidifier (Yes/ No)

Field technicians will record whether there is a dehumidifier incorporated into the central system.

Fan Type

Field technicians will record what type of motor the central system fan is equipped with. This information will be gathered via visual inspection wherever possible, and via equipment model lookup wherever it is not. The table lists the response options.

Fan Response Options

Response Options
ECM
PSC

Filter Type

Field technicians will record what type of filter the central system is equipped with. The response options are:

- **Electrostatic air filter:** An electrically charged filter attracts particles in the air using electro-forces. This type of filter has electrostatic fibers as well as mechanical fibers.
- **Electronic air cleaner:** This type of filter does not use any mechanical filtration. A high voltage electrode arrangement of plates charges particles in the air that are attracted to a ground electrode.
- **Disposable thin filter.** This type of filter is typically one inch thick and requires frequent replacement (once every few months).
- **Disposable thick pleated.** This type of filter is usually about four inches thick with one-inch pleats.
- **Other.** There are many types of air filters. The technician will record the filter type if known.
- **None.** No air filter is present.

Filter Response Options

Response Options
Electrostatic Air Filter
Electronic Air Cleaner
Disposable Thin
Disposable Thick Pleated
Other
None

Electric Strip Heat

Some units, in addition to their heat pump capabilities, can also provide heat through electric resistance. Field technicians will determine if the packaged unit can provide additional electric heat by inspecting the nameplate data and looking for the presence of the strip heat coil. The amount of electric heat available will be recorded in kW.

Central Dual-Fuel Air Source Heat Pump

An air source heat pump uses a refrigerant system involving a compressor and a condenser to absorb heat from the air at one place and release it at another. A central dual-fuel air source heat pump can provide either warm or cold air to the space and uses a backup furnace to provide additional heating capacity when needed. A heat pump with electric resistance strip heat can operate both the heat pump compressor (refrigeration cycle) and the strip heat simultaneously. A dual-fuel heat pump cannot run both heating systems simultaneously.

Zones Served

Field technicians will note the space(s) served by the central unit. The table shows the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool. This information will be collected for each indoor head.

Cooling Capacity

Field technicians will collect the unit's cooling capacity from the equipment nameplate. This information will be recorded in Btuh.

Heating Capacity

Field technicians will collect the unit's heating capacity from the equipment nameplate. This information will be recorded in Btuh.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Dehumidifier (Yes/ No)

Field technicians will record if there is a dehumidifier incorporated into the central system.

Fan Type

Field technicians will record what type of motor the central system fan is equipped with. The table shows the response options.

Fan Response Options

Response Options
ECM
PSC

Filter Type

Field technicians will record what type of filter the central system is equipped with. The response options are:

- **Electrostatic air filter:** An electrically charged filter attracts particles in the air using electro-forces. This type of filter has electrostatic fibers as well as mechanical fibers.
- **Electronic air cleaner:** This type of filter does not use any mechanical filtration. A high voltage electrode arrangement of plates charges particles in the air that are attracted to a ground electrode.
- **Disposable thin filter.** This type of filter is typically one inch thick and requires frequent replacement (once every few months).
- **Disposable thick pleated.** This type of filter is usually about four inches thick with one-inch pleats.
- **Other.** There are many types of air filters. The technician will record the filter type if known.
- **None.** No air filter is present.

Filter Response Options

Response Options
Electrostatic Air Filter
Electronic Air Cleaner
Disposable Thin
Disposable Thick Pleated
Other
None

Forced Air Furnace

A forced-air furnace heating system uses air as its heat transfer medium. These systems rely on ductwork, vents, and plenums to distribute air. Regardless of type, all furnaces consist of an air filter, blower, heat exchanger/element/coil, and various controls.

Zones Served

Field technicians will note the space(s) served by the central unit. The table lists the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Fuel Type

Field technicians will record how the equipment is fueled. This information will be gathered from consultation with the homeowner.

Fuel Response Options

Response Options
Wood (cord)
Wood (pellets)
Natural Gas
Propane
Oil
Electric
Other

Equipment Type

- Field technicians will record the type of furnace system. The response options are shown below.
- **Atmospheric.** An atmospherically vented furnace depends purely on chimney effect to vent combustion gases to outside and draws air into the combustion chamber from the space around the furnace. Venting is typically single-wall metal pipe.
- **Induced Draft.** An induced-draft furnace includes a small fan that helps induce the movement of combustion gases through the vent piping. These units draw air into the combustion chamber from the space around the furnace and are usually vented with double-walled, B-vent metal pipe.
- **Condensing.** Condensing furnaces have a secondary heat exchanger that extracts heat from the combustion air. They typically use PVC vent pipe rather than metal venting.
- **Condensing, Sealed Combustion**. In addition to having a secondary heat exchanger to extract heat from the combustion gases, these furnaces draw combustion air directly from outside. The combustion chamber and venting system are sealed off from the inside of the home, which enhances safety.

Equipment Type Response Options

Response Options
Atmospheric
Induced Draft
Condensing
Condensing, Sealed Combustion

Ignition

If the equipment is gas-powered, field technicians will record the unit's ignition type. The two options available are standing pilot and intermittent ignition. If the unit has a standing pilot, field technicians may be able to visually identify that the pilot light is on.

Intermittent ignition devices use electricity to spark the burner. When the unit is activated, gas flows to the pilot where a spark ignites the fuel; once the fuel is ignited, gas is allowed to flow into the main burner and

the unit is turned on. Intermittent units typically emit a clicking sound during unit startup. Similar to a gas stove, this clicking sound is caused by the electrical spark which will ignite the unit.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Dehumidifier (Yes/ No)

Field technicians will record if there is a dehumidifier incorporated into the central system.

Heat Capacity

Field technicians will record the heat capacity of the unit. If the unit is electric, field technicians will record the unit's kW output. If it is a combustion furnace, field technicians will record the input and output Btuh (both, if available). This information is typically available on the equipment nameplate or may need to be looked up using the equipment model number.

Fan Type

Field technicians will record what type of motor the central system fan is equipped with. The table lists the response options.

Fan Response Options

Response Options
ECM
PSC

Filter Type

Field technicians will record what type of filter the central system is equipped with. The response options are:

- **Electrostatic air filter:** An electrically charged filter attracts particles in the air using electro-forces. This type of filter has electrostatic fibers as well as mechanical fibers.

- **Electronic air cleaner:** This type of filter does not use any mechanical filtration. A high voltage electrode arrangement of plates charges particles in the air that are attracted to a ground electrode.
- **Disposable thin filter.** This type of filter is typically one inch thick and requires frequent replacement (once every few months).
- **Disposable thick pleated.** This type of filter is usually about four inches thick with one-inch pleats.
- **Other.** There are many types of air filters. The technician will record the filter type if known.
- **None.** No air filter is present.

Filter Response Options

Response Options
Electrostatic Air Filter
Electronic Air Cleaner
Disposable Thin
Disposable Thick Pleated
Other
None

Geothermal Heat Pump

A geothermal heat pump or ground source heat pump (GSHP) is a central heating and/or cooling system that transfers heat to or from the ground. It uses the earth as a heat source (in the winter) or a heat sink (in the summer).

Zones Served

Field technicians will note the space(s) served by the central unit. The table shows the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Loop Type

Field technicians will identify whether the system is an open or closed loop. This information will be gathered through consultation with the homeowner.

Loop Response Options

Response Options
Open Loop
Close Loop

System Type

Field technicians will identify whether the system is a water or ground loop. This information will be gathered through consultation with the homeowner.

System Response Options

Response Options
Ground Loop
Water Loop

Distribution Type

Field technicians will identify how the geothermal heat pump system distributes conditioned air or a heating/cooling fluid throughout the home.

- **Ducts/Forced Air.** This system is similar to a typical furnace or air source heat pump system. A central air handler and heat exchanger circulates conditioned air throughout the home via a duct system.
- **Hot Water Distribution.** This system is similar to a typical boiler or hydronic heating system. Conditioned water is circulated throughout the home, either through a baseboard or radiant floor system.
- **Both.** Some geothermal heat pump systems may make use of both types of distribution systems—radiant floor in the winter for heating and forced air in the summer for cooling.

Distribution Response Options

Response Options
Ducts/Forced Air
Hot Water Distribution
Both

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number of Outdoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Model Number of Indoor Unit

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool. This information will be collected for each indoor head.

Cooling Capacity

Field technicians will collect the unit's cooling capacity from the equipment nameplate. This information will be recorded in Btuh.

Heating Capacity

Field technicians will collect the unit's heating capacity from the equipment nameplate. This information will be recorded in Btuh.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

Dehumidifier (Yes/ No)

Field technicians will record whether there is a dehumidifier incorporated into the central system.

Fan Type

Field technicians will record what type of motor the central system fan is equipped with. The table lists response options.

Fan Response Options

Response Options
ECM
PSC

Filter Type

Field technicians will record what type of filter the central system is equipped with. The response options are:

- **Electrostatic air filter:** An electrically charged filter attracts particles in the air using electro-forces. This type of filter has electrostatic fibers as well as mechanical fibers.
- **Electronic air cleaner:** This type of filter does not use any mechanical filtration. A high voltage electrode arrangement of plates charges particles in the air that are attracted to a ground electrode.
- **Disposable thin filter.** This type of filter is typically one inch thick and requires frequent replacement (once every few months).
- **Disposable thick pleated.** This type of filter is usually about four inches thick with one-inch pleats.
- **Other.** There are many types of air filters. Field technicians will record the filter type if known.
- **None.** No air filter is present.

Filter Response Options

Response Options
Electrostatic Air Filter
Electronic Air Cleaner
Disposable Thin
Disposable Thick Pleated
Other
None

Backup Electric Strip Heat

Some units, in addition to their heat pump capabilities, can also provide heat through electric resistance. If the geothermal heat pump cannot meet the heating demand, the backup electric strip heat kicks in and supplies additional heat to the space. Field technicians will identify if the unit can provide additional electric heat by inspecting the nameplate data and looking for the presence of the strip heat coil. The amount of electric heat available will be recorded in kW.

Boiler

A boiler is a closed vessel in which water is heated. The heated or vaporized fluid exits the boiler for use in various processes or heating applications, including water heating and space heating.

Zones Served

Field technicians will note the space(s) served by the central unit. The table lists the response options. In the event that the system does not serve the entire home (as may be the case when there are two systems), field technicians will provide a detailed description of the zone served.

Zones Served Response Options

Response Options
Whole Home
Other

Loop Type

Field technicians will identify whether the system is an open or closed loop. This information will be gathered through consultation with the homeowner.

Loop Response Options

Response Options
Open Loop
Close Loop

System Type

The field technician will identify whether the system is a hot water or steam system and will indicate whether the boiler also provides domestic hot water. This information will be gathered through inspection and consultation with the homeowner.

- **Hot Water.** Hot water is circulated throughout the home's baseboard, radiator, or radiant floor heating systems. This system requires a circulation pump.

- **Hot Water with Indirect Water Heater.** This system provides space heat in the same way as a typical hot water boiler. Additionally, the boiler may provide domestic hot water by indirectly heating a hot water storage tank.
- **Steam.** A steam boiler system uses steam to circulate heat through radiators in the home.

System Response Options

Response Options
Hot Water
Hot Water with Indirect Water Heater
Steam

Distribution Type

Field technicians will identify how the boiler system distributes the water or steam throughout the home. The response options are:

- **Radiant Slab.** In a radiant slab system, hot water or steam is circulated through a series of cables or tubes in either the floor or walls to provide space heating.
- **Radiators.** In a radiator system, hot water or steam is circulated through radiators or baseboard panels throughout the home to provide space heating.
- **Fan Coils.** Some boiler systems provide heat to a central air handler, which circulates hot air through a duct network.

Distribution Response Options

Response Options
Radiant Slab
Radiators
Fan Coils
Other

Fuel Type

Field technicians will record how the equipment is fueled. This information will be gathered from consultation with the homeowner.

Fuel Response Options

Response Options
Wood (cord)
Wood (pellets)
Natural Gas
Propane
Oil
Electric
Other

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Smart/Wi-Fi Thermostat (if unable to determine between the two)
Smart Thermostat
Wi-Fi Enabled Thermostat
Programmable Thermostat
Manual Thermostat - Digital
Manual Thermostat - Analog
Timer
None
On/off

Ignition

If the equipment is gas-powered, field technicians will record the unit's ignition type. The two options are standing pilot and intermittent ignition. If the unit has a standing pilot, field technicians may be able to visually identify that the pilot light is on.

Intermittent ignition devices use electricity to spark the burner. When the unit is activated, gas flows to the pilot where a spark ignites the fuel; once the fuel is ignited, gas is allowed to flow into the main burner and the unit is turned on. Intermittent units typically emit a clicking sound during unit startup. Similar to a gas stove, this clicking sound is caused by the electrical spark which will ignite the unit.

Combustion Type

Field technicians will identify how the geothermal heat pump system distributes the conditioned air throughout the home.

- **Atmospheric.** An atmospheric combustion boiler draws air into the combustion chamber from the space in which the boiler is located. If the boiler is located in the house, this air must come from the house.
- **Sealed Combustion.** A sealed combustion boiler has an air intake pipe that uses a draft inducer motor to draw the air used for combustion directly from outside and force combustion air out.
- **Condensing.** Condensing boilers have a secondary heat exchanger that extracts heat from the combustion air.

Combustion type Response Options

Response Options
Atmospheric
Draft Assist
Condensing

Heat Capacity

Field technicians will record the input and output Btuh (both, if available). This information is typically available on the equipment nameplate or may need to be looked up using the equipment model number.

Whole-House Fan

A whole-house fan is a type of fan, or exhaust system, designed to circulate air in a home or building and commonly vents into a building's attic.

Present (Yes/No)

Field technicians will record the presence of a whole-house fan. These fans are installed in the highest point of the home, typically attics.

Usage

Field technicians will ask the homeowner how often the fan is used. Field technicians will record how many hours per week the system is used during the summer.

Central Vent

A central ventilation system draws air into the air handler connected to the home's central duct system.

Working (Yes/No)

Field technicians will indicate whether the central ventilation system is in working condition at the time of the site visit.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table list all response options.

Control Response Options

Response Options
Manual Switch
Continuous
Timer

Hours per Day

Field technicians will ask the homeowner how many hours per day the central vent is used.

Central Vent with Return

A central ventilation system with return draws outside air into the air handler connected to the central duct system in a house and balances it by mechanically exhausting an equivalent amount of air. Fresh air supply

and exhaust vents often supply fresh air to the most commonly occupied rooms and exhaust air from rooms where moisture are most often generated (kitchen, bathrooms, laundry room).

Working (Yes/No)

Field technicians will indicate if the central ventilation system is in working condition at the time of the site visit.

Equipment Type

Field technicians will indicate if the central ventilation system with return is controlled or not controlled.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table list all response options.

Control Response Options

Response Options
Manual Switch
Continuous
Timer

Hours per Day

Field technicians will ask the homeowner how many hours per day the central vent is used.

Heat or Energy Recovery Ventilation

One type of energy recovery ventilation system uses equipment known as a heat recovery ventilator (HRV) that employs a cross-flow or counter-flow heat exchange between the inbound and outbound air flow. An HRV provides fresh air and improved climate control while also saving energy by reducing heating (and cooling) requirements. Another closely related type uses energy recovery ventilators (ERVs); however, ERVs also transfer the humidity level of the exhaust air to the intake air.

Brand

Field technicians will collect the brand from the outdoor unit nameplate, selecting from a predetermined set of options or manually entering the brand into the iPad collection tool.

Model Number

Field technicians will collect the model number from the unit nameplate and manually enter it into the iPad collection tool.

Hours per Day

Field technicians will ask the homeowner how many hours per day the recovery unit is used.

Equipment Type

HRVs and ERVs can be stand-alone devices that operate independently, or they can be built in or added to existing HVAC systems. Field technicians will indicate the type of HRV/ERV observed in the home.

Equipment Type Response Options

Response Options
Stand-Alone Ducts
Attached to Duct System

Working (Yes/No)

Field technicians will indicate whether the system is in working condition at the time of the site visit.

Rated CFM

Field technicians will determine the rated flow rate of the unit in cubic feet per minute (cfm). This information may be available on the equipment nameplate, or it may need to be looked up using the model number.

Controls

Field technicians will record how the unit is controlled by indicating if there is a control device, such as a thermostat or timer, or if the unit is operated manually. The table lists all response options.

Control Response Options

Response Options
Manual Switch
Continuous
Timer

NEEA RBSA Domestic Hot Water Inventory: Protocols for Field Technicians

This document outlines the protocol for field technicians performing data collection related to domestic hot water (DHW) systems as part of the NEEA RBSA home surveys, encompassing each data point to be collected and the proper method for collecting these data. Field technicians will populate every data field, using "N/A" or some variation to indicate data points that could not be collect or did not apply.

Domestic Hot Water Data Collection

Field technicians will collect showerhead and faucet data in parallel with collecting lighting data and other inventories. Technicians will collect all of the DHW heater data from the mechanical area where the unit is installed. When unable to collect a specific data point directly, field technicians will note that they gathered this information from some other source (asked the homeowner, assumed based on similar equipment in the home, etc.). Possible scenarios of this include:

- DHW system is inaccessible
- It is not safe to inspect the DHW system
- Information is not available/legible on the DHW nameplate
- Bathrooms are not accessible

Though there is some flexibility in the walk-through process, the type of data collected for each piece of equipment is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data collection software.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

- Data point cannot be safely determined (such as needing to climb over equipment to assess)
- Label has been removed or is old and information is unrecognizable
- Water device is in a locked room or a room the homeowner asked field technicians not to enter
- Unusual specification and field technicians cannot determine

Notes

Field technicians will provide any additional information that may prove useful during the data analysis phase, such as when the resident refuses access to certain rooms or areas of the home, or when data collection is limited due to equipment being inaccessible.

Data Collection by Category

Showerhead

Field technicians will collect all of the data points outlined below for each showerhead in the home.

Flowrate, Rated

Field technicians will record the rated flowrate of the showerhead. Typically this value is stamped or printed on the showerhead. If the rated flowrate cannot be determined by visual inspection, the technician will mark "Unknown."

Flowrate, Measured

Field technicians will measure flowrate using a 5-quart bag, following these steps:

1. Turn the water on full. If there are both hot and cold handles, turn both handles to full.
2. Place the 5-quart bag into the water stream for 15 seconds.
3. Record the ounces filled after 15 seconds.
4. Repeat steps 1-3, then average the two results.
5. Divide the average ounces by 32 to calculate GPM.

A 5-quart bucket is the minimum size for field technicians to use, as smaller buckets may overfill in 15 seconds with high-flow faucets.

Primary Status

In order to gauge shower usage, field technicians will ask homeowners which shower in the home is primary (and used the most). The table below shows the response options.

Primary or Secondary Response Types

Response Types
Primary
Secondary
All used about the same
Unknown

Secondary Showerhead Usage

For secondary showerheads only, field technicians will ask homeowners how frequently the shower is used. The table below shows the response options.

Secondary Showerhead Usage Response Types

Response Types
A few times per week
A few times per month
A few times per year
Unknown

Faucets

Field technicians will collect all of the data points outlined below for each kitchen or bathroom faucet in the home.

Flowrate, Rated

Field technicians will record the rated flowrate of the faucet. Typically this value is stamped or printed on the faucet. If the rated flowrate cannot be determined by visual inspection, the technician will select "Unknown."

Flowrate, Measured

Field technicians will measure flowrate using a 5-quart bag, following these steps:

1. Turn the water on full. If there are both hot and cold handles, turn both handles to full.
2. Place 5-quart bag into the water stream for 15 seconds.
3. Record the ounces filled after 15 seconds.
4. Repeat steps 1-3, then average the two results.
5. Divide the average ounces by 32 to calculate GPM.

A 5-quart bucket is the minimum size for field technicians to use, as smaller buckets may overfill in 15 seconds with high-flow faucets.

Primary Status (Yes/No)

In order to gauge faucet usage, field technicians will ask homeowners which faucet in the home is primary (and used the most). The table below shows the response options.

Primary or Secondary Response Types

Response Types
Primary
Secondary
All used about the same
Unknown

Water Heater (Single Family)

Field technicians will collect the data outlined below—and in the order outlined—for domestic water heaters, specifically for each individual domestic water heater serving a single dwelling. The Central Water Heater (Multifamily) section provides guidance for a water heater system serving multiple units.

Some special cases field technicians will consider when collecting water heater information include:

- If they cannot access the water heater (because it is in an inaccessible crawlspace, locked room etc.), they will select "Cannot Access" and provide a brief description of the issue.
- If the home uses solar heating in addition to a traditional fuel like electricity or natural gas, field technicians will select the traditional fuel in the "Fuel" field and select "Yes" in the "Solar Water Heating" field.

Fuel Type

Field technicians will inspect the water heater to determine fuel type from a natural gas line (pipe) that runs into it, if present. Field technicians may also confirm a combustion fuel from a vent on top of the unit. If visible and legible, the nameplate will specify if the unit is electric. Field technicians will use visual inspection to determine if the unit uses wood as fuel.

DHW Fuel Types

Fuel Options
Natural Gas
Oil/Kerosene
Electricity
Wood
Propane
Unknown

Solar Water Heating (Yes/No)

Field technicians will determine and note if the home uses a solar water heating system to heat the DHW. This may be a supplementary fuel, used in conjunction with a traditional fuel from the table above. In this scenario, the field technicians will indicated the type of traditional fuel and select "Yes" for solar water heating.

Technology Type

Field technicians will select the appropriate technology type of the water heater from the list below.

DHW Technology Type

Technology Type Options
Electric Resistance
Electric Heat Pump
Natural Gas Non-Condensing
Natural Gas Condensing
Unknown

Electric Resistance units have no vent on top of the unit and no natural gas line (pipe) entering the unit.

Electric Heat Pumps typically have no vent on top of the unit and no natural gas line (pipe) entering the unit. These units are typically newer than traditional electric resistance units, and typically have a "hat" on top with the heat pump and controls. The nameplate may indicate that the unit is a heat pump unit.

Natural Gas Non-Condensing units have a vent on top of the unit and a natural gas line (pipe) entering the unit. These units may have an atmospheric vent; Field technicians will confirm the presence of such a vent by visually inspecting whether the vent cone is separated from the top of the vent pipe (whether there is daylight between the vent cone and the vent pipe).

Natural Gas Condensing units have a vent on top of the unit and a natural gas line (pipe) entering the unit. These units usually have an enclosed vent system with a draft assist installed whereby a fan or blower pushes

the exhaust gases out of the house. These systems also have a PVC drain pipe for the condensed water. The nameplate may indicate that the unit is a condensing gas water heater unit.

System Type

If the heater has a water storage tank greater than one or two gallons, field technicians will determine that the system type is "Storage." If the unit is instantaneous with only a small tank (less than one or two gallons), the system is "Instantaneous."

DHW System Type

System Type Options
Storage
Instantaneous
Unknown

Tank Wrap (Yes/No)

Field technicians will visually inspect whether tank wrap was installed on the water heater.

Tank Wrap R-Value

Field technicians will inspect the thickness of tank wrap to estimate the insulating R-value, determined as approximately 2-R per inch thickness of tank wrap (for example, 2-inch thick tank wrap correlates to R-4).

Tank Size

Technicians will determine the water heater tank size (in gallons) from the equipment nameplate, typically on the side of the unit. If the information is not available on the nameplate, field technicians will select "Unknown" or ask the homeowner.

Instantaneous water heaters are often called "tankless" water heaters, which implies the units have no tank; however, these units do have a small tank. The volume of the instantaneous water heater tank is usually listed on the nameplate.

Input Capacity

Technicians will determine the water heater input capacity from the equipment nameplate, recording this information in the same units presented on the water heater, typically either Btu or kW. If the information is not available on the nameplate, field technicians will select "Unknown" and attempt to find the information based on brand and model information.

Manufacturer and Model Number

Technicians will determine the water heater manufacturer and model number from the equipment nameplate. If the information is not available on the nameplate, field technicians will select "Unknown."

Year of Manufacture

Technicians will determine the water heater year of manufacture from the equipment nameplate. If the information is not available on the nameplate, they will select "Unknown."

Vent Type

Field technicians will determine the water heater vent type. If the water heater has an enclosed vent system, where the ventilation pipe is connected directly to the top of the unit, technicians will select "Draft-Assist."

Often, draft-assist vents have a blower or fan installed in-line. “Atmospheric” vents have space between the vent cone/duct and the top of the water heater unit.

DHW Vent Type

Vent Type Options
Atmospheric
Draft-Assist

In Conditioned Space (Yes/No)

Field technicians will document whether or not the space where the unit is installed is within the conditioned boundary of the home. In most cases a basement will be considered as inside the conditioned area. A basement will only be considered unconditioned if it is vented or has a dirt floor and does not contain HVAC equipment.

Type of Drain

Field technicians will determine the type of drain for the water heater. Floor drains are where there is a drain nearby in the floor, but the unit is not plumbed directly into it. If the unit drain is plumbed into the floor drain, it is considered a “Plumbed Drain” (note that a drain pan installed under the unit does not constitute a plumbed drain). Some homes with a basement may have a pumped drain, in which water heater drainage is pumped up and out of the basement.

DHW Drain Type

Drain Type Options
Floor drain
Plumbed drain
Pumped drain
Unknown

Pipe Wrap (Yes/No)

Field technicians will record if the hot and/or cold pipes leading into and out of the water heater are insulated with pipe wrap.

Pipe Wrap Type

Field technicians will determine the type of pipe wrap from the table below.

DHW Pipe Wrap Type

Pipe Wrap Type Options
Polyethylene Foam
Rubber
Fiberglass
Other

Pipe Wrap Length

Field technicians will estimate and record the pipe wrap length in inches. The recorded length should reflect the total length of pipe wrap on the hot side of the water heater. Pipe wrap on the cold side of the water heater should not be included.

Pipe Wrap Thickness

Field technicians will estimate the thickness of pipe wrap in inches.

Heat Pump Water Heater Potential

In addition to the collecting data on the existing water heater, field technicians will record information related to the potential for heat pump water heaters. These units rely on heat generated from the surrounding air, and the data collected will help field technicians determine how much of this heat the water heater is able to capture. The technician may estimate distances for these questions.

Garage Heater: Supply Air from Inside House (Yes/No)

For existing water heaters installed in the garage, field technicians will identify if a new unit might be able to obtain supply air from inside the house. As a rule of thumb, if the unit is within six unobstructed feet of the house/garage wall, the answer to this question is "Yes."

House Heater: Exhaust to Garage (Yes/No)

For existing water heaters installed in the house, field technicians will identify if a new unit in this location might be able to exhaust air to the garage. As a rule of thumb, if the unit is within six unobstructed feet of the house/garage wall, the answer to this question is "Yes."

Room Volume Greater than 1,000 Cubic Feet (Yes/No)

Field technicians will identify whether the volume of the room where the unit is located is greater than 1,000 cubic feet.

Within Four Feet of a Drain (Yes/No)

Field technicians will determine if the drain is within four feet of the existing water heater.

Eight Feet of Vertical Clearance (Yes/No)

Field technicians will determine whether there is at least an eight-foot vertical clearance in the room where the existing water heater is located.

Central Water Heater (Multifamily)

The information provided in this section is unique to central water heater systems, typically found in multifamily apartment or condominium buildings. Information common to the single family application is provided in the Water Heater (Single Family) section.

Configuration

Field technicians will determine the central water heater configuration by visual inspection and/or by obtaining feedback from the facilities engineer.

Central DHW Configuration

Configuration Options
Tank
Boiler
Boiler Shared with Space Heat
Tank Shared with Space Heat

Tanks are a stand-alone water heater system, similar (maybe larger) to single family systems.

Boilers may be used for DHW heating if there are many units to provide water to.

Boilers shared with space heat provide DHW and hot water for space heat.

Tanks shared with space heat are also called a "side boiler arm" or an "indirect" water heater.

Boiler Vintage

If the water heater system for the multifamily unit includes a boiler, field technicians will determine if the boiler is original or a replacement by asking the facilities manager or by estimating based on the relative age of the boiler and facility (building).

Central DHW Boiler Vintage

Boiler Vintage Options
Original
Replacement
Unknown

Boiler Material

If the central water heater system employs a boiler, field technicians will determine if the boiler material is iron or copper by visual inspection, asking the facilities engineer, or reading the nameplate.

Central DHW Boiler Materials

Boiler Material Options
Iron
Copper
Unknown

Separate Storage Tank (Yes/No)

Field technicians will indicate if there is/are separate storage tank(s) in addition to the primary unit for the domestic hot water.

Circulation System (Yes/No)

Field technicians will inspect the water heater for a pump installed in-line with the central system to determine if it employs a circulation system.

Circulation System Control

Field technicians will consult with the facilities engineer to determine the type of circulation system control type, shown in the table below.

Central DHW Circulation System Control

Circulation System Control Options
None
Timer
Demand
Other
Unknown

Number of Months Operational

Field technicians will consult with the facilities engineer to determine how many months of the year the central water heater system is operational.

Circulation Hours per Day

Field technicians will consult with the facilities engineer to determine how many hours per day the circulation system operates.

Serves Common Areas (Yes/No)

Field technicians will inspect pipe labels (if present) and work with the facilities engineer to determine if the system serves common areas of the building (such as hallways, entryways, or common kitchen areas).

Serves Dwelling Units (Yes/No)

Field technicians will inspect pipe labels (if present) and work with the facilities engineer to determine if the system serves the residential dwelling areas of the building.

Serves Commercial Areas (Yes/No)

Field technicians will inspect pipe labels (if present) and work with the facilities engineer to determine if the system serves commercial areas of the building (such as shops, offices, or restaurants).

NEEA RBSA Appliance Inventory: Protocols for Field Technicians

This document describes the protocols for field technicians who are collecting appliance data as part of the NEEA RBSA home surveys. The primary data points to be collected are outlined in the table below.

Data Collection Overview

Inventory

Appliance data collection has the potential to be very time consuming. To ensure that all relevant data is collected in a complete and efficient manner, Cadmus has the following restrictions for appliance data collection:

- Field technicians will only collect data for pieces of equipment that are actually plugged in, or that are unplugged and in their normal place of operation, at the time of inspection. For instance, a dehumidifier in storage will not be captured.
- Field technicians will try to obtain equipment model numbers in all scenarios, except when it is not reasonable because of site conditions (appliance mounted within a wall, unable to move furniture for fear of breaking it, etc.). In these scenarios, field technicians will collect as much data as possible.

Though there is some flexibility in the walk-through process, the type of data collected for each piece of equipment is fixed and will be consistent across all sites. Field technicians will record the attributes of each piece of equipment using Cadmus' proprietary iPad data collection software.

Unknown Designation

In the following instances, a data point will not be determinable and field technicians will record the data as unknown, entering a brief note explaining the circumstance:

- Data point cannot be safely determined (such as needing to climb over equipment to assess it, or when equipment is off the ground and cannot easily be assessed with a stepstool)
- Information is unrecognizable or label has been removed
- Equipment is in a locked room or a room the homeowner asked field technicians not to enter
- Unusual specification and field technician cannot determine

Notes

Field technicians will provide any additional information that may prove useful during the data analysis phase, such as when the resident refuses access to certain rooms or areas of the home, or when data collection is limited due to equipment being inaccessible.

Data Collection by Category

Thermostat

Field technicians will collect numerous data points for each thermostat within a home, as outlined below. This information is very important because it relates to the home's HVAC consumption, one of the largest residential end uses.

Type

Field technicians will identify the thermostat type. Many new thermostats are entering the market, including those that users can interact with via Wi-Fi, are capable of "learning," and/or have occupancy sensing. There are four main categories of thermostats:

Manual thermostats must be manually controlled by users to adjust the HVAC system's temperature settings. Typically, they have a dial rather than a digital display. They do not have any programming or Wi-Fi connectivity capabilities.

Programmable thermostats can be programmed by the user to automatically change the HVAC system's temperature settings by hour of day and day of week. Standard programmable thermostats do not have Wi-Fi connectivity.

Wi-Fi thermostats have the same capabilities as programmable thermostats, with added Wi-Fi connectivity that enables the user to also program or adjust the thermostat via a smartphone, tablet, or computer. Because of the Wi-Fi connectivity, these thermostats can also be used in utility demand response programs, where the utility controls the temperature settings to help reduce energy consumption and power draw during periods of peak demand. Typically, Wi-Fi thermostats have additional features, such as color displays or touchscreens, to enhance the user interface.

Smart thermostats have the same capabilities as Wi-Fi thermostats, plus occupancy sensing. Occupancy sensing could include motion sensors (Nest or Ecobee3) or geo-fencing (Ecobee3 or Honeywell Lyric). The Ecobee3 thermostats have the option to add remote sensors to different rooms so the thermostat can adjust the temperature settings based on which room(s) is occupied. In addition, some smart thermostats have "learning" capabilities (such as Nest), using historical temperature data to automatically program a schedule of setpoints for the user.

Field technicians will choose from the following response options.

Thermostat Types

Response
Smart/Wi-Fi (if unable to determine between the two)
Smart
Wi-Fi Enabled
Programmable
Manual

Brand

Field technicians will collect the thermostat brand from the unit display, typically found on the front of the unit. Field technicians will select from a predetermined set of options or manually enter the thermostat brand into the iPad collection tool.

Programmed (Yes/No)

For smart, Wi-Fi, and programmable units, field technicians will record whether the thermostat is programmed at the time of the site visit. If field technicians encounter a programmable unit that was manually overridden and set to "Hold," they will record the unit as NOT being programmed. This question will have a yes/no response.

Current Thermostat Setpoint

Field technicians will record what temperature thermostat is set to at the time of the site visit.

Thermostat Wi-Fi Control (Yes/No)

If field technicians identify a smart or Wi-Fi thermostat within the home, they will ask the homeowner how they interact with the thermostat. If the homeowner uses a phone, tablet, or computer to control their thermostat, field technicians will record the question as "yes" (only populated for smart and Wi-Fi thermostats).

Clothes Washer

Field technicians will collect a number of data points for clothes washers, most of which are available on the unit nameplate or information tag/label. Typically, these labels are located on the inside rim of the clothes washer, but may be on the back or the side of unit where it is not easily accessible. In these instances, field technicians will not shift the clothes washer unless it can be easily and safely moved.

Washing Machine Orientation

This data point describes the actual configuration of the washing machine. The full list of options available to the field technician is shown in the table below.

Washing Machine Orientation

Response
Vertical Axis (with agitator)
Vertical Axis (without agitator)
Horizontal Axis
Combined Washer/Dryer in One Drum
Unknown

The washing machine axis is the direction of the drum. If the drum is oriented horizontally, the washing machine has a horizontal axis. Similarly, if the drum is oriented vertically, it is a vertical axis clothes washer.

For vertical axis clothes washers, field technicians will note whether the unit has an agitator. The agitator is a finned tube component in the center of the drum. If the unit does not have an agitator, there will be no tower in the drum. Top loading units with no agitator will still likely have a small set of fins at the bottom.

In addition to being oriented horizontally and not having an agitator, some horizontal axis washers may also serve as a dryer. These combined washer/dryer units tend to look the same as a horizontal axis washer or dryer, and are often used when space is limited. If there is no dryer present and no clear labeling, field technicians will ask the homeowner to confirm. In order to discern between an all-in-one unit and a horizontal axis washer, field technicians will refer to the product label.

In stacked washer/dryer setups, the dryer is stacked on top of the washer. These units are interconnected; a dryer located on a shelf above the washer does not count as a stacked washer/dryer system configuration.

Capacity (cubic feet)
Field technicians will record the washing machine's rated capacity, listed on the equipment label.

Brand
Field technicians will record the washing machine brand, listed on the equipment label.

Model Number
Field technicians will record the washing machine model number, listed on the equipment label.

Year of Manufacture
Field technicians will record the washing machine's year of manufacture, as listed on the equipment label.

ENERGY STAR Label (Yes/No)
Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Clothes Dryer

Field technicians will collect a number of data points for clothes dryers (brand, model number, and year of manufacture), most of which will be available on the unit nameplate or information tag. These details may also be on the equipment label, typically located on the inside rim of the dryer, or on the back or side of the unit.

Brand
Field technicians will record the clothes dryer brand, listed on the equipment label.

Model Number
Field technicians will record the clothes dryer model number, listed on the equipment label.

Year of Manufacture
Field technicians will record the clothes dryer's year of manufacture, as listed on the equipment label.

Fuel Type
Field technicians will record the dryer fuel type. This information can typically be ascertained from visual inspection. Electric dryers are typically 240V, which requires a special outlet and electrical cord. The power cord is typically thicker than a normal power cord because of the increased insulation. If the unit is fired by natural gas, there will be a gas line running from the wall to the unit. To determine if the unit is actually run on natural gas or propane, field technicians will consult the homeowner. This information can also be

obtained from the utility service at the home: if a home does not have natural gas service, but the dryer has a gas line, it is a propane fired dryer.

The full list of response options is shown in the table below.

Clothes Dryer Fuel Types

Datapoint	Response
Fuel	Natural Gas
	Electric
	Propane
	Unknown

Capacity (cubic feet)

Field technicians will record the dryer's rated capacity, listed on the equipment label. This may be looked up from the model number.

Location

Field technicians will record what type of space the dryer is located in.

Matched Pair (Yes/No)

Field technicians will record whether the washer and dryer appear to be a matched pair.

Gas Line Connection (Yes/No)

Field technicians will record whether there is a gas line connection in the vicinity of the dryer. This information will be collected for all dryers; an electric dryer is not excluded from this question.

Dryer Vented (Yes/No)

Field technicians will identify if the dryer is vented to outside or unvented. If the dryer is vented, there will be ducting running from the rear or bottom of the unit and running through a wall, floor, or ceiling to outside. This ducting moves the hot, moist air from inside the dryer to outside the home. Unvented units may have ducting that terminates inside the home or may have a drip pipe to collect condensate and transfer it to a drain or container.

For vented systems where the ducting is not hooked up correctly, field technicians will still identify the system as a vented system. Field technicians will collect this data point as a yes/no response.

ENERGY STAR Label (Yes/No)

Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Refrigerator/Freezer

Field technicians will collect numerous data points for refrigerators and freezers, most of which will be available on the unit nameplate or information tag. Typically, these labels are located on the inside of the refrigerator door. For smaller units, this information may be located on the back or side of the unit.

Style

Refrigerator style describes the actual composition (refrigerator, freezer, or both) and orientation of the unit. Field technicians will collect this detail via visual inspection of the unit.

A full list of options is shown in the table below.

Refrigerator and Freezer Configurations

Datapoint	Response
Style	R/F Bottom Freezer
	R/F Top Freezer
	Freezer, Chest
	Freezer, Upright
	Full-Size Single Refrigerator Only
	Side by Side
	Side By Side Refrigerator w/ Bottom Freezer
	Unknown

Volume (cubic feet)

Field technicians will record the unit's rated capacity as listed on the equipment label.

Brand

Field technicians will record the unit brand as list on the equipment label.

Model Number

Field technicians will record the unit model number as listed on the equipment label.

Year of Manufacture

Field technicians will record the unit year of manufacture as listed on the equipment label.

ENERGY STAR Label (Yes/No)

Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Icemaker Type

Field technicians will record the presence and type of the freezer's icemaker. There are three primary icemaker configurations: through door, in freezer, and none. Through door icemaker are capable of dispensing ice through the door, without having to manually open the freezer. In freezer icemakers are capable of automatically creating ice cubes, but the user must manually open the freezer to get the ice cubes.

If no automatic icemaker exists, field technicians will record the icemaker type as "None." The full list of options is provided in the table below.

Icemaker Types

Datapoint	Response
Icemaker Type	Through Door
	In Freezer
	None
	Unknown

Percentage of Use

Field technicians will ask the homeowner how often the refrigerator is plugged in and operational. The main refrigerator in the kitchen will be listed as 100%. Secondary units, found in basements and garages, could be used just a portion of the time. Field technicians will collect this data as a percentage of total year that the unit is operated.

The full list of response options is shown in the table below.

Refrigerator Usage Percentage

Datapoint	Response
Percentage of Use	0%
	25%
	50%
	75%
	100%
	Unknown

Location

In addition to noting the percentage of the year the unit is used, field technicians will record whether the unit is located in a conditioned space or an unconditioned space. The full list of response options is shown in the table below.

Refrigerator Location Options

Datapoint	Response
Location	Conditioned
	Unconditioned
	Unknown

Cooking Equipment

Field technicians will collect a couple of data points for cooking equipment, mostly through visual inspection and conversation with the homeowner.

Oven Fuel Type

Field technicians will collect the oven fuel type by visual inspection and through conversation with the homeowner, if needed. The full list of response options is shown below.

Oven Fuel Types

Datapoint	Response
Oven Fuel Type	Electric
	Natural Gas
	Propane
	No Oven
	Other
	Unknown

Electric ovens can be identified by the heating coils at the bottom and possibly top of the oven. This coil functions as a resistor and generates heat when current is run through the coil.

Natural gas and propane ovens can be identified by looking inside the oven. Typically, these ovens have a burner located below the bottom of the cooking area, though there may also be one at the top. There will be vents located on the bottom of the cooking area; the burner is underneath this cooking area, and hot air flows into the oven through these vents. Additionally, there will be a natural gas/propane pipe and valve located near (typically behind) the unit. To differentiate between natural gas and propane, field technicians will consult with the homeowner or rely on context: if the home has a large propane tank on the site, it is likely that the unit is propane.

If the home does not have an oven, field technicians will record the data as "No Oven." Field technicians will only collect data for full-size dedicated ovens; countertop microwave ovens and toaster ovens will not be included.

Cooktop Fuel Type

Field technicians will collect the cooktop fuel type by visual inspection and through conversation with the homeowner, if needed. The full list of response options is shown in the table below.

Cooktop Fuel Types

Datapoint	Response
Cooktop Fuel Type	Electric
	Natural Gas
	Propane
	No Cooktop
	Other
	Unknown

Electric cooktops can be identified by the type of burner. These coils glow bright red when the unit is on (field technicians will not turn cooktops on). This coil functions as a resistor and generates heat when current is run through the coil.

Natural gas and propane cooktops can be identified by the type of burner. When the appliance is in use, these burners are ignited and have a blue flame (again, field technicians will not turn cooktops on). Additionally, there will be a natural gas/propane pipe and valve located near (typically behind) the unit. To differentiate

between natural gas and propane, field technicians will consult with the homeowner or rely on context: if the home has a large propane tank on the site, it is likely that the unit is propane.

If the home does not have a cooktop, field technicians will record the data as "No Cooktop." Field technicians will only be collect data for full-size dedicated cooktops; countertop hotplates will not be included.

Dishwasher

Field technicians will collect several details of dishwashers, which are typically under-counter or in-counter appliances, but may also be standalone units.

Brand

Field technicians will record the unit brand as list on the equipment label.

Model Number

Field technicians will record the unit model number as list on the equipment label.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label, typically located on the inside of the dishwasher door. For smaller units, this information may be located on the back or side of the unit.

ENERGY STAR Label (Yes/No)

Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Dehumidifier

Field technicians will collect several details of dehumidifiers, which are typically standalone units.

Brand

Field technicians will record the unit brand as list on the equipment label, typically located on the rear of the dehumidifier cabinet.

Model Number

Field technicians will record the unit model number as list on the equipment label.

Year of Manufacture

Field technicians will record the unit's year of manufacture, as listed on the equipment label.

ENERGY STAR Label (Yes/No)

Field technicians will record the presence of an ENERGY STAR label, which may be included on the equipment label.

Large Unusual Loads

In addition to the standard appliances outlined above, the RBSA field technicians will also include information on the number and type of large unusual appliance loads within the home. As with the other appliances, field technicians will only record details for those items that are plugged in and operational at the time of the site visit. Field technicians' general approach to data collection for these pieces of equipment is to identify the

type and quantity of each piece of equipment, then provide additional high-level information about the unit in the notes section.

Equipment Type

Field technicians will record the presence of the full list of equipment types shown in the table below.

Large Unusual Load Types

Datapoint	Response
Equipment Type	Air Filter/Purifier
	Central Vacuum
	Chicken Heat Lamp
	Engine Block Heater
	Fish Tank
	Freshwater Pump (i.e., House Supply)
	Heated Pool
	Heated Waterbed
	Hot Water Circulation Pump
	Kiln (electric, natural gas, or other fuel)
	Pipe Heater
	Potable Water Pump
	Sauna
	Septic Pump
	Standalone Ice Maker
	Swimming Pool Heater
	Swimming Pool Pump
	Water Feature
	Water Softener Equipment
	Welder (electric)
	Well Pump
	Unknown

A brief description of each equipment type is provided here:

- **Air Filter/Purifier.** This is typically a standalone appliance that is plugged into a wall outlet. These fan-based devices remove contaminants from the air in a room. Field technicians will identify the brand and model number, if readily available.
- **Central Vacuum.** A central vacuum cleaner is installed into a building as a semi-permanent fixture. These devices use a central motor and a series of ducts installed throughout the home to vacuum debris from inside the home and exhaust this debris to the home exterior or a collection container. Typically the central motor and collection container are located in the basement, garage, or storage room. Field technicians will record the make and model of the motor, as well as the rated horsepower.
- **Chicken Heat Lamp.** A heat lamp is a type of incandescent light bulb used for the principal purpose of creating heat. These lamps are designed to produce more infrared light than a typical incandescent.

For homeowners with a chicken coop or similar chick incubator with heat lamps located on the site, field technicians will document the wattage and color of the lamps.

- **Engine Block Heater.** Block heaters are used in cold climates to warm an automobile or other engine to increase the changes that the engine will start. These heaters can run on a number of fuels, including electricity and the vehicle's own gasoline. The most common type is an electric heating element in the cylinder block, connected through a power cord located in the vehicle grill. Field technicians will record the fuel type and rated capacity for these units.
- **Fish Tank.** Field technicians will identify large fish tanks or aquariums located within homes. These units often have a number of lighting elements, as well as a circulation pump. Field technicians will only collect information for units with a pump system; they will not document fish bowls. Field technicians will enter the approximate size of the fish tank (length, width, and height), as well as the rated horsepower of the motor.
- **Freshwater Pump.** Also known as booster pumps, some homes are equipped with their own pump system to boost the water pressure within the home and improve circulation. Field technicians will note the rated horsepower of the unit and whether there is a VFD present.
- **Water Heating Equipment (Heated Pool, Heated Waterbed, Hot Tub, and Swimming Pool Heater).** Field technicians will note the presence of water heating equipment, which may be used to heat a pool, hot tub, or waterbed. Field technicians will note the fuel type and capacity of this equipment.
- **Hot Water Circulation Pump.** These circulation systems may be installed in homes with radiant or hydronic heating systems, or in homes without these space heating systems as a way of providing near-instantaneous hot water at faucets throughout the home. Field technicians will identify if the system has a pump, the rated horsepower, and how the system is controlled.
- **Kiln.** Kilns are a type of oven that produces temperatures sufficient to complete a process, such as hardening, drying, or chemical changes. Typically, kilns are used to harden objects made from clay into pottery, tiles, and bricks. Field technicians will note the fuel type and rated capacity of all kilns.
- **Pipe Heater.** Also known as electrical heat tracing or surface heating, pipe heaters are used to maintain or raise the temperature of pipes. Pipe heating may be used to protect pipes from freezing or to maintain a constant flow temperature in hot water systems. Field technicians will note the purpose of the equipment and estimated usage.
- **Potable Water Pump.** Also known as booster pumps, some homes are equipped with their own pump system to boost the water pressure within the home and improve circulation. Field technicians will note the rated horsepower of the unit and whether there is a VFD present.
- **Sauna.** Field technicians will identify the type of fuel used to heat the sauna.
- **Septic Pump.** Septic systems are a type of on-site sewage facility common in areas that lack connection to main sewage pipes. The septic pump is a key component of the system, and pumps effluent out of the septic tank. Field technicians will record the rated horsepower of the pump.
- **Standalone Ice Maker.** These appliances are used to produce ice from liquid water. Standalone ice makers are their own piece of equipment, not incorporated into a refrigerator or freezer. Field technicians will record the make, model, and capacity (cubic feet) of the unit.

- **Swimming Pool Pump.** Residential swimming pools have a pump that recirculates water. During this process, the water is filtered then returned to the pool. Field technicians will record the pump horsepower and operation schedule.
- **Water Feature.** Field technicians will record the size and type of water features encountered on the site. If readily accessible or it can be gathered from the homeowner, field technicians will record the horsepower and operation schedules of the pump.
- **Water Softener Equipment.** Field technicians will record the presence and capacity of any water softening equipment found on the site.
- **Well Pump.** Similar to a domestic water pump, a well pump is used to facilitate the transport and circulation of potable water within the home. These pumps are typically submersed in the well or located in a pump house near the well. Field technicians will record the horsepower and operating schedule of the pump.
- **Unknown/Other Large Unusual Loads.** For loads not discussed in this protocol, field technicians will record the quantity, location, and type of equipment. In the notes section, field technicians will provide a detailed explanation of what the equipment is, how it operates, and an estimate of the power draw.

Quantity

Field technicians will record the quantity of each type of large unusual load as a numerical value.

Location

Field technicians will record the location of each piece of unusual load equipment, identifying whether the space is conditioned or unconditioned.

NEEA RBSA Blower Door Testing: Protocols for Field Technicians

This document describes the protocols for field technicians while performing blower door testing as part of the NEEA RBSA home surveys. The primary data points to be collected are outlined below.

Importance of the Blower Door Data Collection

Blower-door testing indicates the amount of air leakage for the structure, which is a primary determinant of thermal energy efficiency. Air leakage can also affect occupant comfort, indoor air quality, and building durability. The two-point blower door test strikes a balance between the expediency of single-point testing and the greater reliability and accuracy of multi-point testing.

Two-Point Blower Door Test

The two-point blower door test requires depressurizing the house to near 50 Pa and 25 Pa with respect to the outside. Note that the house pressure with respect to the outside does not have to be exactly 50 Pa or 25 Pa, because the field technician will calculate flow at 50 Pa during analysis.

Blower Door Safety

Blower door testing creates exaggerated pressure differences between the inside and outside of a structure in order measure air leakage. Indiscriminate use of blower door equipment in homes with combustion appliances and/or that contain hazardous materials (such as asbestos or mold) may create unsafe conditions inside a home. Accordingly, technicians conducting site visits for the RBSA will adhere to a strict safety policy:

Field technicians will follow all steps required by the separate Safety Protocol for the NEEA RBSA home survey.

Field technicians will NOT run a blower door test when they encounter one or more of these conditions:

- A fire is burning in any wood-burning fireplace or wood-burning or pellet stove, or there has been such a fire burning in the previous six hours.
- Hot or warm ashes are located in a wood-burning fireplace or wood-burning or pellet stove.
- Asbestos tape, wrap, or insulation is observed on ducting in any unconditioned area of the home, such as any crawlspace, attic, or garage space.
- Vermiculate is present in any attic space of the home or is known to have been present in the past.
- Any wall or ceiling that separates conditioned from unconditioned space appears to contain asbestos ceiling tile.

- Mold is observed or strongly suspected at the boundary of the conditioned and unconditioned areas of the home.
- There is evidence of heavy rodent infestation.
- One or more persons living in the home suffer from respiratory conditions such as severe asthma or chronic obstructive pulmonary disease.

Field technicians will not disqualify a home from blower door testing for any of the following conditions, which do not pose any serious threat to health or safety:

- Asbestos tape, wrap, or insulation is present on ducting inside the thermal boundary of the home, such as a basement.
- Floor tile contains or may contain asbestos.
- Acoustic tile or popcorn texture suspected of containing asbestos is observed on the basement ceiling or, where there is a second floor, on the first floor ceiling.

Field technicians will advise homeowners with pets and young children that harm can result from objects coming in contact with the blower door fan blades. One technician will always remain at the blower door to guard against harm to occupants or occupant pets.

It is likely that combustion gases from any unsealed combustion appliance that is running during a blower-door test will be back-drafted into the home. To prevent this potential safety hazard, technicians will ensure that no combustion appliance can run during testing, as outlined in the following section.

Blower Door Depressurization Test Procedure

Field technicians will follow these steps to conduct a blower door test:

1. In accordance with safety protocols included in this document, field technician will determine whether a blower door test can be safely run. This will require that technicians run the blower door test only after they survey the conditioned and unconditioned areas of the home. Technicians will not proceed with the test if they find any disqualifying condition specified above or if other conditions would render running the test unsafe or impractical.
2. Technicians will set up the blower door with the fan oriented to depressurize the conditioned space of the home. Field technicians will choose the location of an exterior doorway that is fairly central to the living space, usually the front door. A different door on the leeward side of the home may be preferable during strong winds.
3. In breezy or windy conditions, field technicians will shelter the end of the outside pressure tube from the wind by inserting it in a bottle or by some other method (per technician training).
4. Field technicians will close and latch all windows, skylights, and doors to the outside.
5. Field technicians will close and latch all doors and hatches between conditioned and unconditioned areas of the home. Unconditioned areas include:
    a. Garages
    b. Crawlspaces, except for the relatively few in the Northwest that have been encapsulated

c. Attics, except for the relatively few in the Northwest that have been sealed and insulated at their exterior surfaces
d. Mechanical/furnace closets that have been intentionally vented to outside or to unconditioned space to provide adequate combustion air
e. Basements that are clearly outside of the conditioned area of the home, such as those that are vented or have a dirt floor and do not contain HVAC equipment

6. Field technicians will close any pet doors to outside or unconditioned space, sealing with register masking or tape as needed.
7. Field technicians will close and latch all garage doors and windows, noting any doors or windows that cannot be closed.
8. Field technicians will make sure external hatches to any crawlspace or attic are closed.
9. Field technicians will open all interior doors between conditioned areas of the home. Conditioned areas include:
   a. Living space
   b. Closets, including unvented mechanical closets
   c. Basements, unless the basement is clearly outside of the thermal and pressure boundary of the home
   d. Encapsulated crawlspaces, which are rare in the Northwest
   e. Attic spaces that have been sealed and insulated at their exterior surfaces, which are rare in the Northwest
10. Field technicians will open operable crawlspace vents, unless the crawlspace has been encapsulated so that it is clearly inside the pressure boundary of the home.
11. In any homes or areas of homes that have been vacant for a long time, field technicians will pour water into drains to fill plumbing traps to avoid pulling in sewer gases.
12. Field technicians will close all dampers and doors on wood stoves and fireplaces. Where practical, field technicians will seal fireplaces or woodstoves as necessary to prevent ash disaster, as well as clean the ash from open fireplaces (recommended) or cover the ash with wet newspaper, and protect the area in front of each fireplace or stove with a drop cloth.
13. Field technicians will make sure the furnace cannot come on during testing, noting the thermostat setting before turning the furnace or other ducted heating system off at the thermostat.
14. Field technicians will make sure the water heater cannot come on during testing. If the temperature control has a “vacation” setting, technician will note the water temperature water setting and turn the dial to “vacation.” Alternatively, they will set the gas control knob to “pilot.” (We recommend that field technicians leave their keys next to the water heater to ensure they turn it back on after testing.)
15. Field technicians will make sure no other combustion appliance will run during blower door testing.
16. Field technicians will make sure the clothes dryer, all exhaust fans, window air conditioning units, and any other systems that move air across the conditioned boundary of the home are off.
17. Field technicians will set the baseline using the manometer’s baseline function over a time duration of at least 20 seconds.

18. With the blower door set up to depressurize the house, field technicians will ensure that the manometer is set to provide actual flow values in CFM rather than calculated CFM25 or CFM50 values. (With the DG-700, field technicians will set operating mode at PR/FL, not PR/FL@25 or PR/FL@50.)
19. Field technicians will depressurize the house to between -15 Pa and -25 Pa for a safety check. One technician will look into every room of the house to watch and listen for any problems, such as ash entering from a fireplace or air entering through open windows or doors. (If necessary, field technicians will keep knee-wall attic doors closed by putting a tool bag or other heavy object against them.)
20. Field technicians will depressurize the house to -50 Pa (or as close as possible) and set the manometer to present averaged readings every 10 seconds. Field technicians will record house pressure, blower door fan pressure, blower door ring, and blower door flow (see table below).

Blower Door Test Results

Category	Data Entry Examples
Blower door location	_____ For example, "front, main floor"
Blower door results, 50 Pa	At a house pressure of roughly 50 Pa with respect to the outside, record: _____ P_{50}: House pressure in Pascals near 50 Pa _____ Blower door fan pressure in Pascals at P_{50} _____ Blower door ring installed (0, A, B, C) _____ Q_{50}: Flow in CFM at P_{50}
Blower door results, 25 Pa	At a house pressure of roughly 25 Pa with respect to the outside, record: _____ P_{25}: House pressure in Pascals near 25 Pa _____ Blower door fan pressure in Pascals at P_{25} _____ Blower door ring installed (0, A, B, C) _____ Q_{25}: Flow in CFM at P_{25}
Flow exponent, n	_____ First trial _____ Second trial (if first is not between 0.5 and 0.75)
Conditions	_____ Windy (yes/no) _____ Unusual conditions

21. Field technicians will reduce house pressure to -25 Pa with respect to the outside and record the same data, again using 10-second averaging.
22. Before uninstalling the blower door, field technicians will verify the integrity of the results using this formula for the flow exponent, n:

$$n = \ln(Q_{50}/Q_{25})/\ln(P_{50}/P_{25})$$

Where:

P_{50} = Actual pressure in Pascals at roughly 50 Pa

Q_{50} = Measured flow at P_{50}

P_{25} = Actual pressure in Pascals at roughly 25 Pa

Q_{25} = Measured flow at P_{25}

If the calculated value of n is not between 0.50 and 0.75, field technicians will check the equipment, better protect the outside pressure from wind, check all relevant conditions inside the house, and repeat the test.

23. Field technicians will note any unusual testing conditions, such as strong winds or open garage windows.
24. Field technicians will return all combustion appliances, thermostats, fans, windows, and doors to their pre-test states.
25. Field technicians will verify that the water heater pilot and any others pilot lights are still lit. If any pilot lights have blown out, they will follow manufacturer instructions to re-light.

NEEA RBSA TrueFlow® Testing: Protocols for Field Technicians

This document describes the protocol that field staff will adhere to while performing airflow testing of electric central heating systems as part of the NEEA RBSA home surveys. The primary data points to be collected are defined below.

Importance of TrueFlow Data Collection

Testing with the TrueFlow® Air Handler Flow Meter collects data that will be used to calculate airflow across an air handler where practical. Considered with other data, this information may also indicate the adequacy of the duct system for the current system and other types of systems, such as a heat pump.

Data Collection Overview

Inventory

Airflow testing can be time-consuming. To ensure that all relevant data are collected in a complete and efficient manner, Cadmus has these restrictions:

- Field technicians will perform TrueFlow testing only on electric central heating systems, such as forced-air electric furnaces and air-source heat pumps.
- Where a heat pump is installed in a system along with a gas or oil furnace, field technicians will perform TrueFlow testing only if the heat pump is identified as the primary heating source.
- Field technicians will perform TrueFlow testing only when the TrueFlow plates can be placed at or near the air handler, so that testing measures essentially all flow across the air handler.
- Field technicians will perform TrueFlow testing with a plate installed in a return grille only when that grille is the only return grille in the system and is located within 10 feet of the air handler.
- Field technicians will not attempt to perform TrueFlow testing on any system that appears unsafe to operate or that is known not be in good working order.
- Field technicians will not attempt to perform TrueFlow testing where gaining access to the equipment or return grilles involves moving heavy furniture or a significant amount of stored goods.

Field technicians will record test results and other related attributes using Cadmus' proprietary iPad data collection software.

Unknown Designation

In the following instances, a data point will not be determinable, and field technicians will record the data as unknown and enter a brief note explaining the circumstance:

- The data cannot be determined because of any condition noted under Inventory (listed above).
- Determining the data point would require entry into a locked room or a room or area of the structure that the occupant asked the field technicians not to enter.
- The field technicians cannot determine the data point with confidence because of unusual conditions, structure, or materials.
- Determining the data point involves significant risk to occupant property or technician.

Notes

Field technicians will provide all information that may prove useful during data analysis, such as conditions that may affect the accuracy of test results.

TrueFlow Testing Procedure

Field technicians will collect airflow data where practical using the TrueFlow Air Handler Flow Meter.

Preparation

Field technicians will follow these steps to prepare for testing:

1. Field technicians will inform occupants that they will be collecting data about airflow through the heating system and will verify with the occupants that the system is in good working order.
2. Field technicians will confirm that no restriction listed under Inventory above disqualifies the heating system from airflow testing. For example, field technicians will ensure that:
    a. A TrueFlow plate can be installed at or near the air handler, or
    b. There is only one return grille in the system, and the return grille is within 10 feet of the air handler.
3. Field technicians will open a window in the home and leave it open during testing, as indicated in TrueFlow manufacturer instructions. The window should be away from the air handler and in a location that will not cause discomfort for the occupants.
4. Field technicians will open all registers in the system, even if occupants normally leave some closed.
5. Field technicians will note the current thermostat setting in preparation for restoring the set temperature after testing.

TrueFlow Testing

Field technicians will follow these steps to conduct TrueFlow testing:

1. Field technicians will determine the optimum location for a pressure probe for TrueFlow testing and will drill a one-quarter inch hole in that location. Field technicians will attempt to choose a “Best” location as described in section D.1 of Appendix D of the TrueFlow Air Handler Flow Meter Operation Manual when practical, preferably in the supply ducting. Where choosing a “Best” location is not practical, field technicians will choose one of the “Secondary” locations defined in section D.2 of the

operation manual. Field technicians will indicate the location of the test hole by choosing the appropriate value.

Location of TrueFlow Test Hole

Location of TrueFlow Test Hole
Side of supply plenum (fits “Best”)
Dead-end corner of supply plenum (fits “Best”)
Side of return plenum (fits “Best”)
Supply register (fits “Secondary”)
Side of supply trunk or branch duct (fits “Secondary”
Other

2. To allow measurement of the pressure difference across the air handle and filter, field technicians will locate and drill a second one-quarter inch hole on the other side of the air handler and filter from the TrueFlow test hole. For instance, if the TrueFlow test hole is located in the supply plenum (as preferred), this second hole should be located in the return ducting. Field technicians will follow the same Appendix D guidelines to choose a suitable location for this hole and will indicate the location by choosing the appropriate value.

Location of Second Test Hole

Location of Second Test Hole
Side of supply plenum (fits “Best”)
Dead-end corner of supply plenum (fits “Best”)
Side of return plenum (fits “Best”)
Supply register (fits “Secondary”)
Side of supply trunk or branch duct (fits “Secondary”
Other

If the only filter in the system is in a return grille, field technicians will still choose a hole location on the opposite side of the air handler, but they will note that the pressure difference will not include the pressure drop caused by the air filter.

3. Field technicians will insert a pressure probe into the second hole so that the tip points into the air stream, if applicable. (If the hole location is a dead-end corner as described in Appendix D of the TrueFlow operation manual, then a probe or pressure tube can simply be inserted into the hole.) Field technicians will connect a pressure tube between the pressure probe and a DG-700 manometer.
4. With the filter still in place and with the DG-700 set to PR/PR, field technicians will turn the air handler blower to its highest setting using the thermostat if possible. If the thermostat does not control fan speed directly and there is no switch at the unit to turn on the blower, field technicians will set the thermostat to heat or air conditioning, depending on the season and equipment, and set the temperature at least 10 degrees higher or lower (depending on mode) than the displayed temperature. Field technicians will indicate the operating mode by choosing a value.

Operating Mode

Operating Mode
Fan only, high
Heat
Cool
Other

5. With heat pumps that use two-stage, multistage, or variable-speed compressors, the system will likely start at a lower compressor stage or speed when set to heating or cooling mode. If direct control of fan speed is not possible with such heat pumps, then field technicians will wait for five minutes after heating or cooling begins for the system to ramp up air handler blower speed.
6. With the air handler blower at maximum speed, field technicians will capture a long-term average system pressure at the installed pressure probe, measured over at least 10 seconds. Field technicians should enter a note if the pressure is less than 10 Pascals (Pa) or if pressure fluctuates significantly.

   Pressure at second hole, with filter: _____ Pa
7. Field technicians will move the pressure probe to the TrueFlow test hole so that the tip points into the air stream, if applicable (If the hole location is a dead-end corner described in the Appendix D of the TrueFlow manual, then a probe or pressure tube can simply be inserted into the hole.)
8. With the air handler still at maximum speed, field technicians will capture a long-term average system pressure at the installed pressure probe, measured over at least 10 seconds. Field technicians should enter a note if the pressure is less than 10 Pa or if pressure fluctuates significantly.

   Normal System Operating Pressure (NSOP), TrueFlow test hole: _____ Pa
9. Field technicians will turn off the air handler, remove the filter from the location where the TrueFlow plate will be installed, and set the filter aside for reinstallation after testing is complete. Filters should be removed even if the TrueFlow plate will be installed in a different location.

   When removing the filter, field technicians will note its apparent condition by choosing from a list of values. Where there is more than one filter, field technicians will choose the value that best represents the condition of the filters as a group.

Filter Condition

Filter Condition
Clean, like new
Some dirt
Fairly dirty
Very dirty
Effectively clogged

10. Field technicians will install the TrueFlow metering plate as described in Chapter 2 of the TrueFlow operation manual. Field technicians will indicate the size and location of the installed plate.

TrueFlow Plate Used

TrueFlow Plate Used
Plate #14 (14x20 to 18x20)
Plate #20 (20x20 to 24x24)

TrueFlow Plate Location

TrueFlow Plate Used
Filter slot at air handler
Filter slot next to air handler
Return grille within 10 feet of air handler
Taped inside air handler
Other

11. Field technicians will turn the air handler on again, following the procedures described in Steps 4 and 5 above.
12. With the air handler blower at maximum speed, field technicians will capture a long-term system pressure at the installed pressure probe, measured over at least 10 seconds. Field technicians should enter a note if the pressure is less than 10 Pascals or if pressure fluctuates significantly.

    TrueFlow System Operating Pressure (TFSOP): _____ Pa
13. For the installed TrueFlow plate, field technicians will connect its pressure tubes to Channel B of the DG-700, leaving the DG-700 set to PR/PR. With the air handler blower still at maximum speed, field technicians will record the TrueFlow pressure difference displayed for Channel B.

    TrueFlow plate pressure difference: _____ Pa

Completing Testing

1. To complete testing, field technicians will:
   - Turn off the air handler.
   - Remove the pressure probe (if applicable) and patch both test holes with plugs and/or small, neat pieces of aluminum tape.
   - Close the window opened before testing began.
   - Close any registers opened before testing began.
   - Reinstall the filter, making sure to point the dirty side into the air flow.
   - Restore the thermostat to the settings in effect before testing began.
2. If airflow testing was performed at a return air grille, field technicians will indicate the total estimated distance between the return grille and air handler and how leaky the return ducting appears.

Total Estimated Distance to Return Grilles

Total Estimated Distance to Return Grilles
1 foot
3 feet
5 feet
7 feet
9 feet
10 feet
N/A

Return Air Duct Leakage

Return Air Duct Leakage
Sealed (mastic on all joints and seams)
Unsealed, no obvious holes or disconnects
Unsealed, with substantial holes or gaps
Unsealed, with one or more disconnects
N/A