ALASKA HOUSING FINANCE CORPORATION

ALASKA ENERGY RATER MANUAL

REVISION 1

Rev.1, 12/23/2010

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PART I INTRODUCTION

SECTION 1000 INTRODUCTION

This Alaska Energy Rater Manual (Rater Manual) has been prepared for the use of Alaska Housing Finance Corporation (AHFC)-authorized Energy Raters (Energy Rater) who have a current Energy Rater Agreement (Rater Agreement) with AHFC.

.01 HOW TO BECOME AN AHFC-AUTHORIZED ENERGY RATER

More information on how to apply to become an AHFC-authorized Energy Rater may be found at http://www.ahfc.state.ak.us/energy/becoming_energy_rater.cfm and in the regulations (15 AAC 155.530), which can be viewed at http://www.ahfc.state.ak.us/regulations/155_510.cfm.

.02 THE AHFC ENERGY RATER AGREEMENT

The Rater Agreement spells out the terms and conditions of the Energy Rater's authorization to prepare and submit home energy ratings to AHFC. It also incorporates the provisions of applicable regulations and this Rater Manual.

A sample Rater Agreement is available at http://www.ahfc.state.ak.us/iceimages/manuals/energy_rater_agreement.pdf.

.03 STATUTES, REGULATIONS, AND OTHER AUTHORITY GOVERNING ENERGY RATER ACTIVITIES

A. AHFC Regulations.

A copy of the regulations that govern both the AHFC energy programs and the activities of an AHFC-authorized Energy Rater may be found in Chapters 150 and 155 of the Alaska Administrative Code located at:

- 15 AAC 155.510-560 Alaska Home Energy Rating Systems (http://www.ahfc.state.ak.us/regulations/155_510.cfm)
- 15 AAC 150.225. Appeals Related to Energy Rater Authorization (http://www.ahfc.state.ak.us/regulations/150_200.cfm).

B. State of Alaska Building Energy Efficiency Standards (BEES)

1. A description of the standard is available at http://www.ahfc.state.ak.us/reference/bees.cfm
2. The BEES regulations may be found at in 15 AAC 155.010 – 155.040, located at http://www.ahfc.state.ak.us/regulations/155_010.cfm See also Part II, Section .01 of the Rater Manual.

C. Other governing authority.

Federal, State, and local laws, regulations, ordinances, and other authority that govern the activities of all small businesses also apply to the business conducted by an Energy Rater.

.04 CONTINUING EDUCATION REQUIREMENTS AND PROFESSIONAL CERTIFICATIONS REQUIRED OF AN ENERGY RATER

The continuing education requirements and professional certifications that an Energy Rater must maintain in order to remain in good standing with AHFC are published on the web page located at http://www.ahfc.state.ak.us/energy/energy_rater_guidance.cfm .

.05 MAINTAINING THE ENERGY RATER AGREEMENT

The Energy Rater shall remain in good standing in accordance with the minimum standards described in this manual and the Rater Agreement. AHFC may suspend or terminate the Rater Agreement as described in 15 AAC 155.560 (http://www.ahfc.state.ak.us/regulations/155_510.cfm). Additional information is available at http://www.ahfc.state.ak.us/manuals/er_rater_term_agreement.cfm.

SECTION 1001 PURPOSE OF THE RATER MANUAL

The Rater Manual is not intended as a tool to teach an Energy Rater how to properly perform an energy rating. Instead, it is to be used as a reference document that defines the *minimum* standards of practice that every AHFC-authorized Energy Rater must adhere to.

SECTION 1002 REVISIONS TO THE RATER MANUAL

AHFC will notify Energy Raters, in writing, of proposed revisions to the Rater Manual. In addition, all proposed revisions will be posted on the AHFC internet site.

Revisions to the Rater Manual become effective 30 calendar days after AHFC notifies the Rater, in writing, that the proposed revisions have been posted on the AHFC internet site.

Suggestions for improvements to the Rater Manual are welcome and may be submitted to the director of the AHFC Rural Research and Development Division (R2D2).

PART II AHFC ENERGY EFFICIENCY PROGRAMS

SECTION 2000 AHFC PROGRAMS

.01 STATE OF ALASKA BUILDING ENERGY EFFICIENCY STANDARDS (BEES)

The State of Alaska has adopted a Building Energy Efficiency Standard (BEES) that establishes criteria for a building's thermal envelope and other mandatory energy efficiency measures for a residential building.

The BEES statutes, regulations, and amendments may be found at http://www.ahfc.state.ak.us/reference/bees_standard.cfm.

In order to qualify for many AHFC loan programs, the borrower's home must comply with BEES.

.02 FINANCIAL PROGRAMS

The Energy Rater should be familiar with all AHFC energy efficiency programs in order to educate customers about programs they may qualify for. Information on the current programs available through AHFC, including, loans, rebates, interest reduction, or other programs, may be found at http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

.03 WEATHERIZATION PROGRAMS

Information on how to rate and weatherize buildings is available in the following resources:

- **Alaska Residential Building Manual** – located at http://www.ahfc.state.ak.us/reference/alaska_residential_building_manual.cfm.

- **Weatherization Operations Manual** – located at http://www.ahfc.state.ak.us/manuals/wx_oper_intro.cfm.

- **Residential Energy: Cost Savings and Comfort for Existing Buildings** - (Krigger/Dorsi) – available from AHFC's Resource Information Center at http://opac.libraryworld.com/cgi-bin/opac.pl?command=catalog_edit_record&cat_id=4918&view=R&modified=0&search_type=search&library_type=home&currentrecord=5&totalrecords=17&pagenumber=1.

- **The MWX Protocol: A Model Minnesota Low-Income Weatherization Program for the 1990's** - (MWX90) available from AHFC's Resource Information Center, http://opac.libraryworld.com/cgi-bin/opac.pl?command=catalog_edit_record&cat_id=1918&view=R&modified=0&search_type=search&library_type=home&currentrecord=3&totalrecords=3&pagenumber=1

PART III HOME ENERGY RATINGS SYSTEMS

SECTION 3000 PURPOSE OF HOME ENERGY RATING SYSTEMS

Home Energy Rating Systems (HERS) use computer-simulation based methods to model a home's existing energy efficiency and they also identify cost-effective opportunities to reduce energy use.

.01 AHFC-APPROVED HERS – AKWARM©©

AHFC has approved a HERS called AkWarm©© to produce energy ratings to be submitted to AHFC. AHFC may approve other HERS at some time in the future.

.02 OFFICIAL ENERGY RATINGS SUBMITTED TO AHFC

Official energy ratings performed by AHFC-authorized Energy Raters must be produced using the most current version of AkWarm©.

Energy Raters must use the newest release of AkWarm© within 30 days of written notification that a new version of AkWarm© is available. The current version of AkWarm© can be downloaded at http://www.analysisnorth.com/AkWarm©/AkWarm©2download.html .

SECTION 3001 HERS ENERGY RATINGS

.01 BUILDINGS THAT CAN BE RATED WITH HERS

HERS, including AkWarm©, can be used to rate detached single family buildings, mobile homes, condominiums, zero-lot line buildings, duplexes, triplexes, four-plexes, townhouses, large apartment buildings, and other structures.

The manner in which multi-family buildings are rated varies depending upon the structure. With few exceptions, multi-family structures are rated as one large building, not individual units.

.02 RATING OUTPUT

The quality of the output from any HERS, including AkWarm©, relies entirely on the quality and accuracy of the detailed building evaluation performed by the Energy Rater and the data the Energy Rater inputs into the software application.

Improvement Options Report. HERS makes typical energy use and energy cost predictions for specific end uses, such as for heating or hot water, as well as for the whole building. The predicted energy cost is simply predicted energy use multiplied by the local utility rate and fuel costs. Unlike scores, which are relative to a reference building, predictions are absolute measures. Absolute measures can be used to compare buildings in the same way that miles-per-gallon ratings are used to compare cars.

Recommended Improvements. HERS/AkWarm© produces a list of recommended improvements that are reported as cost effective based upon estimated annual cost savings.

Typical recommendations may include adding attic insulation, replacing old heating equipment, reducing air leakage, or other options.

Energy Rating Score. The energy rating yields a score based on a 0- to 100-point, or one- to five-star plus, scale. The score is based on a comparison between the rated building and a reference building that meets a desired energy code or standard but is tailored to the same dimensions and conditions as the rated building.

An energy rating score tells only how close a building compares to the standard. Buildings, particularly ones with different sizes and fuels, can have very different energy loads and still be fully compliant with a standard, so energy rating scores should not be used to compare buildings if the goal is to determine which building will cost the least to operate. The score reflects how close a certain building is to its potential given its size, shape, fuel mix, and other factors.

The HERS/AkWarm© energy rating yields a score based on a 0 – 100 point scale which is converted to a 1 star to 5 star plus scale. The energy rating score helps determine if a building qualifies for a loan interest rate reduction or energy rebate.

Score	Stars
0-39	One
40-49	One Star Plus
50-59	Two Star
60-67	Two Star Plus
68-72	Three Star
73-77	Three Star Plus
78-82	Four Star
83-87	Four Star Plus
88-91	Five Star
92-100	Five Star Plus

PART IV ENERGY RATER PROFESSIONAL STANDARDS

SECTION 4000 PROFESSIONAL CONDUCT STANDARDS

The standards of practice described throughout this Rater Manual are the ***minimum*** standards an AHFC-authorized Energy Rater must adhere to in order to remain in good standing with AHFC.

The minimum professional standards described below are intended to ensure that Energy Raters provide all customers with comparable and appropriate professional service. Technical standards of practice are referenced in PART V of this Rater Guide.

The Energy Rater must**:**

- Comply with any federal, State, or local law, regulation, order, or other authority that applies to the Energy Rater's business and professional activities.
- Remain in good standing with the continuing education requirements and the accreditation and certification requirements required of AHFC.
- Present himself/herself and perform his/her professional duties in a courteous and professional manner.
- Commit to performing all business activities in an objective and neutral manner.
- Commit to participating in, and supporting, a quality assurance program as may be required by AHFC.
- Promise to adhere to all standards, practices, and other information published in the Rater Manual.
- Treat all information obtained from a customer or collected for the energy rating with appropriate care. The Energy Rater must take all reasonable steps to protect personal and confidential information.
- Pledge to timely notify AHFC if circumstances arise that might compromise the Energy Rater's ability to perform its business activities consistent with the provisions of the Rater Agreement or this Rater Manual.

SECTION 4001 ETHICAL STANDARDS

The Energy Rater must:

- Assure that the task of performing an energy rating is totally separate from other products or services the Energy Rater may be qualified to provide or recommend. The results of an energy rating must be based solely upon accurate, complete, and independent analysis and data.

- Avoid the appearance, or the practice, of “steering” business to one or a select few providers. If a customer should ask the Energy Rater to recommend products or services, the Energy Rater must provide the customer with several options and must also advise the customer of his/her right to obtain competitive bids for any work recommended in the energy rating.

- Practice professional courtesy and avoid the appearance, or the practice, of expressing a public opinion regarding the professional standards, ethical standards, work product, or reputation of another AHFC-authorized Energy Rater.

SECTION 4002 CONFLICTS OF INTEREST

The Energy Rater must use the Conflict of Interest Form provided by AHFC to disclose any of the following issues to, and obtain the written approval of, both the customer and AHFC, before providing any products or performing any improvement and/or retrofit services at the property in question.

- Circumstances where there is no other option than for the same Energy Rater that performed an energy rating for a customer and to provide products to, or perform other services for, that same customer.

- Circumstances where there is no other option than for a business in which the Energy Rater has a financial or familial interest in, to provide products to, or perform services for, a customer that the same Energy Rater has performed an energy rating for.

- Circumstances where there is no other option than for the same Energy Rater, or a business in which the same Energy Rater has a financial or familial interest in, that has provided products or performed work for a customer, to perform the post energy rating for that customer.

The Conflict of Interest Form is located at:
http://www.ahfc.state.ak.us/iceimages/manuals/conflict_int.doc

AHFC may issue a term-limited Conflict of Interest disclosure to energy raters who supply equipment and materials.

SECTION 4003 PROHIBITED PRACTICES

The Energy Rater shall not:

- Perform an energy rating on the energy rater’s own residence or on a property where the energy rater has either an ownership interest or other financial interest.

- Perform an energy rating on the home of a close family member. Close family member includes a spouse, sibling, in-law, parent, or child of the energy rater.

- Perform a post-energy rating on a building where the Energy Rater, or any business that the Energy Rater has an ownership interest or financial interest in, has performed any retrofit, improvement, or has supplied any materials for retrofit and/or improvement.

- Accept compensation, financial or otherwise, from more than one party for the same service.

- Perform destructive testing or take any other action that will damage the structure(s) he/she is responsible for evaluating without the written consent of the customer.

  It may be necessary for the Energy Rater to disturb minor portions of a building (e.g., to drill a small hole into sheetrock to check the insulation or to perform diagnostic testing). The Energy Rater must always obtain the customer's written consent, even for minor work.

PART V ENERGY RATER TECHNICAL PERFORMANCE PRACTICES

SECTION 5000 ENERGY RATER TOOL BOX

The Energy Rater must utilize sufficient tools and equipment to properly identify, measure, and document all building shell components and systems (heating, water heating, ventilation, etc.) and to thoroughly analyze the building. Examples include, but are not limited to:

- A personal computer loaded with the most current version of AkWarm©.
- Tools to assess the shell components: tape measure/laser, non-metallic probe, ladder, compass, flashlight, etc.
- Tools to identify air leakage**:** blower door unit, fan, tubing, manifold, optional thermal imagery equipment, smoke stick/wizard, etc.
- Equipment to perform combustion safety testing: combustion gas analyzer, carbon monoxide tester, etc.

SECTION 5001 ELEMENTS OF AN ENERGY RATING

The Energy Rater must thoroughly understand and be able to competently perform both the technical and administrative elements of an energy rating.

.01 MINIMUM REQUIRED TECHNICAL ELEMENTS

At a minimum, the technical elements of an energy rating must include:

- An on-site assessment of both the exterior and the interior of the building to be rated.
- A blower door test.
- A combustion safety test.
- A ventilation assessment.

.02 OPTIONAL TECHNICAL SERVICES

When performing the energy rating, the Energy Rater is not required to perform the following work or provide the following services, but may elect to do so at the Energy Rater's discretion so long as the work or services do not create a conflict of interest as described in SECTION 4002 or conflict with the provisions of SECTION 4003 .

- Thermal imagery
- Heat loss calculations

- Pressure diagnostics
- Other non-retrofit/non-improvement work or supplies

.03 ADMINISTRATIVE ELEMENTS

At a minimum, the administrative elements of an energy rating must include:

- Working with the customer; informing and educating the customer about:
    - The on-site assessment process.
    - The technical elements, cost, and end-use of an energy rating.
    - The results of the on-site assessment; the rating score, the Energy Rater's observations about the building, the improvement options report.
    - AHFC energy efficient programs the customer might qualify for.
- Completing an official energy rating certificate (all buildings).
- Completing an Improvement Options Report (IOR) for As-Is ratings.
- Appropriate follow-up to ensure that the official energy rating submitted to AHFC represents an accurate end-product:
    - Timely responding to customer and/or AHFC questions.
    - Completing additional on-site assessments, if necessary.
    - Correcting errors in the official energy rating.
    - Correcting AkWarm© input.

SECTION 5002 TYPES OF ENERGY RATINGS

There are three types of official energy ratings used for AHFC programs:

- BEES Ratings (see SECTION 5002 .01)
- As-Is Ratings (see SECTION 5002 .02)
- Post Ratings (see SECTION 5002 .03)

AHFC financial programs described in SECTION 2000 .02 usually require an energy rating. See the specific program guidelines for the type of energy rating required to meet the guidelines. The programs are described at http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

.01 BEES ENERGY RATING

A. Minimum BEES Requirement

- Must be certified BEES compliant by an authorized person with a current BEES Compliance Certification (BCC). The current BCC List is located at http://www.ahfc.state.ak.us/iceimages/reference/bees-compliance-cert-list.pdf .

- Buildings constructed between December 31, 1991 and December 31, 1994 must meet the minimum BEES requirement of 4 Star.

- Buildings constructed after December 31, 1994 must meet the minimum BEES requirement of 4-Star-Plus.

B. BEES Rating Categories:

Every BEES rating falls into one of the following categories:

- Proposed from Plans (see SECTION 5002 .01E)

- Completed New Construction (see SECTION 5002 .01G)

- Existing Building Constructed after December 31, 1991

C. A BEES rating applies to the whole building.

- It does not apply to portions of a building.

- Additions that are contiguous with, and connected to, the existing structure are considered portions of the building, and cannot be rated independently.

  For example, if an addition to the primary structure is constructed according to the BEES standards, but the primary structure itself does not meet BEES, the building cannot be certified BEES-compliant.

- “Not attached or not connected” buildings (as described in SECTION 6001 .10D*)* which are located on the same lot are rated separately.

  For example, a separate building on the same lot as the primary structure, such as a mother-in-law home is rated separately.

  Any building that does not share a roof, walls, floors, or a foundation with the primary structure will be rated separately.

D. Performance or Prescriptive Method

Buildings that are certified as BEES compliant are evaluated by either the performance method or the prescriptive method

- Performance Method:

  An energy rating that includes a blower door or other approved air tightness test to certify that the building meets the criteria outlined in Section 404.3, “Performance-based compliance,” of the Alaska BEES Amendments.

  AHFC’s Blower Door Procedure is located at http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_final.pdf .

- Prescriptive Method:

  Relies upon inspections and documentation to ensure the building meets the criteria outlined in Section 101.5.3.2, “BEES Certification using the Prescriptive Compliance Path.” The BEES amendments are located at http://www.ahfc.state.ak.us/iceimages/reference/bees_amendments.pdf.

Both the performance and prescriptive compliance methods require a BEES Compliance Certified (BCC) professional to sign AHFC Form PUR-101. AHFC Form PUR-101 is available at http://www.ahfc.state.ak.us/iceimages/loans/pur101-fillin.pdf.

E. BEES Energy Rating – Proposed from Plans

Proposed from plans ratings are prepared using the Energy Rating Type: "Proposed from Plans" found in the AkWarm© "Client" screen. For AkWarm© modeling purposes, the occupancy for “proposed from plans” energy ratings is the number of bedrooms, plus 1.

The Energy Rater must receive and review:

- A complete set of building plans.
- A complete set of specifications, including, but not limited to: windows, doors, mechanical equipment, electrical, and plumbing.
- Installation plans, including: air leakage controls, ventilation, and insulation levels.
- The site plan including the building orientation. If the site has not been determined, the Energy Rater will use the worst case scenario.

Any assumptions the Energy Rater makes in projecting an energy rating must be added to the "Notes to Homeowner" or “Notes to AHFC” on the General screen in AkWarm©.

F. BEES Energy Rating - Substantially Complete Construction

Before a building may qualify for an official energy rating certificate, the building must be determined substantially complete as defined in 15 AAC 155.990 (15):

- "Substantially complete" means that a building has all of the normal integral parts, including foundation, floor, walls, roof, windows, doors, and permanent heating system.

In addition:

- Poly sheeting covering windows or doors is not acceptable; all windows and doors must be installed.
- An unfinished basement is acceptable if the proposed plans called for it and the majority of the wall space is covered by a finish material.
- If a portion of the wall is not covered with a finish material (e.g., an unfinished basement), the area can only be rated if one of the following situations apply:

  If there is a local building code and enforcement authority:

  There must be a certificate of occupancy and it must be possible to perform a blower door test on the building.

  If there is not a local building code enforcement authority:

  The electrical wiring in the walls must be physically protected from damage either by the installation of an appropriate finish material or by placing the wiring in an approved raceway, and it must be possible to perform a blower door test on the building.

G. BEES Energy Rating - Completed New Construction

The Energy Rater will:

- Determine if the building is occupied and will apply the occupancy standards identified in AkWarm©.
- Will perform an on-site assessment and blower door test.
- Verify that the construction was completed as proposed and will record any changes in AkWarm©.

The following professionals may complete and sign a form PUR-101:

- Energy Rater,
- Alaska-licensed New Home Inspector,
- the builder,
- the architect, or,

- the engineer.

To be determined BEES compliant, the building must:

- Achieve a Four Star Plus or better rating.

Documentation Required:

- Performance Method: Four-Star-Plus or better rating and a form PUR-101.
- Prescriptive Method: Form PUR 101.

H. BEES Energy Rating - Existing Buildings Constructed after 12/31/1991

The Energy Rater will:

- Determine if the building is occupied and will apply the occupancy standards identified in AkWarm©.
- Will perform an on-site assessment and blower door test.
- To be determined BEES compliant, the building must:
- Achieve a Four Star or better rating if constructed between December 31, 1991 and December 31, 1994.
- Achieve a Four Star Plus or better rating if constructed after December 31, 1994.

.02 AS-IS ENERGY RATING

An As-Is rating includes an on-site assessment of an existing building before energy efficiency improvements are made to the building. The As-Is rating is used to evaluate the energy efficiency of the building and to identify cost-effective improvement options (the IOR).

Most As-Is-ratings will be performed on an occupied building. While BEES energy ratings rate the building itself, an As-Is energy rating includes a measure of the building and how the occupants use it.

If the building is occupied, the Energy Rater will:

- Determine the number of occupants based on interviews with the customer or by observation. For example, a building may have been constructed as a 1 bedroom home with a small office, but the office may have been converted to a bedroom.

If the building is not occupied, the Energy Rater will:

- Attempt to determine the occupancy, and if the occupancy cannot be determined, will use the default occupancy for AkWarm© modeling purposes which is the number of bedrooms, plus 1.

The Energy Rater will complete:

- An on-site assessment.
- A blower door test.
- A combustion safety test.
- A ventilation assessment.

.03 POST IMPROVEMENT ENERGY RATING

A Post-Improvement, or “Post-rating,” is used to evaluate a previously rated building (As-Is) after recommended energy efficient improvements (IOR) have been made.

The Energy Rater will complete:

- An on-site assessment.
- A blower door test.
- A combustion safety test.
- A ventilation assessment.

Post-ratings are typically program-dependent, and may not be required for all AHFC energy efficiency programs (e.g., Weatherization).

.04 PROGRAM-REQUIRED RATINGS

AHFC financial programs described in SECTION 2000 .02 usually require an energy rating. See the specific program guidelines for the type of energy rating required to meet the guidelines. The programs are described at http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

SECTION 5003 DIFFERENT KINDS OF CUSTOMERS

.01 HOMEOWNER

A homeowner might use an energy rating to:

- Pinpoint specific areas that waste energy and money, and to help define the most cost-effective steps to fix those problems.
- Determine how effectively in-place energy efficient improvements may have reduced the home’s total energy use.

- In preparation for selling the home; to determine if the home will qualify for the interest rate reduction program or other programs and/or to obtain information to be provided to a potential purchaser.
- To qualify for a rebate under the Home Energy Rebate program.
- To qualify for free weatherization services under the Energy Conservation & Weatherization program.
- To qualify for financing to make energy efficient improvements to the building.

.02 BUYER

A person who is purchasing a home might use an energy rating to:

- Learn whether a home is energy efficient or an energy waster before buying.
- To apply for an interest rate reduction on his/her mortgage loan.

.03 REAL ESTATE AGENT

A real estate agent might use an energy rating as a sales tool; to share information with potential purchasers.

.04 BUILDER

A builder might use an energy rating to:

- Provide information about energy efficient features to potential Buyers.
- If the building is qualified, to provide a Buyer with the opportunity to apply for an interest rate reduction on his/her mortgage loan.
- Prove that a newly constructed building meets BEES requirements.

.05 LENDER

A lender might consider a BEES “proposed from plans” energy rating (as described in SECTION 5002 .01E) as part of the builder’s financing package.

.06 APPRAISER

An appraiser might use information found on an energy rating to identify special energy efficient appliances or mechanical equipment to be listed on the appraisal.

.07 RESIDENTIAL HOME INSPECTOR

A residential home inspector might use information found on an energy rating to identify special energy efficient appliances or mechanical equipment to be listed on the inspection report.

.08 PUBLIC HOUSING AUTHORITY

A public housing authority might use information found on an energy rating to identify special energy efficient appliances, mechanical equipment, or other measures that might improve the energy efficiency of its housing.

SECTION 5004 WORKING WITH THE CUSTOMER,

.01 FIRST CONTACT WITH THE CUSTOMER – GATHERING PRE-RATING INFORMATION

As indicated above, anyone can request an energy rating, but reasons for the request may vary.

To reduce misunderstandings, Energy Raters should ask specific questions of the customer, including, but not limited to:

What is the end purpose of the energy rating?

Describe the property where the energy rating will be performed.

- How old is the building?
- Have there been any additions to the original structure?
- What is the approximate square footage of the building?
- What direction does the front of the building face? How is it oriented?
- How tall is the structure? One story? Two stories? Three stories?
- Is there a garage? Is it attached to the structure?
- Where is the access to the attic/attics?
- Is there a crawl space? Where is the access to the crawl space?

The Energy Rater should provide the customer with preliminary information about the on-site assessment and the energy rating process, including, but not limited to:

- Telling the customer how much the energy rating will cost.
- Explaining that an “As-Is” rating is a separate professional service from a “Post-Improvement” rating; that it is not necessary that the same Energy Rater who performs the “As-Is” rating be the same person who completes the “Post-Improvement” rating.
- Explaining that the customer will be charged separately for an “As-Is” rating and a “Post-Improvement” rating.

- Explaining what a blower door test is and how it relates to the rating, how the results will be used.
- Explaining about how long the assessment and blower door test will take – a single story building might be completed in a few hours, but a large multi-story building might take all day.
- Asking that the customer prepare clear access to attics, crawl spaces, and other less-used areas.
- Asking that the customer remove any personal belongings from areas immediately around the attic access in order to keep insulation from falling on the items.
- Reminding the customer to extinguish fires in woodstoves and fireplaces and to remove ashes to keep the ashes from being blown around during the blower door test.
- Asking that the customer keep pets and small children away from the immediate area where the Energy Rater will be working.
- Asking the customer to obtain copies of their heating and electric utility bills for the past 12 months; explain how this information will be used in determining energy use.
- Asking that the customer accompany the Energy Rater during the assessment.

.02 THE ON-SITE ASSESSMENT

The Energy Rater should arrive on time/as scheduled and be prepared to perform at a minimum, each of the following services:

A. The On-Site Customer Interview.

An important function of the energy rating process is to educate the customer to make informed decisions regarding energy efficiency improvements. The Energy Rater is an educator, as well as a fact finder and must take care to be thorough and accurate.

If the Energy Rater does not know the answer to a question that is within the scope of the energy rating, the Energy Rater must advise the customer that he/she will get back to them with the correct answer as soon as possible and must follow through with an answer within 48 hours.

The Energy Rater will spend a few minutes reviewing the parameters of the on-site assessment and the energy rating process with the customer and will explain that the energy rating includes:

- Information about loans, rebates and other AHFC programs is available at http://www.ahfc.state.ak.us/energy/weatherization_rebates.cfm.

- A blower door test.
- A copy of an energy rating certificate and report for the customer and a copy of the same for AHFC.
- An Improvements Options Report (IOR) if applicable, with estimated costs and point values combined with the official energy rating certificate.

The Energy Rater will:

- Make certain the customer understands the services that are included as part of the standard energy rating, and which services are not (i.e. heat loss calculations, diagnostic testing, etc.)
- Make certain that the customer understands exactly what he/she will be paying for the energy rating, and exactly what he/she will be paying for any additional services. If additional services are provided, the services must be clearly and separately itemized on the invoice presented to the customer.
- Ask again about the customer's reason for requesting the home energy rating. Use this information to educate the customer about energy efficiency measures and energy conservation they can take, as well as other energy efficiency programs that may be available to them.
- Ask that the customer to accompany the Energy Rater on the assessment. Physically identify energy features of the building to educate and involve the customer in the energy rating process.
- Ask the customer about the dates: the building was built, the building was renovated, energy efficient measures were taken, and when energy efficient equipment was installed.
- Ask the customer about problems they may be aware of.

B. The Exterior Assessment

The Energy Rater shall carefully observe and take notes of the exterior of the building and the immediate surroundings.

The following signs may indicate heat loss and/or moisture transfer. Recognizing them and the building science elements that causes them can help the Energy Rater prepare a more thorough energy rating.

Ground surface:

- Slope near the building foundation to assess the direction of surface drainage that does not flow away from the building foundation.

- Uneven ground or slumping that may indicate frost-heave/jacking or heat loss.

Excessive Moisture:

- Moss on the roof, exterior sheeting, etc.
- Water stains that might indicate moisture intrusion into wall cavities.
- Mold stains.
- Pooling water or snow-melt near the foundation or on the roof.
- Poor drainage near the foundation.

Ice Formations:

- Ice dams on the roof
- Icicles under eaves and soffits
- Frosted gable-end vents may signify moisture intrusion into the attic.

Experienced Energy Raters may recognize how a building is constructed by having carefully rated other buildings of the same type. Answers to the following and other questions may help the Energy Rater identify methods to correct flaws in the building shell and/or building maintenance:

- Are there any vertical penetrations (shafts, chimneys, etc.) through the roof?
- Do the walls access porches, bay windows, an attached or built-in garage, or cantilevered floors that may break the continuity of the air barrier and insulation?
- Are there major seams between the building component elements? Do they show deterioration?
- Was the building built at one time or in stages?
- Is the exterior shell airtight or leaky?

C. The Interior Assessment

The Energy Rater shall note the general condition of the interior of the building. The Energy Rater should take note of:

- Odor - moisture, mold, and/or mustiness that might indicate poor ventilation.

- "Ghosting" – images of studs and rafters that are visible on the walls.
- Vent locations – determine if intake/exhaust vents are properly separated and oriented to ensure proper ventilation and air quality.
- Condensation on glazings indicating ventilation and/or pressure balancing problems or high indoor humidity.
- Soot accumulation on walls/ceilings that may indicate back-drafting appliances.
- Doors, especially garage doors that are out of square and may signify a shifting foundation.

D. Identify the True Thermal Envelope

The first step an Energy Rater should take in rating a building is to identify which elements are, or should be, part of the "thermal envelope," also known as the "thermal boundary." Reducing heat loss from the living space through the thermal envelope is a key efficiency improvement in cold climates.

The Energy Rater must outline the thermal envelope by:

- Defining the living space and the associated building systems:
  - Garages
  - Crawl spaces
  - Arctic entries
- Determine which portions of the building are presently conditioned spaces and which should be conditioned to maintain comfort within the living space.
- Identify and document air leakage sites.
- Determine if the building has been modified and if the modifications may have affected the thermal envelope.

An accurate energy rating will define the thermal envelope and identify air leakage paths. For more help in evaluating thermal boundaries, the Energy Rater should consult the references listed in PART I .03and SECTION 2000 .03.

E. Identify Conditioned and Un-conditioned Spaces

As part of the interior assessment, the Energy Rater must:

- Identify areas of the building that are conditioned (even unintentionally) and un-conditioned.

- Determine the insulation levels of the walls, floors, and roofs.
- Perform an assessment of the air and thermal barriers surrounding the conditioned space and notes voids, edge gaps, and other flaws.
- Enter basements, crawl spaces, attics, and other seldom-seen areas to identify major air leakage sites.
- Answer at least the following questions:
    - Where is the existing thermal envelope?
    - What penetrations - plumbing, electrical, combustion air vents, and others - break the building's thermal envelope and the wall, floor, and ceiling continuity?
    - What areas are used and unused?
    - What indentations and shafts are intruding into the conditioned space from outdoors or from un-conditioned spaces?
    - What structures protrude from the building shell and are they currently conditioned or un-conditioned?
    - Do the protrusions and indentations allow air to enter the building?
    - Are insulation and air barrier continuous at the perimeter of the protrusions and indentations?
    - What are the current and potential health and safety concerns?

The following sections of the manual provide more detailed information on how to examine each specific area of the building to answer the above questions.

F. Define the shell components.

AkWarm© uses different heat loss calculations for different parts of the building - depending on whether heat is lost directly to the outside air, or to the ground, or to a buffer zone.

When labelling building components, the Energy Rater must ensure he/she has selected the correct heat loss calculation category.

AkWarm© identifies the following shell components:

1. Category I: Floors
    - On/Below Grade Floor

If the exterior floor can lose heat directly to the ground, such as a “slab on grade” floor or a basement floor, it qualifies as “On/Below Grade Floors.”

- Exposed Floor

If the exterior floor can lose heat directly to the outside air, such as a floor over an un-conditioned crawl space, a cantilevered floor, or a floor on pilings, it is an “Exposed Floor.”

2. Category II. Walls

- Below Grade Walls

A Below-Grade Wall is constructed below-grade, but is also used to describe the part of that wall that is above grade if it is built to the same specifications as the below-grade portion. AkWarm© prompts the user for the below grade and above grade dimensions.

- Above Grade Walls

An Above-Grade Wall starts out above grade and continues on up. There are no below-grade portions.

3. Category III: Ceilings

With ceilings, it is especially important to consider heat-loss potential rather than appearance.

- Ceiling With Attic

The Ceiling with Attic designation is for ceilings that have a large buffer zone between the building’s warm interior, conditioned air and the (typically cooler) air outside the building. AkWarm© calculates the effect of this buffer zone. Most will be obvious, but some ceilings that appear to be vaulted may fit this category if they use a scissors truss. These are sometimes called "cold" roofs

- Cathedral Ceiling

Cathedral Ceilings are sometimes called "warm" or ‘hot” roofs because there is little or no space between the top of the insulation and the underside of the roof sheathing. Most vaulted and flat roofs are built this way.

4. Category IV: orientation of Windows & Skylights

In each window class, all windows with the same U-value and exposure can be included as one item. Separate entries are required for each location and for each different type of window. If a window will be replaced, it must be listed as a separate component.

- South-Facing Windows

The South-facing Window designation covers any window facing south or within 45 degrees of South.

- Not-South Facing Windows

All windows that do not face South (except skylights) fit in the Not-South designation.

- Skylights

Skylights on roofs with a pitch less than 45º: fit under the Skylight orientation in AkWarm©.

Skylights on roofs with a pitch greater than 45º: are described as south or not-south based on the orientation of the roof.

5. Category V: Doors - Exterior Doors

All doors that are of the same type construction and insulation can be included as one AkWarm© item. Separate entries are required for different types of exterior doors.

G. Identify Air Sealing Opportunities

The Energy Rater shall complete a blower door test, identify specific sources of air leakage, and document them for the homeowner in the Improvement Options Report (IOR).

H. Describe each shell component.

Since wood has less ability to resist heat loss than insulation does, certain information must be input into AkWarm©.

- The percentage or estimate of how much of a wall, ceiling, or floor is wood and how much is insulation.
- The surface area in square feet of all interior shell components (walls, ceilings, floors) combined.
- The framing details. Is it ‘2 by lumber’, metal studs, or truss joist wood? Are studs 16” or 24” on center?

I. Group shell components.

The Energy Rater may group building components of the same construction in AkWarm©. For example, if all of the above-grade walls are constructed of the same framing and insulation values, the Energy Rater can combine the total area into a single above-grade wall component.

Separate entries are necessary only if there are different framing, insulation or, in the case of windows, different orientation.

J. Identify insulation quality and quantity.

Insulation that is placed between studs or joists is described as "Bottom Layer" or "Top Layer." This allows for two types of insulation to increase the total R-value of a component, such as fiber-glass batts with additional rigid foam, or an R-11 batt with an additional R-8 batt.

It doesn't matter which layer is labelled “top” vs. “bottom” since AkWarm© will calculate the total R-value. There are two input fields so the Energy Rater can describe a combination of two types or amounts of insulation within the shell cavity. The section of the shell that is part insulation and part framing will have a lower overall "R-value" than a section that is completely insulation, since the R-value/inch is less for wood than for insulation. AkWarm© calculations the total R-vale for the component – including the wood and the insulation – but requires accurate information on what portion of the wall is wood vs. insulation.

Insulating sheathing – insulation that is installed outside the shell cavity - on either the outside or inside - and covers or “sheaths” the framing members. The R-value for insulating sheathing is not "down-graded" because it extends across the framing members (studs, rafters, etc.) and the cavities between them, reducing the effect of thermal bridging. Rigid insulation such as Thermax or styrofoam, is usually used for sheathing, but may be installed as insulating batts or blown insulation that cover the full length of a basement wall with no studs or furring strips.

Then Energy Rater may not use the “insulated sheathing” description, described below, for insulation located between framing members and/or within cavities.

When accounting for insulation, it is important correctly identify insulating sheathing vs. an added or top layer of insulation, as their thermal properties can differ significantly.

1. Verifying Insulation Levels

Insulation levels shall be verified for energy ratings on buildings that **exceed** the minimum thermal standard, as defined in the Alaska Building Energy Efficiency Standard (BEES). It is not always possible to physically verify insulation levels, especially in closed spaces that cannot be physically verified during the normal course of an energy rating, so the energy rater must use best judgment to determine insulation levels. This will usually apply to walls and cathedral ceilings but is not limited to those areas.

a. By Installer

Insulation levels in closed spaces must be certified in writing by the installer in one of the following manners:

- Where the installer is a licensed insulating subcontractor, the owner or builder must provide the Energy Rater with a copy of the insulation certification. These forms are available from the insulating contractors upon request.

- Where the installer is an employee of the builder or an owner-builder, the owner or builder must provide receipts showing the purchase of the insulation in question. The receipts must show the property address of the building in which the insulation was installed.

- Photos detailing the work and insulation levels. These photos must also be retained in accordance with the Rater Agreement record retention policy.

b. By Energy Rater

The Energy Rater may use other methods to verify the insulation levels during the on-site assessment but shall document his/her assumptions and/or observations in the “Notes to AHFC” section of AkWarm©.

PART VI ON-SITE ASSESSMENT STANDARDS

SECTION 6000 DESCRIPTION

Energy Raters must follow the on-site assessment procedures described below, unless otherwise directed by AHFC in writing. These procedures assume the building being rated is a detached, single family residence and may require slight modifications for application to other buildings.

Every element of the field assessment should assess the building from the perspective of:

- Where are the building's pressure and thermal envelopes? Are they aligned? What defines their limits?
- Is the space conditioned or un-conditioned? .
- When evaluating a space, ask: Should the space be conditioned or un-conditioned? Which better serves the building and its systems?

SECTION 6001 CONDITIONED AND UN-CONDITIONED SPACES.

.01 TYPES OF SPACES

Conditioned spaces are spaces that are designed to maintain a temperature above freezing to maintain comfort and the operation of systems (water, heating, etc.). They may be conditioned directly, by design and heat support systems, or indirectly, through heat loss from other systems or adjacent rooms. Conditioned spaces are mechanically conditioned to living space temperature.

Un-conditioned spaces are designed maintain a temperature consistent with the surrounding temperature and to limit the amount of heat the space may absorb from an adjacent conditioned space. Root cellars and cold sheds maintain a consistent temperature due to the thermal mass of the surrounding soil, while the temperatures of arctic entries vary widely based on outside air temperatures.

Indirectly conditioned spaces are typically conditioned by the heat loss from adjacent conditioned rooms or systems. The temperature of the spaces is between that of the outdoor ambient temperature and the conditioned living space temperature.

AkWarm© describes spaces as conditioned or un-conditioned. When making long-term recommendations for improvement options, the Energy Rater and the client should discuss whether the future intent of the space is conditioned or un-conditioned.

.02 ASSESSING SPACE CONDITIONING

To determine whether a crawl space or basement is conditioned, assess the insulation placement in the walls or floor/ceiling assembly and the presence or absence of mechanical or plumbing systems. The issue of conditioned versus un-conditioned spaces typically arises with basements and crawls spaces, but may also include mechanical rooms, arctic entries, and other additions or areas not typically used as living space.

The Energy Rater shall determine the location of the thermal boundary. For example:

A vented crawl space may be considered un-conditioned regardless of the location or existence of insulation if the vents cannot be closed or sealed and there are no mechanical systems that need to be kept from freezing. This is because the ambient temperature of the crawl space should be close to the outdoor ambient temperature. Normally an un-conditioned vented crawl space will have insulation in the floor above. If a crawl space is un-conditioned, its components common with the outside, such as the foundation walls, are not measured for AkWarm©.

A vented crawl space may be considered "conditioned" if the vents are close-able and/or the space temperature is maintained at a fairly constant level, either directly or from distribution system losses. In conditioned crawl spaces there are often water pipes that must be kept from freezing. Insulation is most often on the foundation walls rather than the floor above.

An un-vented crawl space or basement may be considered 1) un-conditioned, or 2) conditioned, based on the following criteria:

- **Un-conditioned** crawl spaces or basements are designed to minimize the heating system losses from the conditioned space and distribution systems, by insulating the floor of the conditioned space (ceiling of the crawl space/basement) and the distribution systems. Un-conditioned spaces are not protected from freezing. For example, a crawl space that includes an insulated crawl-space ceiling, un-insulated walls, and insulated heating or plumbing distribution piping in the space is assumed un-conditioned, since the thermal boundary has been defined at the crawl space ceiling and the distribution system piping is insulated to protect against low temperatures.

- **Indirectly conditioned spaces** are typically between the temperature of the outdoor ambient temperature and the indoor conditioned space temperature. When making long-term recommendations for improvement options, the Energy Rater and the client should discuss whether the future intent of the space is conditioned or un-conditioned.

- **Conditioned** spaces can be conditioned directly or indirectly, but the result of either situation is that the crawl space/basement temperature remains above freezing.

In an **indirectly** conditioned crawl space or basement, heat or cold is unintentionally delivered to the space either through the floor/ceiling assembly or by unintentional losses from the heating/cooling system. The temperature of the crawl space/basement is typically between that of the living space and the outside temperature. A **directly** conditioned space is designed to maintain a temperature near that of the conditioned living space, and to protect the space or systems within it from freezing. These are some construction details that may result in conditioned space:

- The foundation walls of the crawl space/basement are **not** insulated **and** the crawl space/basement ceiling **is** insulated **and** the water/heating distribution system is **not** insulated. Thus, heat losses from the distribution system result in **indirect** warming of the crawl space/basement.

- The foundation walls of the crawl space/basement **are** insulated; the crawl space/basement ceiling **may or may not** be insulated, **and** the water/heating distribution system is **not** insulated. Thus, heat losses from the distribution system are retained by the foundation wall insulation and the space is **indirectly** conditioned.

- The foundation walls of the crawl space/basement **may or may not** be insulated, **and** the space is intentionally or unintentionally conditioned via warm air distribution ducts, hydronic heating pipe, or radiant heat pipe, or electric resistance systems.

- The foundation walls of the crawl space/basement **are** insulated, crawl space/basement ceiling is **not** insulated, **and** the space is conditioned via warm air distribution ducts, hydronic heating pipe, or radiant heat pipe, or electric resistance systems. Thus, heat losses from the conditioned living space and heat supplied by the heating system combine to **directly** condition the space.

- The foundation walls of the crawl space/basement **are** insulated, crawl space/basement ceiling is **not** insulated, **and** the water/heating distribution system **may or may not** be insulated. Thus, heat losses from the conditioned living space and/or from the water/heating distribution system **indirectly** condition the space.

To determine if a space is conditioned vs. un-conditioned, identify the true thermal envelope of the building. Where should it be? Does the crawl space/basement need to be heated to:

- protect foundation footers from freezing,

- minimize heat loss from air ducts, and/or,

- protect plumbing systems from freezing?

If not, determine the best recommendation based on building science, cost-effectiveness, should the crawl space/basement be converted to an un-conditioned space? What changes can be made to the building to achieve the most cost-effective energy efficiency improvement?

NOTE: Occasionally a building owner may install additional insulation in the crawl space/basement, with the intention of improving efficiency. For example, insulation may be present in the crawl space/basement ceiling and on the foundation walls, or any combination of the ceiling, walls, and floor of the crawl space/basement. The key is to make the best improvement recommendation for the building. If the crawl space/basement needs to be heated or insulated to protect /water heating systems, then treat it as conditioned space, and make the appropriate recommendations to minimize losses. If there no insulation, on the walls or the ceiling of the crawl space/basement, then choose the best limit for the thermal envelope and recommend improvements accordingly.

.03 BUILDING ELEVATION, SURFACE AREA, AND VOLUME

To model the energy use and calculate the building's air-tightness (discussed in later sections), measure the square footage and the volume of all conditioned space. This requires accurate measurements for the floor area and wall height, taking into account sloped ceilings.

A. Elevation

The building elevation is necessary to infer the stack effect within the building. The elevation is based on the building's average exposed height.

B. Surface Area

Measure the interior linear perimeter to the nearest 1/2 foot of all floors over un-conditioned space. Use these dimensions to calculate floor area. For conditioned basements and crawl spaces, find dimensions of basement walls and floor. Divide walls into above and below grade sections.

Note on Garages: Include the square footage *for attached-and-connected garages*, and *connected-but-not-attached garages*.

- **For BEES Ratings** - include the square footage but use the garage temperature.
- **For As-Is ratings** - include the square footage but use the temperature of the living space. If the garage is conditioned, leave the door between the garage and the living space **OPEN** while conducting the blower door test.

C. Volume

Determine the volume of conditioned space by multiplying conditioned floor area by ceiling height. Conditioned spaces include those areas that are directly or indirectly heated or cooled. This may be a single measurement if the building's interior walls are all the same height, or may require multiple measurements for vaulted ceilings or sloped roof pitches. For areas with vaulted ceilings, volume must be calculated geometrically. Check for concealed interior volume areas that may be hidden by floors and interior walls.

Note: Include the volume of "attached and connected" (see SECTION 6001 .10B) and "connected but not attached" (see SECTION 6001 .10C) buildings in the building's total volume calculation.

.04 OCCUPANCY

If the building is occupied, the occupancy is the number of occupants who live in the building.

If the building is unoccupied, or the energy rating is for a BEES "Proposed from Plans" building, and occupancy information is not available, assume that the number of occupants is the number of bedrooms, plus 1. A bedroom is defined as a room:

- which could be used as a sleeping room,
- where interior dimensions equal or exceed 9'-0" x 8'-0" in their narrowest dimensions measured one foot above floor level, and,
- includes **both** a window and a closet.

It's important to note that the number of bedrooms is based on occupancy. Accurate information on the number of full-time occupants will allow the Energy Rater to better characterize the energy usage for the current users of the building. Identify rooms that are not officially defined as bedrooms, but that are used as sleeping rooms (for example, a closet or office used as a sleeping area). Include them as bedrooms and record it in the "Notes to AHFC."

.05 IDENTIFYING FLOOR COMPONENTS

Floor areas that border exterior unenclosed space above grade are exposed floors. For example, in a two story building, the second story may extend (cantilever) horizontally further than the first story, creating some floor area that is exposed to the exterior.

Floors over un-conditioned garages shall be treated as floors over un-conditioned crawl spaces. The joist cavities in the garage ceiling are generally insulated. There is usually no heat source (either direct or indirect) in the garage.

A slab on grade is constructed by pouring a concrete slab directly on the ground as the floor for the building. Therefore, there is never a crawl space or basement in a slab-on-grade building.

A walkout basement, if fully conditioned, is typically considered partially slab on grade construction (where the floor level is above grade) and partially a basement (where the floor level is below grade).

A daylight basement usually has a below grade slab and a short (three to four foot) below grade foundation wall. The rest of the wall is above grade and usually of the same construction as the rest of the above grade walls.

Below-grade floors include any floor that is part of the building envelope and is located at or below the level of the finished grade of the building. The floors over un-conditioned basements or crawl spaces are not treated as below-grade floors; these are exposed floors and are above-grade floor components.

On- or below-grade floors are usually concrete slab floors. The ground in a heated crawl space is part of the building thermal envelope and is also a below-grade floor.

A. Floor Surface Area

Measure the interior linear perimeter to the nearest 1/2 foot of all floors over un-conditioned space. Use these dimensions to calculate floor area. For conditioned basements and crawl spaces, find dimensions of basement walls and floor. Divide walls into above and below grade sections.

B. Insulation

1. FLOOR OF CONDITIONED BASEMENT/CRAWL SPACE

If basement or crawl space is determined to be conditioned, its walls and floor are considered part of the building's thermal envelope. The crawl space/basement ceiling is considered an interior boundary with no associated heat transfer calculated.

2. FLOOR OVER UN-CONDITIONED BASEMENT/CRAWL SPACE

If a basement/crawl space is determined to be un-conditioned, the floor above the basement/crawl space (or, the basement/crawl space "ceiling") is considered the shell component.

3. Perimeter Insulation – Slab on Grade

Determine the perimeter of the slab foundation by measuring each dimension to the nearest 1/2 foot and adding them together. If present, slab perimeter insulation is usually installed on the outside of the slab and extends both above and below grade.

To identify slab perimeter insulation, look for a protective coating above grade as opposed to the usual exposed slab edge at any conditioned space(s). Move a little bit of dirt or snow away from an edge of the slab where conditioned space is located. If present, the rigid insulation around the perimeter of the slab may be seen. However, it may be difficult to visually verify the existence of slab perimeter insulation because of the protective covering which may be installed over the rigid insulation.

Slab insulation may also occur in the narrow gap (may be less than 1-inch wide) between the foundation wall and the perimeter of the slab. It may be possible to probe this narrow gap by probing a needle through the carpet near the baseboard on an exterior wall. If the needle penetrates beyond the depth of the carpet, there is probably foam insulation between the slab and foundation wall. As of February 2010, the Alaska-Specific Amendments to the IECC 2006 and ASHRAE Standard 62.2-2004 (February 9, 2010) prohibit placing insulation between the slab and the foundation wall (Section 402.2.7). The Amendments are located at http://www.ahfc.state.ak.us/iceimages/reference/bees_amendments.pdf .

Under slab insulation cannot be assumed to exist unless visually verified by a photograph of construction, at chase way, at sump opening or at plumbing penetrations. Rigid insulation may be installed on top of a foundation slab with a wood floor installed over the top.

.06 WALLS

A. Construction Type

Wood framing is very common in residential construction. Wood studs are located 16" or 24" on center all along the wall. Knocking on the wall will give a "hollow" sound in the cavities between the studs and a "solid" sound at the stud locations.

Metal framing can be found in some newer residential construction. A strong magnet slid against the wall will hold to metal framing. Also check inside the attic at the edges for evidence of metal wall framing.

Masonry walls include walls constructed of concrete (e.g., concrete masonry unit (CMU)) or brick. A wood frame wall with brick veneer would not be considered a masonry wall. Also note the siding or finish material on the wall.

Foam core walls consist of a panel with a foam core sandwiched between outer layers of structural sheathing, gypsum board or outer finish materials. Foam core panels may be structural (load bearing) or non-structural. Non-structural panels are frequently used in post and beam construction.

Log walls are typically solid wood walls, using either milled or rough logs or solid timbers. Some buildings may have the appearance of solid log walls, yet may actually be wood frame walls with siding that looks like solid logs inside and out. Some log walls are made with insulated cores. Unless manufacturer's documentation is available or visual assessment of insulation type and thickness can be made, assume no added insulation exists in a log wall.

B. Wall Types

A visual assessment may not be enough to determine the differences in some types of wall construction in existing buildings. Insert a non-metallic probe into the wall via an electrical outlet or plumbing penetration to help determine the insulation depth.

Single Stud Wall

The standard practice in wall-framing system is two-by-four studs at 16 inches on center (o.c), filled with fiber-glass batts. More recent practice is two-by-six studs, either at 16 inches or 24 inches o.c.

Strapped Stud Wall

The strapped wall technique provides for an additional layer of insulation at the interior by running horizontal strapping over the standard two-by-six single wall system. Since the additional insulation layer extends across the framing members, it is “insulating sheathing,” while the batts in the cavity between the studs are insulation. The most common size for this strapping is two-by-three run horizontally at 24 inches o.c.

Double Stud Wall

A wall system consisting of a load-bearing structural wall and a lighter, non-bearing wall section that supports either exterior siding or interior drywall allows for higher wall insulations. The thickness of the wall assembly and the amount of insulation may vary.

Curtain Wall

The curtain wall has a single outside framing layer attached at its top and bottom without any intervening layers of framing. The Larsen Truss system is a type of curtain wall that can be attached directly to the wall or to the rafters at the top of the wall.

Stressed Skin Panel

Stress-skin panels are fiber-glass, polystyrene or polyurethane insulating cores sandwiched between skins of wood, wood panel sheathing, wafer board or drywall.

Log

Log walls are solid wood timbers that serve as both the structural and sheathing members of the assembly.

Strapped Log

Strapped log walls are standard log walls that have been furred out on either the inside or outside wall to provide insulation.

C. Framing Members

Determine whether 2 x 4 or 2 x 6 framing exists:

- Measure the width of the window jambs;
- Subtract the widths of the wall coverings and sheathing materials (approximately .25" to 1.0" for stucco, .5" to .6" for interior sheetrock' and .5" to .75" for other exterior siding materials);
- Compare the remaining width to 3.5" for a 2 x 4 wall or 5.5" for a 2 x 6 wall

If exposed garage walls exist, examine them for reference (although they will not always be the same as other walls).

If a wall does not come close to the framing width of a 2 x 4 or 2 x 6, look for foam sheathing on the inside or outside of the walls. In super-insulated construction, "double stud" or "strapped" walls may account for thickness greater than 5.5". Brick veneer walls can add up to 5" to the wall thickness, which includes 4-inches of brick veneer, a 0.5-inch airspace, and 0.5” of sheathing material.

Check the framing member size on all sides of the building. If an addition has been added, be sure to check the walls of the addition separately. If the building has more than one story, check the framing member size for each floor.

D. <u>Insulation Value</u>

Determine insulation type, thickness, and R-value in walls.

Framed Walls: Check at plumbing outlet under sink or, in order of preference, remove cable outlet plate, telephone plate, electrical switch plates and/or electrical outlet plates on exterior walls. Probe the cavity around the exposed plate with a non-metal device (such as a plastic crochet hook or wooden skewer). Determine type of insulation (fiber-glass, cellulose insulation, foam, etc.). Check outlets/switch plates on each side of the building to verify that all walls are insulated.

Be sure to use the actual thickness of the insulation when calculating the total insulation R-values. Use 3.5" for 2 x 4 walls and 5.5" for 2 x 6 walls constructed after 1945.

Parts of the Insulated Sheathing: Insulated sheathing may exist on walls, but can be difficult to verify. Walls with insulated sheathing may be thicker than walls without insulated sheathing. Visual verification of insulated sheathing may be found in the attic at the top of the wall, exterior wall penetrations, and at the connection between the foundation and the wall.

Foundation Walls: Wall insulation may be located inside the foundation wall (studs and batts, foam under drywall, etc.), integral with the foundation wall (insulated cores of block wall, insulating concrete block such as insulating form work), or outside the foundation wall (rigid foam insulation).

E. <u>Location</u>

Determine the type of un-conditioned space that the wall adjoins.

- **Wall to exterior**: Exterior walls that border the outside of the building and are exposed to outside air and weather.

- **Wall to enclosed un-conditioned space**: Walls that border un-conditioned attics, garages and crawl spaces.

F. <u>Surface area</u>

- Measure the interior linear perimeter of the walls to the nearest 1/2 foot.
- Measure the interior height of the walls to the nearest 1/2 foot.
- Use these measurements to calculate surface area.

G. <u>Exterior Sheathing</u>

Determine what kind of exterior sheathing is attached to the walls:

- siding without plywood sheathing (such as T-111) or
- siding plus plywood sheathing.

.07 ROOF/CEILING

The Energy Rater must visually assess the insulation levels in the roofs and/or attics. If the space is not accessible, the Energy Rater shall document the reason in the “Notes to AHFC.”

A. For Ceilings between Conditioned and Un-conditioned Space

1. Determine the Surface Area

Measure the linear perimeter of the ceiling area to the nearest 1/2 foot, and use these measurements to calculate surface area of the ceiling. If a ceiling area is vaulted, it may be necessary to calculate dimensions geometrically. AkWarm© can calculate the surface area with user-supplied data on the slope and the ratio of the vertical to horizontal (rise (height) ÷ run (length)).

2. Identify the ceiling as one of the following types.

Ceiling With Attic: if the ceiling has attic space above (even if the ceiling is vaulted, as in a scissors truss) it is considered ceiling to attic. If there is a vaulted ceiling check its angle against the angle of the roof - if the ceiling angle is gentler there is attic space above the ceiling. Also check for an attic access, either separate or from an attic over another part of the building.

Framed/Cathedral Ceiling: these can be roofs on exposed beams or rafters or finished framed ceilings with drywall, plaster, or paneling on the underside of the framing members. The ceiling may also be flat or sloped.

3. Determine the framing member size for framed ceilings exposed to un-conditioned spaces.

Check the framing by looking for an access through an attic over another part of the building or by looking at the rafters from the outside. Be aware that rafter tails can be cut down. Example: 2 x 12 rafters inside a building often are 2 x 6's on the soffit area.

B. Type of Roof Truss

Determine if the roof trusses are standard or energy trusses. Energy trusses provide vertical clearance for insulation over wall top plates. They may be either raised heel or oversized.

A **raised heel truss** is an exposed rafter tail truss with webbing members that raise the height of the top chord, allowing extra space for insulation over the exterior walls.

An **oversized truss** (sometimes called a cantilever truss) is longer than a standard truss. The extra length provides added height above the exterior wall.

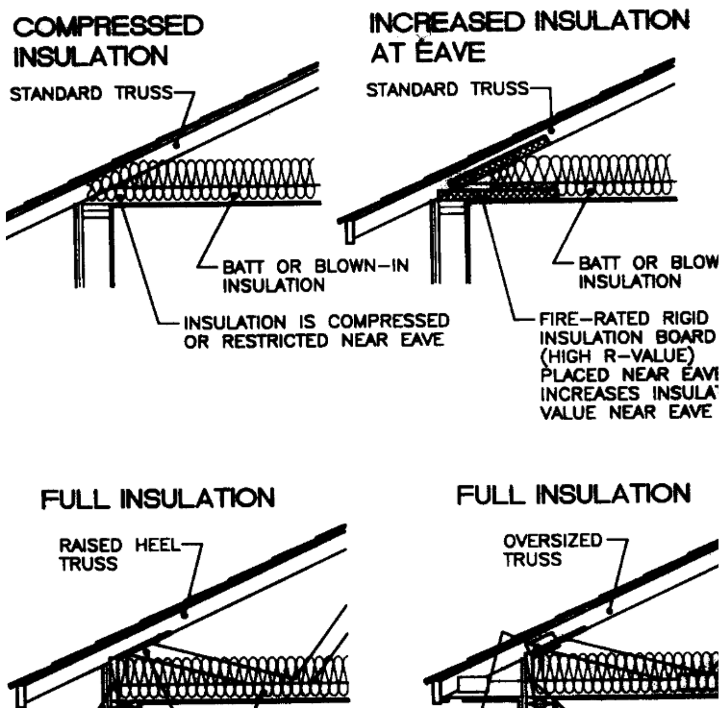
C. Insulation Value

1. Determine the type: cellulose, fiber-glass, rock-wool, etc.

2. Depth of attic insulation

Determine the depth of the attic insulation by thorough visual inspection. Collect sufficient measurements to accurately describe the insulation.

NOTE that cavities between roof rafters are typically sealed with sheet rock and cannot support a person's weight. Step only on rafters or other structural support.



a. Insulation R-value

Determine the insulation R-value which exists in the ceiling area (cavity). Use the following method for calculating the overall ceiling R-value:

1. Determine the type of ceiling insulation present (may be a combination of more than one type);

2. Determine the depth/ thickness of each insulation type.

3. If there is no access to the framed ceiling, ask the customer for documentation of insulation or use a default value based on age.

D. Rim Joist Insulation

The rim joist is the band joist around the perimeter of the floor joists over a basement or crawl space, or between 2 stories of a building.

Crawl space or basement: from the basement or crawl space, visually identify and measure the depth of insulation at the rim joist. The insulation used is generally fiber-glass batts, often folded in an L-shape and attached to the rim joist. Rigid board insulation may also be found.

Between stories: look for access to the area from a garage or a utility access trap door. Visually identify and measure insulation if it exists. If no access can be found, assume insulation exists at the rim joist between stories if insulation was found at the rim joist at the top of the crawl space or basement in the same building; or insulation is found in the walls of the same building. Otherwise, assume no rim joist insulation exists.

.08 EXTERIOR DOORS

Exterior doors are those that separate the conditioned from the outside or un-conditioned space. For example, the door from an interior conditioned space into an arctic entry that is (a) not insulated and (b) is not directly or indirectly heated to ≥ 60ºF, is an exterior door. However, if the arctic entry is insulated and/or directly or indirectly heated, or the occupants state that the door from the living space into the arctic entry is left open year-round, then the door is an interior door; the door from the arctic entry to the outside would be the exterior door.

Exterior doors do not include:

- interior doors
- doors between the occupied space and
    - *heated* garage(s),
    - *heated* arctic entries,
    - other buildings that are within the building's thermal envelope

- exterior doors with more than 50% glazing (see "gross area calculation," below, to address full-light doors)
- storm doors.

Include the doors between the occupied space and the garage, arctic entry, etc., if these rooms are *unheated* and are not included in the energy rating.

There is a great deal of variation in exterior door construction. It may be rather simple to determine the primary construction (wood, metal, fiber-glass), it may be very difficult to determine what's inside a hollow-core door (fiber-glass, urethane, honeycomb, EPS, XPS, etc.). The National Fenestration Rating Council (NFRC) (http://www.nfrc.org/getratings.aspx) rates all exterior doors. However, not all manufacturers have their doors rated by the NFRC, so an NFRC label may not be present.

A. Construction Type

Determine if the exterior door(s) is fiber-glass, metal, or wood by making a close evaluation of its texture, distinguishing the sound produced when knocking on it, and checking its side view.

B. Insulation

Determine if the doors are insulated, and the type of insulation.

By sound: judge whether the exterior door(s) is insulated (or not) by its sound, temperature transfer, labelling, or thermal break. An insulated/solid door will sound dull when knocked on. An uninsulated/hollow door will sound hollow.

By heat transfer: feel the inside and outside of the door with flat palms. Insulated/solid door will less readily transfer heat. The inside will feel warmer in cold outside weather and cooler in hot outside weather than an uninsulated/hollow door.

By labelling: check the side view of the door at the hinges for a descriptive label.

By thermal break: check the side view of metal doors for thermal breaks.

Wood doors: Insulated wood doors are uncommon, and will typically be either hollow- or solid-core.

Fiber-glass doors: are insulated with polyurethane.

Metal doors: Insulation may be fiber-glass or mineral wool, urethane/polyurethane, and expanded polystyrene (EPS). First, check the side of the door for a thermal break in the metal door cladding, usually about 0.5" to 1," down the center of the door. If present, record EPS (the lowest R-value) as the insulation, unless the homeowner has documentation identifying the fill is polyurethane. Metal doors may also be filled with honeycomb for structural value, but the honeycomb has no insulation properties. If no thermal break is visible on the side of the metal door, assume no insulation is present and the fill is honeycomb. Fiber-glass and wool fills are very rare; if this type of insulation cannot be verified visually, assume the insulation is EPS. Record the basis for insulation type selected in the "Notes to AHFC."

C. Surface Area

Measure the surface area of the door(s) to the nearest 1/2 square foot. Some doors may contain windows, or lights, which will change the R-value. The AkWarm© library includes full, ½-light, and ¼-light windows, and calculates the compensated R-value.

D. Thermal Break

A thermal break is an insulating material that prevents or reduces heat transfer across or through a material ("thermal bridging"). A metal door may contain a thermal break along its perimeter to resist the heat flow from inside a building to the outside by "breaking" the movement with insulation or another material (foam, air, wood) that breaks the flow.

To determine if a thermal break is present, check the edge faces of the door for a gap in the primary door material, such as a metal door with an air gap or foam insulation, wood end faces, or other materials that break the heat flow path from the interior face of the door to the exterior face of the door.

E. Glazing

Some exterior doors contain ¼-light, ½-light, or full-light glazing. For energy use modeling purposes,

- ¼-light and ½-light doors are treated as **doors** in AkWarm©, but
- full-light doors are entered as **windows**.

There is no need to enter the glazing and the framing of a full-light door as two separate components (window and wall). The variation in energy use and rating points calculated by treating full-light doors as windows vs. two (window/wall) components is minimal and within the allowable error of the program.

.09 WINDOWS AND SKYLIGHTS

A. Area

Measure the area of the window openings using (area = width x height) to the nearest 1/4 foot. Window openings are measured from the inside edge of the framing (the rough opening.

B. Construction Type

Determine the window framing and glazing characteristics

Framing Type: examine each window frame in order to determine the type of material used. Open the window and examine it to see whether the frame is made of metal, wood, or vinyl. Tap the frame with fingernail or knuckle to test if it's vinyl or metal. Wood frames are usually thicker than metal.

If the window has multiple panes and is metal framed, determine if a thermal break is present by looking for two separated metal extrusions connected by a rubber spacer. The customer may have documentation to show the presence of a thermal break. Some wood windows may have vinyl or aluminum cladding. Check both the inside and outside, since some windows have vinyl cladding on one side, only.

Glazing type: check each window in the building for number of panes and presence of tint and/or Low-E coating. Look at reflections and edge thickness. To determine if glazing has a tint or Low-E coating, check the customer's product literature if available. Another option is to perform a "flashlight test." Shine a flashlight beam into the window at a slight angle and count the number of times the light is reflected. Assume that each reflection indicates one pane or coating, including Low-E and tinting. For example, a double-paned window with Low-E **and** tint should show 4 reflections: 1 reflection for each pane of glass (2 panes) and one reflection for each coating (2 coatings – low E **and** tint). Most Low-E coatings are tinted. For new construction, most windows will display NFRC labels.

C. Orientation

Use a compass (adjusting for magnetic deviation) to determine whether windows are “south” or “not south”. South windows include all windows within 45 degrees of true south that are not completely blocked or shaded.

D. Shading

Determine the shading level of the windows.

Shaded windows do not get the full advantage of solar gain. Identify shading by external shade screens, building overhangs/awnings, and shade from trees and other buildings.

- **Little** applies to a window which has 0-25% of its view of the sky blocked by an external obstruction;
- **Moderate** applies to windows which have 25-50% of their view of the sky blocked;
- **Heavy** applies to windows which have more than 50% of their view of the sky blocked.

E. U-factor

To determine window U-factor, look for an NFRC label on new windows (it will display full window U-value). If no label can be found but customer has documentation, look up product information in NFRC Certified Products Directory to determine U-factor, or use AkWarm©'s default value, an average based on framing type, thickness of air space, and type of gas fill.

NOTE on doors with more than 50% glazing: **Is it a door or a window**? For modeling purposes, doors with more than 50% glazing, including ¾-light and full-light doors, are treated as windows. Treating these doors as windows is consistent with the current ASHRAE tables (2009 ASHRAE Handbook of Fundamentals p. 15.12 Table 6 (Doors) and Table 4 (Windows –operable). This way, the rater can enter SHGC rating information, if known, and the door orientation.

.10 BUILDING ADDITIONS

Some buildings include buildings that must be handled differently in AkWarm© to achieve an accurate rating, and may include building add-ons, such as storage units, arctic entries, exterior boiler rooms, or other structures. Determine if the addition is attached and/or connected.

A. Addition Type: Attached but not Connected

The building is connected if a window, man-door, or other penetration(s) allows air to move freely between the building and the addition. Examine the framing, cavity, or other elements of the addition walls that are not common to the building to see if they are insulated. If they are not insulated, then they are not part of the building's thermal envelope. If they are insulated, then the addition is part of the thermal envelope, and a blower door must be performed on the structure. Examples of attached but not connected additions include:

- An insulated and heated garage with no man door between the occupied space and the garage.
- An exterior boiler room that is insulated and heated by the presence of a boiler or other heat source.
- An insulated storage shed attached to the building, but with access only from the outside.
- An apartment addition that does not share a common entry with the other primary living space in the building, or does not have a man-door into the primary living space.

If an addition is part of the building's thermal envelope, but is too small to accommodate a blower door test (BDT), include its square footage in the total for the building being rated, and document it in the "Notes to AHFC."

Perform a BDT on the addition and add the CFM50 from the BDT to the CFM50 for the building, in AkWarm©. AkWarm© will calculate the air changes per hour (ACH) for the total area for both buildings. Tally the CFM50 for multiple additions: total the CFM50 results for all the additions and add that total to the CFM50 for the building, in AkWarm©.

B. Addition Type: Attached and Connected

The addition is connected if a window, man-door, or other penetration(s) allows air to move freely between the primary building and the additional building. If the addition is attached, examine its framing to see if the walls that are not common to the building are insulated. If they are not insulated, then the building is not part of the building's thermal envelope and is not included in the BDT or the square footage.

If the walls are insulated, the building is part of the building's thermal envelope. Close any doors and windows that open to the addition's exterior, and open any doors or windows that open into the building. Prepare other openings as described in Table 1, "Building Preparation for Air Tightness test," located at http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_table_bld_prep.pdf . Perform a single blower door test for the building and all attached-and-connected additions, to yield a single CFM50 for the building. Include the square footage of each attached and connected addition in the building's total square footage.

Examples of attached and connected additions include:

- An insulated and heated garage with a man door between the living space and the garage.
- An insulated boiler room with a door that opens directly into the living space.
- An insulated arctic entry.
- An apartment addition that shares a common entry with the primary living space, or has a man-door into the primary living space.

C. Addition Type: Connected but not Attached

The Energy Rater will need to determine if the heating and/or domestic hot water systems serve a stand-alone, un-attached building.

Some buildings that are physically detached from the primary living space, such as cabins, garages, mother-in-law homes, or other stand-alone buildings, may have heat or hot water supplied from the building heating and/or DHW system. If the stand-alone building is conditioned with heat and/or hot water, assess the building to determine the source of the system. If and only if the unattached building shares a common heating or domestic hot water system with the building (or the main building being rated) then the unattached building will be included as part of the rating.

D. Addition Type: Not Attached, not Connected

The client may want to include separated buildings in the energy rating for the property. However, if the building does not share a common wall, foundation, and/or roof, then it is not attached, is not connected, is not an addition, and is not part of the primary building or its thermal envelope – regardless of whether the building is insulated and/or heated. If the client wants the building rated, the Energy Rater must complete a separate energy rating and BDT. Do not include the buildings components or the BDT results in the building's energy rating. Educate the client that these buildings may not qualify for AHFC programs. Examples of these buildings include:

- Mother-in-law homes, cabins, and apartments that are stand-alone structures.
- Detached garages, even if they are heated and insulated.

Detached storage sheds.

Notes on Garages: Include the square footage for all attached-and-connected garages, and connected-but-not-attached garages.

- **For BEES ratings**, include the square footage but use the garage temperature;
- **For As-Is ratings**, include the square footage but use the temperature of the living space.

Leave the door between the garage and the living space **OPEN** while conducting the blower door test.

.11 AIR LEAKAGE

The Energy Rater **must** perform a blower door test to prepare an official energy rating. The blower door test is a critical tool that:

- Is used by the AkWarm© software to model the **energy use** of the building, and,
- helps the energy rater prescribe air sealing measures appropriate to each building.

It is important to note that the blower door test for AHFC energy ratings is used to determine the building's **energy use**, not to test the integrity of the building pressure boundary. The energy rater may test the building's pressure boundary as an additional diagnostic testing service, but the blower door test for the energy rating must be performed, and the building prepared, in accordance with AHFC BD-1.97 Blower Door Test Procedure, Table 1.

Including the customer in the blower door test process provides an excellent education opportunity by allowing the customer to physically see where the air leaks into/out of the building. The Blower Door procedure is located at http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_final.pdf .

If for any reason the Energy Rater cannot conduct the blower door test, the Energy rater shall:

- Estimate the air leakage rate as described in SECTION 6001 .11E, **and**,
- Document the reason in the "Notes to AHFC."

A. Air Leakage Improvements

Air leakage reduction is related to the installation of every weatherization measure. The blower door test (http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_final.pdf) and the Building Airflow Standard (described in SECTION 6001 .14A are powerful diagnostic tools used to evaluate air tightening needs. Blower door directed air sealing uses pressure diagnostic procedures to focus air-sealing efforts and is more effective than prescriptive lists of air sealing locations.

Priority areas for air sealing include:

- **All large, obvious leaks in the residence envelope**, whether ceiling, floor or wall;
- **The forced air heating duct work**, including, in order of importance, building cavities used as ducts, air handler and plenum. T's, elbows, and Y's boots where the ceiling, floor or wall meet the ducts; and the joints of each duct section.
- **Attic Bypasses**. A bypass is defined as any gap in the envelope of a building between a heated and an unheated area or the exterior. Bypass locations include, but are not limited to, the following areas: chimneys (masonry and metal), soil stacks and plumbing walls, open top plates of interior partition walls, housing of exhaust fans and recessed lighting fixtures, dropped ceilings, the area beneath knee walls, around duct work, electrical work (wires and electrical boxes), clothes chutes and dumb waiters, party walls, and attic access points.
- **Attic/Ceiling:** Fireplace chimney; furnace flue; plumbing pipes and service areas (plumbing chases); electrical wire holes, recessed lights; ceiling fans; wall/ceiling joints; soffited ceilings; stairway (walk up attic); split level stud spaces; knee walls; drawers into knee wall; attic door; cathedral ceiling stud spaces at wall interfaces; whole building fan; finished attic stud spaces; around ceiling-mounted (not recessed) light fixture outlet boxes; any area where there is a floor level change; dumb waiter shafts; areas above laundry chute; heating or cooling ducts; balloon construction cavities; plaster lath voids; foldaway attic stairway
- **Basement:** Outside basement entrance; basement windows; basement window frames; holes in cinder block connecting to outside; sill plate; fireplace; hearth; doorsill (below living space exterior door); gas or plumbing pipes to the outside (or living space); air ducts or hot water pipes to living area; dryer vents; furnace flue; stairway studs, walls and/or ceiling; foundation cracks; wiring holes to outside or unheated space; balloon frame, ceiling cavities; rodent holes; plumbing vents to roof; split level basement-slab (or unheated crawl space) interface

- **Living Area:** Wall cavity above heating or cooling ducts; wall mounted light fixtures; floor molding; ceiling molding; window molding (especially top); recessed light fixtures; ceiling and bathroom fans; kitchen fans; kitchen soffited ceilings; built in buffets; oven soffited ceilings; bathroom soffited ceilings; penetrations above dropped ceilings; around bathtub cut-outs; medicine cabinets; plumbing holes into walls under kitchen and bathroom sinks; vents under fixed windows; attic doors; door moldings (especially bottom end); plumbing intrusions (around faucets, shower piping, etc.); door seals; under thresholds (ends); around exhaust fan cut-out; heating returns that utilize joist spaces; ceiling or wall cracks or holes; hollow walls for fish tank, stereo, etc.; electric light switches and outlets (usually not big leaks).

- **Envelope Penetrations**: All large, obvious leaks in the residence envelope, whether ceiling, floor or wall; forced air heating duct work, including, in order of importance, building cavities used as ducts, air handler and plenum. T's, elbows, and Y's boots where the ceiling, floor or wall meet the ducts; and the joints of each duct section.

A cost effectiveness guideline (CEG) is useful in determining how much air sealing to recommend. This guideline is used to determine whether to continue blower door guided air sealing work or to stop sealing. It tells the contractor the minimum amount of air leakage reduction that is needed for each hour of work to be cost effective.

B. <u>Blower Door Test</u>

Determine energy use, air leakage rates and equivalent leakage area.

Follow procedure AHFC-BD1.97, "Blower Door Test" to prepare building, conduct test, and restore building after the test. The Blower Door Test Procedure is located at http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_final.pdf .

C. <u>Stack Effect</u>

Temperature differences between indoors and outdoors cause air density differences, and therefore pressure differences that drive infiltration. The pressure differences create a horizontal pressure plane of neutral in the building where high and low pressure air meets. The neutral pressure plane is a moving zone that varies with air temperatures and infiltration/ex-filtration. Air losses above a building's horizontal neutral pressure plane can lead to stack effect. Stack effect occurs when air enters the building through from leakage sources lower in the building – such as crawl spaces and appliance vents. Air then warms, rises, and exits the building through leaks higher in the building – such as chimney flues, can-light fixtures, windows, etc. Stack effect can ultimately result in negative pressure lower in the building. Since this is often where combustion appliances are located, the risk of back-drafting appliances is high. For this reason, air sealing is typically done "from the top down," to reduce the potential for stack effect.

During the heating season, the warmer inside air rises and flows out of the building near its top. It is replaced by colder outdoor air that enters the building near its base. The airflow is dependent on amount and size of leaks and the height of that "stack" - the distance from the lowest leaks to the highest leaks.

D. Wind Effect

In addition to the horizontal neutral pressure plane, a vertical pressure plane exists that is affected by wind pressures. The pressure from wind against the exterior wall(s) of a building create a pressure differential between the inside and outside air, which leads to air infiltration on the windward side of the building, while air ex-filters from the leeward side of the building.

E. Estimating Air Leakage

Although the blower door test is a required element of the energy rating, and all reasonable efforts must be taken to complete the test, there are limited circumstances when a blower door test cannot be performed.

- Performing an energy rating based on plans
- In a multi-family facility, it is not possible to gain access to all units
- **NOTE**: The energy rater should always coordinate with the customer before arriving to perform the test, and work with the customer to obtain access for a blower door test, if feasible.
- If sustained wind on an exposed/un-shielded building prevents the blower door manometer from stabilizing to within ±50 CFM, attempt to control wind influence using a manifold, box, or other wind shield.

  Extreme cold may lead to frozen pipes. The blower door test should not be performed at ambient air temperatures < -25ºF. Interior weatherization crews have developed methods to install and complete the test very rapidly, limiting the amount of cold air infiltration to the building.

- Fire in primary/sole heating appliance (e.g. wood stove).

  NOTE: Always coordinate with the customer before the test, and remind them that the fire must be extinguished and ashes cleaned from the appliance, in order to complete the rating.

- At extreme cold temperatures it is not feasible to turn off the heat.

If one of the conditions listed above prevents the energy rating from completing a blower door test, use the "Estimating Air Changes" table (http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_table_no50.pdf) to estimate natural air leakage when a blower door test is not possible. Refer to the CFM50 conversion table (http://www.ahfc.state.ak.us/iceimages/manuals/blower_door_test_table_bld_prep_cfm50_convert.pdf) to convert pressures below 50 Pascals.

If estimate will be used for an official energy rating, the Energy Rater must provide a detailed description in the "Notes to AHFC" documenting why it was not possible to perform a blower door test. Document the method used to estimate the Air Changes Per Hour (ACH) (software, table, etc.) in "Notes to AHFC" in AkWarm©. If the table was used, include the calculations in the "Notes to AHFC."

.12 HEATING SYSTEMS

A. Heat Energy Source: Fuel Type

Determine the type of fuel(s) used to heat the building. Heating systems may use natural gas, propane, oil, electricity, or some other fuel. Typically the customer will know what type of heating fuel is used.

1. Natural Gas/Propane Space Heating Equipment

Natural gas: look for a meter connected to piping on the exterior of the building. Piping to the heating equipment is typically done with 1/2 " to 1 " cast iron piping.

Propane: look for storage tank(s). Large tanks may be buried with a 12" to 18" cap exposed above grade. Fuel is typically supplied to equipment through 1/4" to 3/8" diameter copper piping.

- Space Heaters

Space heaters are self-contained (un-ducted) air-heating appliances intended for heating the room or area in which they are installed. They may be vented or non-vented, and can include floor furnaces, wall furnaces, and room heaters. Heat circulation may be through natural convection or by circulating fan.

Unvented space heaters have very high efficiency rates because they discharge their combustion by-products directly into the space being heated rather than outside. This is a major attraction of unvented space heaters, but is also a source of poor indoor air quality and moisture problems.

Vented space heaters are similar in design, efficiency and application to free standing space heaters, but draw combustion air in and discharge combustion gases out through a vent to the outside of the building. They may include an air circulating fan to promote heat distribution.

- Central Heating Systems

Central heating systems are furnaces or boilers with distribution lines that carry warm air or water to locations throughout the building.

Furnaces heat air and have ducted distribution systems that carry warm air throughout the building. Boilers heat water and distribute water or steam through pipes, radiators or baseboards.

Conventional atmospheric gas furnaces and boilers use a naturally aspirating atmospheric burner (air for combustion enters the combustion chamber freely) and a standing (always lit) pilot light. Dilution air is introduced into the gas venting system through a draft hood, either free standing on the chimney stack or built in, as an open slot on the front of the appliance.

Improved efficiency gas furnaces and boilers have electronic instant ignition instead of a standing pilot light and built-in vent dampers that prevent heated air from being drawn up the chimney during the appliance off-cycle. In some circumstances, conventional gas appliances may be retrofitted with the fuel-saving technologies such as electronic ignition, automatic flue dampers, induced draft fans and even condensing flue systems. These modifications require a professional heating system contractor with proper training and tools.

Electronic ignition (intermittent ignition device) eliminates the pilot light that ordinarily burns constantly. These devices ignite only when the thermostat calls for heat.

An automatic flue damper is a metal flap that closes off the flue when the burner shuts off. There are two types of flue damper: thermal and electric. Thermal dampers respond to the presence of hot flue gases while electric dampers are wired directly to the burner.

Power venting boilers and furnaces, either by induced draft or forced draft, use a fan to force the combustion products out of the building, usually through a small plastic pipe that can be routed through the perimeter wall. This reduces the potential for backdrafting. Such appliances still draw combustion air from the surrounding room atmosphere, however.

Condensing furnaces hold the exhaust products in the appliance longer. The exhaust products cool to the point where they partially condense. Some of the latent heat contained in the water vapor of the exhaust gases is recovered from a secondary heat exchanger, thereby increasing the unit's efficiency. Condensing appliances also use an induced fan to exhaust the combustion products and combustion air is often ducted directly from the outdoors into the combustion chamber.

2. Oil Space Heating Appliances

Look outside the building for a large storage tank (typically cylindrical) or fill pipes which would indicate a buried tank. Oil is typically supplied to the heating equipment via a 1/4" or 3/8" copper line. A fuel filter may be evident in the line.

- Space Heaters

Space heaters are self-contained (un-ducted) air-heating appliances intended for heating the room or area in which they are installed. They may be vented or non-vented, and can include floor furnaces, wall furnaces, and room heaters. Heat circulation may be through natural convection or by circulating fan.

Unvented space heaters have very high efficiency rates because they discharge their combustion by-products directly into the space being heated rather than outside. This is a major attraction of unvented space heaters, but is also a source of poor indoor air quality and moisture problems.

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- Central Heating Systems

Central heating systems are furnaces or boilers with distribution systems that carry warm air or water to locations throughout the building. Furnaces heat air; boilers heat water.

Conventional atmospheric oil furnaces and boilers use a naturally aspirating atmospheric burner (air for combustion enters the combustion chamber freely) and a standing (always lit) pilot light. Dilution air is introduced into the exhaust venting system through a draft regulator on the chimney stack.

Improved efficiency oil furnaces and boilers have improved burner design (retention head burners), vent dampers and improved heat exchanger design. In some circumstances conventional oil furnaces may be retrofitted with fuel-saving technologies such as electronic ignition, automatic flue dampers, induced draft fans and even condensing flue systems. These modifications require a professional heating system contractor with proper training and tools.

An automatic flue damper is a metal flap that closes off the flue when the burner shuts off. There are two types of flue damper: thermal and electric. Thermal dampers respond to the presence of hot flue gases, while electric dampers are wired directly to the burner.

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Condensing furnaces hold the exhaust products in the furnace longer. The exhaust products cool to the point where they partially condense. Some the latent heat contained in the water vapor of the exhaust gases is recovered from a secondary heat exchanger, thereby increasing the unit's efficiency. Condensing furnaces also use an induced fan exhaust. The combustion products and combustion air are often ducted directly from the outdoors into the combustion chamber.

3. Electric Space Heating Equipment

Electric: look for large gauge cables running to a central piece of equipment or look at circuit breaker panel for circuits marked for resistance heat circuits (electric resistance or electric radiant systems).

Electric resistance heating systems include both centralized furnaces or boilers and baseboard heaters. Baseboard systems include both convection units and radiant heating cables and panels. They do not require combustion air for operation. Efficiency for all electric space heating systems is assumed to be 100 per cent.

Electric heat pumps work much like refrigerators. A heat exchange coil containing a refrigerant extracts heat from outside sources (air, ground or groundwater). The refrigerant evaporates, absorbing the heat, and is then pumped inside to another heat exchange coil where it condenses at high pressure and releases the heat it absorbed earlier.

A heat pump supplies more energy than it actually uses. The ratio of energy supplied to energy used is defined as the coefficient of performance (COP). The COP drops as the difference between the supply (outdoor air or ground) and use (indoor) temperature increases. At some point it reaches a ratio of one, a figure equivalent to electrical resistance heating. In Alaska the outdoor air temperature during the heating season is not high enough to provide a COP much higher than 1, so outdoor air-source heat pumps are not cost-effective. Since earth and groundwater temperatures are more stable and tend not to drop below freezing, heating systems using these heat sources tend to be more efficient than air source heat pumps.

4. Other fuels

Other fuels include coal, wood, processed wood pellets, or other combustible products.

B. <u>Heating Equipment</u>

1. Equipment Type

Identify the type(s) of equipment used to heat the building. The region and its energy sources may limit the options for heating systems. For example, diesel-fired boilers are used almost exclusively in the Interior, North, and rural Alaska.

Where natural gas is available (Anchorage Bowl, Kenai Peninsula), natural gas furnaces are commonly used.

Furnace: comprised of a combustion chamber and heat exchanger (natural gas, propane or oil) or an electric resistance element (electric) and a fan which forces air across the heat exchanger or resistance element to provide heat in a forced air system.

Fan coil unit: hot water from a boiler, domestic water heater, or heat pump is circulated through a coil. A fan blows air over the coil to provide heating. This device is used in a forced air system.

Boiler: this device creates hot water or steam, and can be powered by any fuel type. Can be used with forced air (in conjunction with a fan coil unit), forced hot water, steam, or hot water radiant slab systems.

Split system central air source heat pump: these systems move energy from one location to another using the vapor compression cycle. They are electrically driven, and can provide heating in winter and cooling in summer by reversing the direction of heat flow. Split system heat pumps consist of an outdoor unit and an indoor air handling unit, resembling a furnace. These systems require ductwork for air distribution. Most air source heat pumps incorporate electric resistance supplemental heat in the indoor section. However, some heat pump systems use fossil fuel furnace for supplemental heating. These are known as "dual fuel" or add-on systems.

Use the "Air Source Heat Pump HSPF Adjustment based on Climate" spreadsheet (http://www.ahfc.state.ak.us/iceimages/manuals/erm_air_source_ht_pump_hspf_climate_adj.xls) to calculate the Heating Seasonal Performance Factor and equivalent AFUE ratings, based on the local climate factors.

Single package central air source heat pump: a single package central heat pump is similar to a split system, except it combines the functions of the indoor and outdoor units into one cabinet, usually mounted on the roof or on the ground. It also requires a separate distribution system. These are uncommon in single-family residences, however they are sometimes found in multi-family dwellings.

Ground source heat pumps are coupled to the ground through the use of a water well - sometimes the same well as used for domestic water - (known as "open loop" or "ground water" system) or through a series of buried pipes through which water or a water/antifreeze mixture is circulated (known as "closed loop"). Look for 3/4" or larger diameter piping going to and from the heat pump. Circulating pumps may be installed in this piping (closed loop systems) or the pump for the water well may be used for circulating water through the heat pump (open loop). The same piece of equipment can be used in either open or closed loop applications. However, given the same piece of equipment, closed loop applications typically have lower efficiency ratings than open loop applications. Ground source heat pumps can also utilize a direct expansion of the refrigerant with copper piping buried in the ground. Look for 0.25"- 0.50" copper piping leading from the unit to the outdoors with no outdoor unit.

Use the “Air Source Heat Pump HSPF Adjustment based on Climate” spreadsheet (http://www.ahfc.state.ak.us/iceimages/manuals/erm_air_source_ht_pump_hspf_climate_adj.xls) to calculate the Heating Seasonal Performance Factor and equivalent AFUE ratings, based on the local climate factors.

Unitary space heater: these are fossil fuel burning heaters which have individual controls and no distribution system. They may be equipped with a fan for forcing air circulation over a heat exchanger, or they may use simple convective forces. These heaters are typically mounted on outside walls in order to facilitate venting and can use natural gas, kerosene, propane, or other types of fossil fuel.

Sidearm Units: Commonly used in the Interior, sidearm units may include water storage tanks or electric water heaters that are plumbed to a boiler unit, and are used to generate domestic hot water from the heating system boiler. These units are treated as sidearm units even if they are not currently operating, because it is assumed that they operate 6-months or more annually. When the unit is off, electricity is used to power the hot water system, and the hot water system is considered the sidearm.

2. Control System

Identify the control system for the heating system. Thermostat controls may be programmable. Note types of features available and/or utilized. Some systems are described below.

a. Heating Thermostat Set-point

The program assumes one heating set-point for the entire conditioned space. This information will be used in calculating energy use and for energy improvement recommendations, but will not affect the energy rating.

b. Outdoor Temperature Reset Control (also called, “modulating aquastat”)

An outdoor temperature reset control (often inaccurately referred to as an “outdoor reset”) measures the outside air temperature to maintain the boiler water to an established set-point temperature (typically 180ºF). During summer months when less heating is necessary, this set-point temperature may be higher than needed, resulting in wasted energy. Unlike a *modulating circulator*, which modulates the *flow* through the boiler, an outdoor reset controls the boiler on-off based on the outside air temperature and heating needs. Since the boiler shuts down when heating is not needed, an outdoor reset/modulating aquastat typically results in higher efficiency than that achieved with a modulating circulator, which operates year-round regardless of outside air temperature.

c. Night Setback Thermostat

Indicate the presence, or lack of, an automatic night setback thermostat. This is a thermostat which may be programmed, mechanically or digitally, to provide different settings at different times of the day. AkWarm© makes internal assumptions about the degrees setback and the length of setback time.

3. Efficiency

a. Efficiency Standards

The Air Conditioning, Heating, and Refrigeration Institute (AHRI) rates and certifies the efficiency of heating systems. The Gas Appliance Manufacturer's Association (GAMA) certification has been used to certify the efficiency of residential furnaces, water heaters, and direct heating systems. The IBR certification has been used to certify the efficiency of residential boilers, baseboard radiation, and indirect-fired water heaters. Effective January 1, 2012, the previously used GAMA and I=B=R marks will be phased out and a single AHRI Certified™ mark will be used to certify all heating, ventilation, air conditioning, and commercial refrigeration (HVACR) systems.

Annual Fuel Utilization Efficiency (AFUE) is used to measure the efficiency of furnaces and boilers. Energy Efficiency Ratio (EER) is used to determine the efficiency of room air conditioners and ground source heat pumps. Seasonal Energy Efficiency Ratio (SEER) is used to measure the efficiency of air source heat pump systems and air conditioning systems.

b. Efficiency Measurements

Certified AFUE: The Annual Fuel Utilization Efficiency (AFUE) measures the efficiency of a unit's delivered heat output over a heating season. AFUE accounts for start-up and cool-down and other energy losses that occur under real operating conditions.

Combustion Efficiency Test at Steady-state Conditions: Combustion efficiency is a measure of how efficiently the appliance converts the air/fuel mixture to heat. If a combustion efficiency test is performed at steady state conditions on the appliance at the time of the energy rating, or within one month of the energy rating date, document the results of the combustion efficiency test in writing.

Coefficient of Performance (for Electric Heat Pumps): Ground/water source electric heat pumps are not common in Alaska, but are increasingly being made available. Instead of producing heat from electric current, as electric resistance heaters do, they use electricity to move heat from one place to another. They use the earth or ground water as a heat source. A heat pump can deliver more energy than it consumes. The ratio of delivered energy to consumed energy is called the coefficient of performance or COP. COP ratings are available from the Air Conditioning, Heating, and Refrigeration Institute (AHRI) may be obtained from the AHRI **Directory of Certified Product Performance** located at http://www.ahridirectory.org/ahridirectory/pages/home.aspx.

Outside air-source heat pumps rely on the outside air as a heat source. The colder the outside air is, then the lower the energy performance (the lower the COP). For this reason, air-source heat pumps may not be applicable in Alaska.

c. Determine the heating equipment efficiency

Properly maintained, high quality systems may operate at design efficiency for many years, but based on the age, manufacturer, and maintenance history, the efficiency of a heating system may decline over time.

- Check nameplate for the efficiency rating.

  If the efficiency rating is not shown or legible from the nameplate, use the make and model information from the unit nameplate and consult the AHRI Directory of Certified Product Performance to identify the unit's efficiency. The directory is located at http://www.ahridirectory.org/ahridirectory/pages/home.aspx.

- If no nameplate/make/model data are available **and** the individual is properly trained, perform a combustion efficiency test (also called a Steady-state Efficiency Test, or Flue Gas Analysis) on the appliance to estimate the combustion efficiency.

- If the efficiency cannot be determined by make/model information or a combustion efficiency test:

  For furnaces only: Estimate the % efficiency of the system from the unit nameplate BTU output-input data:

  % Efficiency = $[BTU_{output} / BTU_{input}] \times 100$

  NOTE: Energy Efficiency Ratio (EER) can be calculated from nameplate information by dividing BTU output by watt input

  NOTE: The calculated efficiency does not account for distribution system losses.

NOTE: Record any calculations, assumptions, estimates, or other decisions used to identify the heating system efficiency in the "Notes to AHFC."

- For furnaces without nameplate data, boilers, and water heaters, use the default values in AkWarm©. The Energy Rater **may** use the default in AkWarm© in lieu of the AHRI listing, combustion efficiency test, or calculations but shall justify the assumption in the "Notes to AHFC."

Note on Sidearm Efficiency: If a sidearm is present, expect its efficiency to be 5% less than the rated efficiency of the boiler.

Note on Tank-less Coil Heater Efficiency: The efficiency ratings of a tank-less coil water heaters is 10% less than the rated efficiency of the boiler.

Note on Indirect Heating Systems: If the rated efficiency of the unit is *83% or higher*, then the unit is considered an indirect-efficient unit. If the unit's rated efficiency is *less than 83%,* then the unit is considered indirect-conventional unit.

4. Location

Determine the location of heating equipment. Note whether systems are located in conditioned or un-conditioned space.

C. Heat Distribution System

1. Location of Air Ducts

Determine the location of the ducts

Air ducts may be located in the attic, crawl space, basement, or in a conditioned area. Locate and differentiate between supply and return ducts. Ducts may be located in more than one area (e.g., some return ducts in attic and some in conditioned space, etc.).

2. Air Leakage

Determine the air leakage from the duct system.

If diagnostic equipment is not used, consider location and characteristics of the distribution system to select standard default value. Record the basis for the determination in the "Notes to AHFC."

3. Insulation

Determine the R-value of distribution system insulation. Air ducts may be insulated with insulation blankets or rigid insulation board. Check the duct or pipe insulation for R-value labelling (printed on the insulation by the manufacturer). If the insulation is not marked with the R-value, identify type and measure the thickness of the insulation to determine R-value. Check for internal insulation by tapping on the exterior and listening to the sound.

4. Type of Distribution System

Identify type of distribution system used to provide space heating

Forced air: a central fan unit connected to ducts which supplies heated or cooled air to each room in the building. Forced air systems have supply and return duct work. Supply ducts typically run to each room; return duct work may come from each room or from one or more central locations in the building.

Forced hot water: heated water is pumped through a series of radiator elements to supply heat. The radiator elements may be conventional radiators, baseboard "fin tube" radiators, cast iron baseboards or radiant hot water panels located at the baseboards or on walls or ceilings.

Hot water radiant system: heated water is circulated through plastic or metal tubing which is installed in a concrete slab or finished floor or, occasionally, in walls or ceilings.

Unit heater: heating or cooling is supplied directly from a heating device located within the space it serves. Through-the-wall heaters are common examples. Unitary equipment typically has no distribution system.

Steam heating: steam systems utilize a distribution system with cast iron radiators connected to a boiler that creates steam. The steam rises into the radiators through one set of pipes, condenses into water, and drains back to the boiler through another set of pipes.

Electric radiant system: electric cables are installed in concrete floor slabs or in the ceiling. Electric current is passed through the cables, causing them to heat up, heating the floor or ceiling assembly which radiates the heat to the space. Electric radiant systems may also be comprised of individual radiant panels mounted on the walls or ceilings.

Baseboard electric resistance: electric elements are installed in baseboard enclosures. Electric current is passed through the electric element to provide heat to the space.

D. De-rating Heating Systems

Sometimes it may be necessary to downgrade the efficiency rating (“de-rate”) of an appliance, because a unit may produce heat yet operate inefficiently, or unsafely. De-rating an appliance will be determined by AHFC on a case-by-case basis. If more than routine maintenance will be required to correct the problem, then AHFC may de-rate the appliance 15%. For example, a cracked heat exchanger may allow combustion gases to escape to the living space, posing a safety risk. It is not the intent of AHFC programs to reward improper maintenance and repair, but the cracked heat exchanger is an example where the risk of leaving it in place is high.

NOTE: AHFC will not de-rate appliances due to lack of proper maintenance or repair of the unit.

.13 DOMESTIC HOT WATER SYSTEM

Second to space heating, water heating is typically the largest energy user in the Alaskan building. As buildings have become more and more energy efficient the percentage of energy used for water heating has steadily increased. Therefore, the domestic water heater systems are evaluated in greater detail than other non-space heating energy appliances in the building.

A. Efficiency

Determine the Energy Factor or Seasonal Efficiency of the water heater.

The energy efficiency of a storage water heater is indicated by its energy factor (EF), an overall efficiency based on the use of 64 gallons of hot water per day. The National Appliance Efficiency Standards for water heaters that took effect in 1990 require the Air Conditioning, Heating and Refrigeration Institute (AHRI) minimum energy factors listed below, based on storage tank size, for new water heaters:

AHRI Minimum Energy Factors (EF)

Tank size	Gas	Oil	Electric
30 gallons	0.56	0.53	0.91
40 gallons	0.54	0.53	0.90
50 gallons	0.53	0.50	0.88
60 gallons	0.51	0.48	0.87

Note on Sidearm Efficiency: If a sidearm is present, expect its efficiency to be 5% less than the rated efficiency of the boiler.

Storage Water Heater: for new construction, first look up the water heater in the AHRI Directory of Certified Product Performance at http://www.ahridirectory.org/ahridirectory/pages/home.aspx.

If the unit is not listed in AHRI, look for the water heater's rating plate and product literature. Some water heaters will list the energy factor (EF) right on the rating plate. If the water heater is wrapped and there is no accessible information, approximate the age of the unit and use default efficiency from AkWarm©. If accessible, record the Make and Model #. Record the basis for the decision in the "Notes to AHFC."

Instantaneous and Tank-less Coil Water Heaters: Look up the water heater in the AHRI Directory of Certified Product Performance at http://www.ahridirectory.org/ahridirectory/pages/home.aspx . If not listed, use the default value in AkWarm©.

Combined Systems: Some boiler systems are equipped with a side-arm water heater that uses waste heat from the boiler to heat domestic hot water. This is an example of a combined heating/domestic hot water system. For combined systems, the efficiency of the domestic hot water component is based on that of the heating system, and whether it has a cold boiler control (with nothing calling for heat).

Indirect water heaters use the building's boiler as the heat source, but much more efficiently than the tank-less coil types. Hot water from the boiler is circulated through a heat exchanger in a separate tank. Since hot water is stored in an insulated storage tank, the boiler does not have to turn on and off as frequently. Indirect water heaters, when used in combination with high-efficiency boilers are usually the least expensive way to provide hot water.

Heat pump water heaters (HPWH) transfer heat from the air in the space in which the HPWH is located to the domestic hot water supply. These systems are typically used in warm climates and may not be effective in cold regions.

B. Extra Tank Insulation Value

If present, determine the insulation value of the exterior tank wrap.

Visually determine if the water heater is wrapped with exterior insulation. An insulating blanket reduces standby losses and is particularly useful if the water heater is in semi-conditioned space.

C. Location

Determine whether water heater is located in conditioned or un-conditioned space.

.14 VENTILATION, COMBUSTION SAFETY, AND INDOOR AIR QUALITY

A well-sealed building must have sufficient fresh air to maintain the proper moisture control (ventilation), exhaust combustion appliance gases (combustion safety), and maintain O_2/CO_2 balance for the occupants (indoor air quality). All AHFC-authorized Energy Raters will utilize the Building Performance Institute (BPI) Technical Standards for the Building Analyst Professional (BPI Standards) and ASHRAE 62.2-2004, *Ventilation and Indoor Air Quality*, to assess these aspects of the building for AHFC-authorized energy ratings, specifically:

- Building Airflow Standard (ASHRAE 62-89, by BPI reference), for As-is and Post-ratings
- Building Airflow Standard (ASHRAE 62.2-2004, as amended by BEES), for BEES ratings
- “Combustion Safety and Carbon Monoxide Protection”

The BPI Standards are available at http://bpi.org/Web%20Download/BPI%20Standards/Building%20Analyst%20Professional_2-28-05nNC-newCO.pdf.

A. Building Airflow Standard

The Building Airflow Standard (BAS) measures the amount of fresh air infiltration, in CFM50, necessary to ventilate the building without mechanical ventilation. The BAS applies two calculations, based on either the volume of the building's living space or the occupancy, and the local climate and the height of the building. The greater of these two yields a minimum CFM50 for the building. It is especially important to ensure that sufficient ventilation is available after air-sealing and insulation retrofits. The BAS is the tool used to determine if natural ventilation is sufficient or if mechanical ventilation is recommended or required. Refer to the BPI Standards, "Building Airflow," for BAS calculations.

If mechanical ventilation is recommended or required, continuous ventilation must supply an amount of air sufficient to meet the requirement in the ASHRAE Standard 62.2-2004, "Whole Building Ventilation Standard." Use ASHRAE Table 4.1a, "Ventilation Air Requirements," or the ASHRAE Whole Building Ventilation Standard equation, as amended in Section 4.1 of the "Alaska-specific Amendments to IECC 2006 and ASHRAE 62.2," (BEES Amendments) located at http://www.ahfc.state.ak.us/iceimages/reference/bees_amendments.pdf .

NOTE: Per the BEES Amendments, the ASHRAE Whole Building Ventilation Standard is amended to allow for **10** CFM per occupant, not **7.5** CFM as stated in ASHRAE 62.2-2004.

NOTE: The ASHRAE ventilation rate is based on occupancy. For pre-existing buildings, use the customer's information on actual occupancy, if available. Otherwise, the occupancy is the number of bedrooms, plus 1. A room must have a window and a closet to be defined as a bedroom. However, some buildings may use other rooms as bedrooms; on site observations and interviews with residents will help quantify the number of bedrooms more accurately.

NOTE: Use of the BPI Standards, "Combustion Safety Test Procedure for Vented Appliances," to test the combustion safety of the building can be used in conjunction with, **but not in place of**, meeting the ventilation requirements. The BPI Standards are available at http://www.bpi.org/documents/Building_Analyst_Standards.pdf .

B. Combustion Safety and Indoor Air Quality

Combustion safety testing is part of the energy rating process. The BPI Standards describe the procedures for "Combustion Safety and Carbon Monoxide Protection" and the "Combustion Safety Test Procedure for Vented Appliances."

- The BPI Standards are available at are available at http://www.bpi.org/documents/Building_Analyst_Standards.pdf .

- A sample Combustion Safety test Report used by State of Washington is available at http://www.commerce.wa.gov/DesktopModules/CTEDPublications/CTEDPublicationsView.aspx?tabID=0&ItemID=4204&MId=870&wversion=Staging.

Combustion safety testing includes measurements of the following, for each combustion appliance:

- the carbon monoxide;
- draft and spillage for all atmospherically vented combustion appliances;
- the worst-case depressurization pressure.

The energy rater shall inventory all combustion appliances and their locations to determine the combustion appliance zone (CAZ).

- Carbon monoxide is measured in the undiluted flue gases of all combustion appliances, under steady-state operating conditions.
- Carbon monoxide is measured for all combustion appliances, except unvented gas or propane cooking appliances, under worst-case depressurization and natural conditions.

Combustion safety testing shall be completed initially and after improvements, especially air-sealing, using a “test in and test out” approach, since the potential to alter the pressure balance – and combustion gas risk – of the building can change significantly with improvements.

1. Carbon Monoxide Alerts

BPI retrofit action mandates that, **during retrofit action,** an appliance:

- With measured carbon monoxide **in excess of 400** PPM, **and** ,
- That fails spillage and draft tests under natural and/or worst-case depressurization conditions

must be shut down.

The energy rating is an assessment process and does not involve retrofit work. Energy Raters are not mechanical contractors and shall not perform mechanical work on the appliance. However, the Energy Rater may take immediate actions within the scope of an Energy Rater to reduce the carbon monoxide level, such as shutting the system down for a short period to reduce CO levels, or to re-establish draft.

If the Energy Rater finds the customer’s heating system is unsafe, the Energy Rater must provide the customer with written notice, and request the customer’s signed acknowledgement, that:

- The heating system is unsafe and has been shut down.
- The customer should not turn the system on, and instead should contact a mechanical contractor right away.

In addition, the Energy Rater must use the "Notes to AHFC" in the AKWarm program to document the system test results as well as to document that the customer was notified the system was not safe to use.

2. Sealed Combustion Units

Combustion safety testing is **required** for sealed combustion appliances and shall include carbon monoxide testing of (1) the vent, if possible, (2) in the Combustion Appliance Zone (CAZ) under natural conditions, and (3) in the CAZ under worst-case depressurization conditions.

C. Duration of Ventilation

Identify the type of whole building ventilation system in use. This does not include individual bathroom or kitchen exhaust fans, even if they are rated for continuous operation.

1. No Continuous Ventilation

Any building in Alaska that relies solely on natural ventilation to supply fresh air and exhaust air would be in this category, because it is not feasible to have windows open during all times of the year. Standard bathroom and kitchen fans that operate without automated mechanical control are not considered whole building ventilation. If they supply the only ventilation, then the building has "no continuous ventilation."

2. Continuous Ventilation without Heat Recovery:

The baseline requirement for "continuous ventilation without heat recovery" is:

- ≤ 1-sone fan (ASHRAE 62.2-2007, Section 7.2, "Sound rating for fans"),
- whole-building ventilation system capable of providing the ventilation rates in ASHRAE 62.2-2004, Table 4.1a as amended in the BEES Amendments (http://www.ahfc.state.ak.us/iceimages/reference/bees_amendments.pdf).
- rated and installed for controlled continuous operation per ASHRAE 62.2-2004, Section 5.3, "Continuous Mechanical Exhaust."

The above definition of "Continuous ventilation without heat recovery" includes systems installed to operate without occupant intervention, such as:

- Humidistat
- Pin timer
- Cycler time
- Other controlled exhaust that does not rely on the occupant (e.g., does not include dial timers)

D. Types of Ventilation Systems

Double-Duty Spot/Whole Building: A common whole-building ventilation strategy is to combine a source-specific and whole-building ventilation fan. A centrally located bathroom or laundry fan is upgraded to provide the whole-building rate at a continuous low flow.

Separate Spot/Whole Building: A dedicated whole-building fan is installed in addition to the spot ventilation fans.

Central Ducted Whole Building: A centrally ducted system typically installed in the attic and ducted to individual areas of the building.

Integrated Ventilation System: Fresh outside air is ducted into a forced air heating system and a whole building fan exhausts air. In a properly working system, the central whole building control brings on the whole building exhaust fan, opens the mechanical damper on the fresh air intake duct and activates the furnace fan. The furnace fan circulates fresh air throughout the building.

Balanced Non-heat Recovery System: Central ventilation systems that use two duct systems and two fans. One supplies fresh air, the other exhausts stale air.

Heat Recovery Ventilation

Air-to-air heat exchanger: Central heat recovery ventilation systems that use two duct systems and two fans. One supplies fresh air, the other exhausts stale air. Air flows are routed through a heat exchanger core that transfers heat from the outgoing stale air stream to incoming fresh air.

Exhaust Air Heat Pump: An exhaust ventilation system that uses a small heat pump to recover heat from outgoing stale air. The heat is pumped into the building's hot water system. Most EAHP's heat water only. Some offer an option to provide supplemental space heating and cooling. The EAHP only provides exhaust and control elements of a ventilation system. Fresh air supply is provided through passive air inlets.

.15 MISCELLANEOUS ITEMS

A. Other Appliances

Note the type of fuel used for the range, oven, and clothes dryer installed in the building.

B. Utility

Identify the electric, gas, and/or fuel utility that serve the building. If possible, review utility bills from the prior year to identify consumption rates and/or patterns.

Appliance Usage:

AHFC does not currently require specific data with respect to appliance usage, but AkWarm© can use this information to model energy costs that are printed on the energy rating certificate. Currently, the energy cost data are not incorporated into the building's energy rating (point/star value).

Mobile Home and Multi-Unit Building Considerations

.16 MOBILE HOMES

A. Assessment

Mobile home floors may appear to have multiple thermal, moisture and air boundaries. There may be insulation in the floor, with visqueen above the insulation, a rodent barrier, and insulated skirting below the floor, and a vapor barrier on the ground or/and skirting. The thermal/air/moisture boundary will determine how to assess the existing structure and recommend improvements. Evaluate the crawl space or open area under a mobile home and ask:

- Is the area below the mobile home floor skirted or open to the elements? If it's open, the area should be skirted.
- What effect does freezing have on the footings? If freeze-thaw cycles may affect the footings, then insulate the skirting, not the floor. If the floor is already insulated, as most are, this is one place where irregular thermal boundaries may still improve comfort, and reduce energy use. Insulated skirting can help in this situation.
- What are the moisture conditions on the ground under the mobile home? Is it dry? If it's wet, can vapor barrier be installed on the ground?
- Are water lines or air ducts present? If so, either the duct work or the skirting will need to be insulated. Additional insulation on the ducts and water pipes will probably be needed.
- If no duct work (not common) or footings are present, it may be more effective to insulate the floor than the skirting.
- Regional considerations: is permafrost present? If so, do not make improvements that will destabilize the soil thermal regime. Insulate the floor and around any duct work, to the greatest extent possible.
- If insulation is present in both the floor and the skirting, where is the thermal boundary? Refer to discussion in SECTION 6001 .

As with all energy ratings, evaluate the mobile home from a building science perspective, and recommend improvements that will best improve the mobile home. If the thermal envelope is not clearly defined (as in, a mobile home with and insulated floor **and** insulated skirting), the Energy Rater must use best judgment to establish the boundary where it would best reduce moisture, maintain proper ventilation, reduce heat losses, and protect systems.

B. Component Details

1. Floors

The floor assembly of a mobile home is more complex than that of a conventional building. The floor has 2 x 6 floor joists that are spaced at 16, 18, or 24 inches on center and are supported by the metal chassis. The floor joists run lengthwise along the long axis of the mobile home or crosswise across the width of the mobile home. Floors with crosswise joists have underbellies that are dropped 4 to 10 inches below the bottom of the floor joists because the main heating duct is located below the joists. On floor with lengthwise joists, the duct is between the floor joists or attached in a large blanket to the bottom of the floor joists. Since the 1976 HUD Code, the heating duct must either be insulated or be included in the heated envelope by having the insulating blanket of the floor installed underneath it.

2. Walls

A majority of mobile homes have 2 x 4 studs, with the next most common being 2x3. The newer mobile homes actually built for Alaskan climates will have 2 x 6 studs, while the oldest, pre-1976 mobile homes have 2x2 studs. Many mobile home walls have belt rails of 3/4" thick lumber that is applied horizontally across the studs to provide a nailing strip for the siding. The belt rails are either fastened on top of the stud or fastened into rectangular slots cut in the studs. The studs are usually not doubled up around windows and doors as they are in site-built buildings.

3. Roofs

Many mobile home roofs are constructed with a shallow roof cavity that has 1 to 4 inches of insulation installed between the trusses on top of the ceiling. Other roofs have insulation installed over the top of the trusses. Some have insulation at the ceiling and at the roof. Mobile home roofs are built with either bowstring, standard pitched, or half trusses.

4. Doors

Most doors in mobile homes are uninsulated. Before 1980 they were made of wood or aluminum sheeting on a wood frame and uninsulated. New replacement ones typically have fiber-glass insulation, although foam-filled steel doors are available.

5. Windows

The prime windows on most mobile homes are metal-frame, single-pane, fastened to the outside wall. Storm windows are either removable panels or self-storing, usually installed on the interior. Most windows are opening jalousie and awning types, or sliders.

6. Heating Systems

Sealed combustion furnaces have been standard equipment for mobile homes since the early 1970s. Today, combustion furnaces, space heaters and electric furnaces must be specifically designed and rated for use in mobile homes.

.17 MULTI-FAMILY UNITS & CONDOS

Any unit in which one dwelling unit shares a common wall or floor/ceiling with another unit is considered a multi-family building. Multi-family buildings can be evaluated either by considering the building as a whole, or on a unit-by-unit basis. The type of AHFC financial assistance involved, if applicable, plays an important role in how to perform an energy rating for multi-family units.

From a building science perspective, it is almost always preferable to rate the whole building, rather than a single unit. However, a single unit sometimes has to be rated apart from the rest of the building.

Multi-family units can be very confusing, due to common ownership of some of the building components. Typically, the condominium owner "owns," or is responsible for, the elements inside the living space, including the plumbing and electrical between the framing members and walls. However, many variations exist, depending upon the HOA rules, regulations, bylaws, and/or articles of incorporation.

Most multi-family units must comply with HOA rules, regulations, bylaws, and/or articles of incorporation. The HOA is usually responsible for improvements to large, shared systems, such as the roof area, crawl spaces, common entries, building-wide heating and plumbing systems, etc. The individual unit owners are assessed fees to pay their portion of these improvements.

When evaluating a multi-family unit, consider:

- First and foremost, the thermal envelope and air tightness boundary of the area being rated, as applies for an individual unit or whole building energy rating,
- What areas and systems are shared, and how they apply to the building science of the unit or whole building, whichever is applicable,
- Where is the unit located? For example, a 1st floor unit over a common crawl space may have both below-grade walls and floor entries, in AkWarm©.
- Different orientations and locations of each unit type within the building shall be considered separately. A one-bedroom unit on the ground floor of a three story

building is different from the same plan on a middle floor or the top floor, even if all units have the same orientation and are otherwise identical.

- Which improvements the customer can make,
- What, if any, AHFC financial assistance applies, and,
- Who owns the unit? Does one title apply to a multi-family unit, or does each unit have a separate title?

This is vital information, and must be recorded in the "Notes to AHFC."

1. Multi-family Units – Rated as a Whole

The simplest approach to analyzing the energy efficiency of a multi-family building is to treat the building as a whole. In practice, this process is similar to analyzing a single family residence. Multi-family units shall be rated as a whole if:

- From a building science perspective, if the unit shares a common attic, foundation, and/or crawl space, it shall be evaluated as a single unit, since it's not possible to accurately isolate one unit from the other, especially for blower door tests. However, financial aspects, access to other units, or other issues may require the Energy Rater to evaluate the unit individually (see below).
- Units that share a common entry-way, or hallway, and/or systems, such as heating or plumbing systems, shall be rated as a whole but may be rated individually. However, the common space (hallway, entry) shall not be included in the rating.

A whole-building energy rating for a multi-family structure results in a single energy rating for the entire building. If the energy rating will be provided to more than one customer, be sure to record that the rating was for the whole building in the "Notes to Homeowner" and "Notes to AHFC."

Always record the basis for decisions regarding the energy rating, such as whether or not to perform a whole building or individual energy rating, limits of the thermal envelope, whether or not to include the entry-way, etc.

2. Multi-family Units – Rated Individually

The other approach is to evaluate each dwelling unit separately. In this approach, AkWarm© compensates for walls and floors/ceilings which separate dwelling units, as they are assumed to have no heat loss or heat gain associated with them. This approach can be used when the unit is self-sufficient. Proceed with the rating as for a single-family building and, in AkWarm©, select "multi-family - rate one unit," and be sure to accurately identify common walls in AkWarm©. AkWarm© assigns an R-value of 500 to common walls, since no heat losses are expected. Rate the unit individually if:

- **The unit <u>does not share</u>** a common entry-way or hallway, or common plumbing/heating systems, with the other units in the building. The unit may share common attic and/or crawl space areas.

- **The unit <u>does share</u> applicable common space** with the other units in the building, **and**

  - the HOA is making energy-efficiency improvements to the common spaces **without** AHFC energy efficiency assistance, **and**.

  - more than one unit is participating in AHFC energy efficiency assistance, **and**

  - the common space is physically connected to the unit and would normally be included in an energy rating for a self-sufficient unit. Common spaces that apply include heating systems, attics, crawl spaces, roof area, and perimeter foundations. Common spaces that do not apply include common entries and common hallways.

  - This applies to reimburse customers for portions of improvements made by the HOA and assessed to the unit owner.

- **The unit shares common space**, such as an entry-way, crawl space or, or hallway, and/or systems, such as plumbing and heating systems, **and**

  - the unit owner has the ability to improve the common space, e.g., to insulate the crawl space or attic of that particular unit. NOTE: the HOA may require the unit to have the improvements approved by the HOA.

  - The Energy Rater is only responsible for identifying improvements that can be made. Compliance with HOA requirements is the responsibility of the unit owner.

  - Include heating/plumbing systems in the Improvement Options Report (IOR) only if the systems are independent and support only the unit being rated. Do not include shared systems in the IOR – only the HOA can improve shared heating systems.

If the unit is part of a HOA, be sure to include that the unit was rated as part of an HOA, and include the name of the HOA.

NOTE: When rating a condo that is not “full height” - for example, a single story unit in a four story building–, or any combination where the height of the unit is not the same as the height of the building - and the Energy Rater is not able to rate the whole building, select the location in the building. A top floor unit will not have a floor entry. A middle unit will not have a floor or ceiling entry. A bottom unit will not have a ceiling entry.

.18 NON-CONFORMING CONTRUCTION TYPES

A. A-Frames

An exterior wall description defined by building codes as “an exterior partition that has a slope greater than or equal to 60 degrees from horizontal”. An A-frame structure has no easily defined separation between wall and ceiling. For modeling purposes, the vertical side walls areas treated as above-grade walls and the sloped side walls as vaulted ceiling components.

B. Dome Structures

Domes that have distinct wall and ceiling areas or materials shall be treated as any other dwelling. For domes that have no distinct separation of wall and ceiling, consider the ceiling area to be that area of the exterior structure that begins 8 feet above the highest floor level.

C. Earth-bermed Structures

Consider the bermed walls of earth-bermed structures as below grade walls and the floor as a below grade floor. Any wall that is not earth-bermed shall be considered as an above grade wall. If the ceiling of the earth-bermed structure is also below-grade, consider it as a second below-grade floor.

PART VII ENERGY RATING DOCUMENTATION

SECTION 7000 MINIMUM DOCUMENTATION THE ENERGY RATER MUST COMPLETE

.01 AKWARM DATA INPUTS

The Energy Rater shall input all component and system measurements, identification, or other information as required to generate the energy rating, into AkWarm©. If AkWarm© does not allow the entry, or if the entry otherwise deviates from the minimum technical standards, document the deviation in the "Notes to AHFC."

.02 ENERGY RATING REPORT

The energy rating report shall be completed and delivered to the customer within five (5) business days of the date the on-site assessment is completed.

.03 IMPROVEMENT OPTIONS REPORT – AS IS ENERGY RATINGS

- The initial IOR shall be completed and delivered to the customer the same day the official energy rating certificate is issued to the customer.
- Shall include as many retrofit measures as possible, specific to the home (e.g., where to air seal), showing whether or not they are cost effective.
- Shall be clearly explained to the customer. The Energy Rater will edit and customize each measure for each home, as needed, and provide the AkWarm© notes for each measure to the Customer.

.04 INVOICE FOR ENERGY RATING

The Energy Rater must give the customer an invoice for the energy rating the same day that the on-site assessment is completed, or the energy rating is completed. The invoice must include:

- Energy Rater name, address, telephone #
- Customer name,
- The address of property rated,
- The date the energy rating was performed,
- The type of energy rating performed (BEES, As-is Post),
- The amount charged to the customer.
- Energy Raters must provide the customer with a separate invoice for each energy rating performed (BEES, As-Is, Post).

.05 NOTES TO AHFC

The Energy Rater shall document all information pertinent to the home, the home's components, and generating the rating in AkWarm© and the "Notes to AHFC." If the information is not pertinent to generating the energy rating (e.g., combustion safety test results, etc.), the information shall be retained in the Energy Rater records, in accordance with the Energy Rater Authorization agreement.

.06 ITEMS TO BE UPLOADED TO ALASKA RETROFIT INFORMATION SYSTEM

The Energy Rater shall upload the AkWarm© electronic file into the Alaska Retrofit Information System (ARIS) within 7 days of performing the rating. The Alaska Retrofit Information System (ARIS) is located at http://www.akrebate.com/Rater/Login.aspx .

SECTION 7001 MODIFYING AN ENERGY RATING

Sometimes an energy rating must be modified after it has been uploaded to ARIS. Changes to energy rating data shall be uploaded as soon as possible after the need for the change is discovered. To modify an energy rating, the energy rater shall:

- Modify the data as needed,
- Document the following in the "notes to AHFC:"
    - Provide a detailed description of the basis for the change, and,
    - End the note with the energy rater name, rater #, and the date the file was modified, and,
- Upload the modified rating to ARIS.

If a customer wishes to discontinue an energy rating (for example, to perform additional improvements), the data from the incomplete rating should not be uploaded. If the data are uploaded, the final rating data uploaded will supersede the prior data.

Multiple ratings may exist for a single property. For example, a homeowner may have participated in more than one AHFC program. The most recent energy rating data will supersede prior ratings for the property. Historical data for prior ratings are archived.

PART VIII INFORMATION TO BE SUBMITTED TO AHFC

SECTION 8000 THE ENERGY RATER MUST INFORM AHFC

.01 THE STATUS CHANGE FORM & CONFLICT OF INTEREST FORM

The Energy Rater shall use the Status Change Form or the Conflict of Interest Form as applicable, to timely report to AHFC:

- A conflict of interest as described under SECTION 4002 (the Conflict of Interest Form shall be submitted to AHFC within 5 calendar days of completion of the on-site assessment).
- A change in Energy Rater's criminal history (the Status Change form shall be submitted to AHFC within 10 calendar days of the change).
- A change in Energy Rater's e-mail address (the Status Change form shall be submitted to AHFC within 10 calendar days of the change).
- A change in Energy Rater's name or business name (the Status Change form shall be submitted to AHFC within 30 calendar days of the change).
- A change in Energy Rater's mailing address or business address (the Status Change form shall be submitted to AHFC within 30 calendar days of the change).
- A change in the Energy Rater's business, including but not limited to: sale of the business, closing of the business, restructuring of the business (the Status Change form shall be submitted to AHFC within 30 calendar days of the change).
- A change in the Energy Rater's public listing status, including, but not limited to: BEES Compliance Certification list, Energy Rater list, etc. (the Status Change form and applicable attachments shall be submitted to AHFC within 30 calendar days of the change).
- Any change in the Energy Rater's activities or business the Energy Rater believes should be reported to AHFC (the Status Change form and applicable attachments shall be submitted to AHFC as soon as reasonably possible).

The Status Change Form is available at:
http://www.ahfc.state.ak.us/iceimages/manuals/energy_rater_status_change_form.doc

The Conflict of Interest Form is available at:

http://www.ahfc.state.ak.us/iceimages/manuals/conflict_int.doc

.02 RESPONSE TO AHFC INQUIRIES

The Energy Rater must respond to all written requests from AHFC regarding any of the activities to be performed by the Energy Rater as described in this manual within 10 calendar days of receipt of the request.

.03 FAILURE TO REPORT OR RESPOND

Failure of the Energy Rater to timely provide information to AHFC as described in Sections SECTION 8000 .01and SECTION 8000 .02 above, may contribute to a decision to suspend or terminate the Energy Rater's AHFC authorization as provided under 15 AAC 155.560.

PART IX MANUAL LOCATION

SECTION 9000 ELECTRONIC FILE LOCATION

The electronic version of the Alaska Energy Rater Manual is located at http://www.ahfc.state.ak.us/manuals/energy_rater.cfm . The AHFC file location is \\ahfc\DFS\r2d2\Energy_Raters\Manuals\Alaska Energy Rater Manual\Rev 1\AlaskaEnergyRaterManual_Rev1_FINAL.docx

PART X REVISION HISTORY

SECTION 10000 REVISION HISTORY LOCATION

Revisions to the Alaska Energy Rater Manual are posted on the web site at http://www.ahfc.state.ak.us/manuals/energy_rater.cfm.