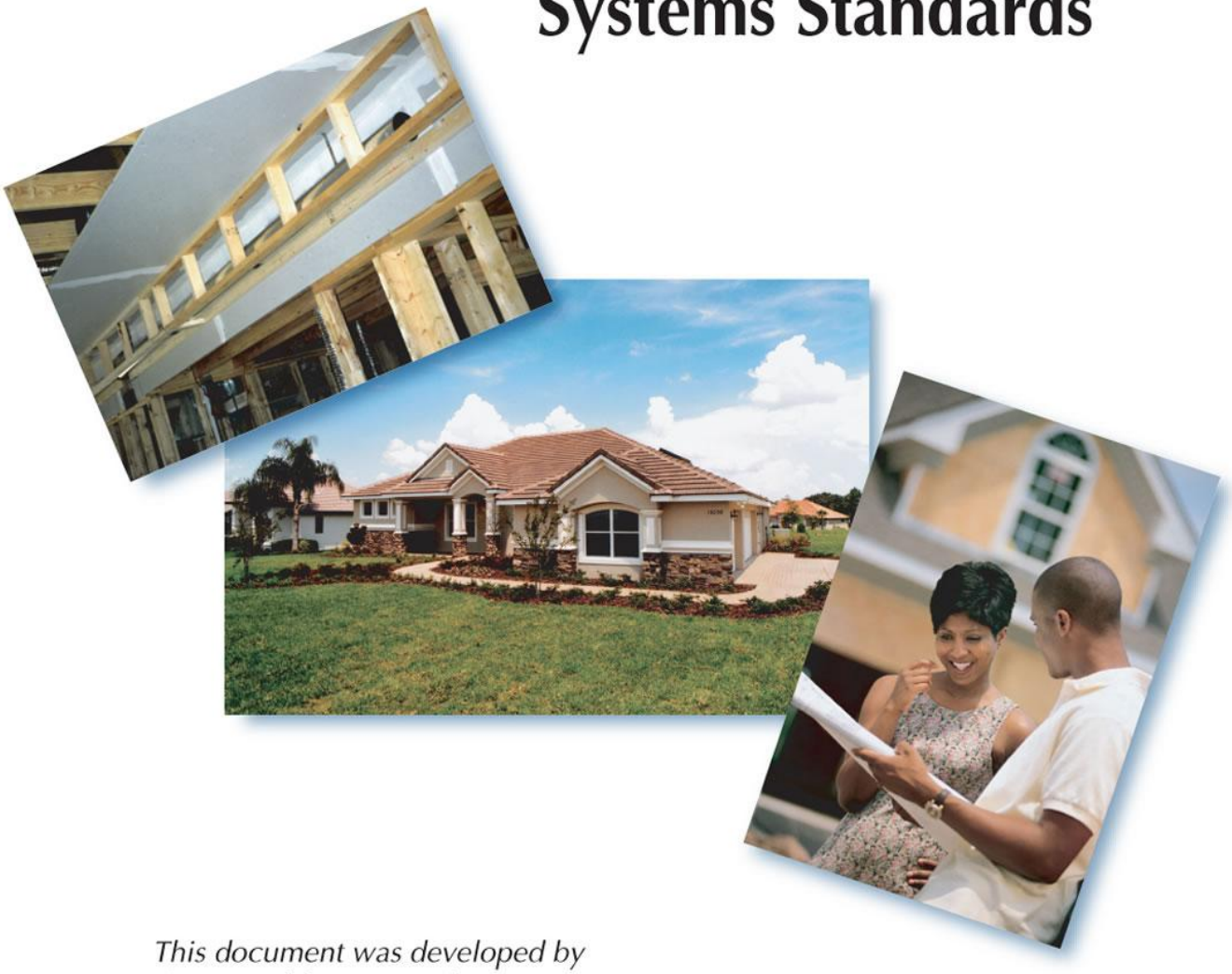
RESNET
Residential Energy Services Network

2006 Mortgage Industry National Home Energy Rating Systems Standards



This document was developed by RESNET and the National Association of State Energy Officials.

Setting the STANDARD for QUALITY

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2006 Mortgage Industry National Home Energy Rating Systems Standards

These consensus Standards were developed by the Residential Energy Services Network (RESNET) as amended in accordance with Chapter 5 of these Standards and adopted by the RESNET Board of Directors on March 2, 2012

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RESNET Standards

100 RESNET NATIONAL STANDARD FOR HOME ENERGY RATINGS

101 GENERAL PROVISIONS

101.1 Purpose

The purpose of these standards is to ensure that accurate and consistent home energy ratings are performed by accredited home energy rating Providers through their Raters nationwide; to increase the credibility of the rating Providers with the mortgage finance industry, federal government, state governments, local governments, utility companies, and the private sector; and to promote voluntary participation in an objective, cost-effective, sustainable home energy rating process.

Leaders in both the public and private sectors have identified the need for an accreditation process for home energy rating Providers. This accreditation process may be used by these stakeholders to accept home energy ratings and to assure accurate, independent information upon which the mortgage industry may accept home energy ratings for the purposes of issuing energy efficient mortgage, or similar, products; a state may recognize the home energy ratings as a compliance method for state building energy codes; as qualification for public and private sector energy programs designed to reach specific energy saving goals; and as a way to provide housing markets the ability to differentiate residences based on their energy efficiency. These home energy rating Standards have been developed to satisfy the above purposes.

101.1.1 Relationship to State Law. These Standards specifically recognize the authority of states that have laws requiring certification or licensing of home energy rating Providers. To the extent that state laws differ from these Standards, state laws shall govern.

101.2 Scope

This document sets out the procedures for the accreditation of home energy rating Providers and technical standards by which home energy ratings shall be conducted so their results will be acceptable to all public and private sector industries that may require an objective, cost-effective, sustainable home energy rating process.

102 ACCREDITATION CRITERIA

102.1 Minimum Standards for Home Energy Rating Provider Accreditation

An accredited Home Energy Rating Provider is responsible for insuring that all of the ratings issued by the Provider comply with all of the criteria by which the Provider was accredited.

Home Energy Rating Providers shall be accredited in accordance with the Accreditation Process specified in Chapter 9 of these Standards. A Home Energy Rating Provider must specifically meet the following minimum standards for Accreditation.

102.1.1 A written Quality Assurance Process that conforms to Chapter 9 of these Standards and any specific QA requirements for other Provider categories that may apply to a particular organization.

102.1.1.1 Have a QA Designee that oversees the Provider's compliance with Chapter 9 of these Standards and any specific QA requirements for other Provider categories that may apply to a particular organization.

102.1.2 Rater Certification Standards. Certification and recertification of energy raters shall be made by Home Energy Rating Providers, which shall include the following provisions:

102.1.2.1 A Home Energy Rating Provider shall provide documentation that their Raters meet the Rater certification provisions contained in Chapter Two of these standards.

102.1.2.2 Performance evaluation of ability to perform accurate ratings.

102.1.2.2.1 In order for a Rater Candidate to be certified as a Home Energy Rater, they must satisfactorily complete two (2) supervised ratings as part of Rater training and a minimum of three (3) probationary ratings within twelve (12) months of successfully passing the National Core Rater Test. A maximum of one (1) of the three probationary ratings may be completed as a projected rating from plans, with the remaining two (2) being confirmed ratings.

102.1.2.2.2 For certified Home Energy Raters who are new to a Rating Provider, as part of Rating Provider's due diligence process, it is a recommended best practice that Providers require a minimum of three (3) probationary ratings with the new Rater to confirm their skills as a Rater.

102.1.2.3 Professional Development for Raters. Raters shall complete one of the below three options:

102.1.2.3.1 Complete 18 hours of professional development every three years. The 18 hours shall include completion of 18 hours of refresher course(s) offered by a RESNET Accredited Training Provider.

102.1.2.3.1.1 Course(s) shall be approved by the RESNET Training and Education Committee annually;

102.1.2.3.1.2 The Training and Education Committee shall identify areas of Importance;

102.1.2.3.1.3 Instructor shall be required to pass an exam.

OR

102.1.2.3.2 Documentation of 18 hours of attendance at a RESNET Conference in three (3) years would fulfill this requirement.

OR

102.1.2.3.3 Pass the Rater Test every three years.

102.1.2.4 Rater Testing. All certified Raters must take the national home energy rater test administered by RESNET by January 1, 2008.

102.1.2.5 Recertification of Raters no less than every three years.

102.1.2.6 Rater Agreements. As a condition of Rater certification, each Provider shall ensure that a certified Rater who has met the requirements of Chapter 2, Rater Training Requirements, has entered into a written agreement with the Provider to provide home energy rating, field verification, and diagnostic services in compliance with these standards. A copy of the Rater written agreement shall be provided to RESNET with the Provider's accreditation application and within 60 days of making changes to the agreement. The written agreement shall at a minimum require Raters to:

102.1.2.6.1 Provide home energy rating and field verification services in compliance with these standards;

102.1.2.6.2 Provide accurate and fair ratings, field verification and diagnostic testing;

102.1.2.6.3 Comply with the RESNET Code of Ethics. The "RESNET Code of Ethics" is posted on the RESNET website. The Code of Ethics shall be attached to the written agreement. An unexecuted copy of the written agreement shall be provided to RESNET with a Home Energy Rating Provider accreditation application and within 60 days of making changes to the agreement.

102.1.3 A Home Energy Rating Provider shall provide documentation with its accreditation application that the energy rating software used to produce energy ratings is properly licensed.

102.1.4 Minimum Standards for Home Energy Rating Provider's Operation Policies and Procedures must be written and provide for the following:

102.1.4.1 Ratings from plans. If the home energy rating Provider's program provides for ratings by from plans, the rating be labeled as from plans. Such ratings may be used to demonstrate energy code compliance or programmatic qualification but must be confirmed through a field inspection upon completion of construction.

102.1.4.2 Field inspection of all homes.

102.1.4.3 Blower Door Test completed on all homes claiming credit for reduced air infiltration.

102.1.4.4 Duct testing completed on all homes claiming credit for reduced air distribution system leakage.

102.1.4.5 When applicable, improvement analysis given to home owner.

102.1.4.5.1 Recommended improvements with the cost basis supplied for each recommendation by the home energy rating software program, home energy rating Provider or the Rater receiving quotes.

102.1.4.5.2 Estimated energy and cost savings of improvements based upon assumptions contained in the home energy rating Provider program.

102.1.4.6 Written conflict of interest provisions that prohibits undisclosed conflicts of interest but allows waiver with advanced disclosure. The" Home Energy Rating Standard Disclosure" form adopted by the RESNET Board of Directors shall be completed for each home that receives a home energy rating and shall be provided to the rating client and made available to the home owner/buyer. Each form shall include, at a minimum, the name of the community/subdivision, city, and state where the home is located. Each form shall accurately reflect the proper disclosure for the home that it is rated (i.e. it should, reflect the Rater's involvement with the home at the time the final rating is issued. For the purpose of completing this disclosure, "Rater's employer" includes any affiliate entities. Recognizing that a number of different relationships may occur between the Rater or the Rater's employer and the rating client and/or homeowner and/or the marketplace in general, the rating Provider shall ensure that all disclosures are adequately addressed by the Provider's QUALITY assurance plan, in accordance with the relevant QUALITY assurance provisions of the standards.

102.1.4.7 Written Rater discipline procedures that includes progressive discipline involving Probation - Suspension – Termination.

102.1.4.7.2 Rating/Tax Credit Verification Recordkeeping. Providers and/or their certified Raters shall maintain records for each rating/tax credit verification.

102.1.4.7.2.1 The QUALITY assurance record for each home shall contain at a minimum the electronic copy of the building file.

102.1.4.7.2.2 The record for each rating/tax credit verification shall be maintained for a minimum of three years.

102.1.4.8 Rater Registry. The Provider shall maintain a registry of all of its certified Raters. The Provider will also keep on file the names and contact information for all, including company name, mailing address, voice phone number, fax number, and email

address. Upon request, the Provider shall provide to RESNET its registry of certified Raters.

102.1.4.9 Complaint Response System. Each Provider shall have a system for receiving complaints. The Provider shall respond to and resolve complaints related to ratings and field verification and diagnostic testing services and reports. Providers shall ensure that Raters inform purchasers and recipients of ratings and field verifications about the complaint system. Each Provider shall retain records of complaints received and responses to complaints for a minimum of three years after the date of the complaint.

102.1.4.10 All Home Energy Rating Providers shall maintain an electronic database of information for each home rated or verified for the tax credit. The minimum content of the database is:

102.1.4.10.1 A unique file reference with ID number;

102.1.4.10.2 Date of on-site inspection;

102.1.4.10.3 Raters name;

102.1.4.10.4 Tool name and version;

102.1.4.10.5 Identification of climate data used for the rating;

102.1.4.10.6 Type of rating, either projected or confirmed;

102.1.4.10.7 Use of rating:

102.1.4.10.7.1 Time of sale rating;

102.1.4.10.7.2 Pre-home improvement rating;

102.1.4.10.7.3 Post home improvement rating; or

102.1.4.10.7.4 Information only rating;

102.1.4.10.8 Address of Rated Home;

102.1.4.10.9 Home type;

102.1.4.10.10 Floor area of conditioned space;

102.1.4.10.11 Fuel types used by building heating, cooling and water heating systems;

102.1.4.10.12 Minimum rated feature energy efficiency data used to determine the rating;

102.1.4.10.13 In the four categories of heating, cooling, water heating and all other uses, the:

102.1.4.10.13.1 Estimated annual purchased energy consumption in total;

102.1.4.10.13.2 Estimated annual purchased energy consumption by fuel;

102.1.4.10.13.3 Estimated annual energy costs in total; and

102.1.4.10.13.4 Estimated annual energy cost by fuel.

102.1.4.10.14 Estimated total annual energy cost for all uses;

102.1.4.10.15 Rating score of the Rated Home on 0-100 points scale and 1-5+ stars category;

102.1.4.10.16 To the extent allowed by state statute, all HERS Providers shall for 10% or for 500 of the homes rated annually, whichever is less, maintain a database of the following:

102.1.4.10.16.1 Homeowners authorization for the release of consumption information by utility companies;

102.1.4.10.16.2 Climate data site used for energy estimation;

102.1.4.10.16.3 Any energy efficiency improvements made to the home and date of completion.

102.1.4.11 Site data collection manual. All HERS Providers shall provide Raters with a manual containing procedures for the on-site collection of data that are at a minimum shall include the on-site inspection procedures for minimum rated features for new and existing homes provided in appendix A.

103 RATING SOFTWARE

103.1 For the purposes of conducting Home Energy Ratings, as defined in these Standards, Providers shall be required to use the most current version of one of the RESNET approved rating software programs contained in the "National Registry of Accredited Rating Software Programs" posted on the RESNET website.

103.2 Rating Software Changes. Should changes that affect the calculated results of the home energy rating occur in the engineering algorithms of a RESNET approved home energy rating software program, Providers shall be required to do the following:

103.2.1 Transition period. On announcement of a new software version release, Providers have a maximum of 60 days to begin all new ratings with the new version.

103.2.2 This requirement only applies to changes mandated by the technical standard or otherwise affecting the calculations of the rating score or projected energy savings.

103.2.3 Persistence. Once a projected rating has been made on a property, the version of the rating software that was used initially may be used for the final rating on that property. Providers, at their option, may update to the latest software version for in-process ratings.

104 RATINGS PROVIDED FOR THIRD-PARTY ENERGY EFFICIENCY PROGRAMS

104.1 See Appendix B for definition of Third Party Energy Efficiency Program (EEP)

104.2 When working with EEP's, Home Energy Raters may be required to perform tests, inspections, verifications and reporting that require skills related to energy efficiency not specific to Home Energy Ratings as defined in these Standards and/or are required to become a Certified Home Energy Rater. However, it is the responsibility of Certified Home Energy Raters to perform all of the stipulated tests, inspections, verifications and reporting related to energy efficiency required by the EEP when agreeing to work with their program, including proper completion of any and all checklists, certificates, or other documentation. Where a Rater does not possess the proper skill or knowledge of a particular test, inspection, verification or reporting requirement, they shall be responsible for obtaining sufficient training from the EEP, or trainer approved by the EEP, to properly fulfill the requirement. An exception may be made in cases where portions of an EEP's testing, inspection, verification or reporting process are completed by another company or individual who holds the required training or certifications.

104.3 See Section 906 for QA Requirements for EEP's

Chapter Two
RESNET Standards

200 RESNET NATIONAL STANDARD FOR RATER TRAINING AND CERTIFICATION

201 GENERAL PROVISIONS

201.1 Purpose

The provisions of this document are intended to establish national Rater training and certification standards which an accredited home energy rating Provider shall follow in certifying home energy Raters. This enhances the goal of producing nationally uniform energy efficiency ratings for residential buildings.

201.1.1 Relationship to other Standards. These standards are a companion document to the "National Accreditation Procedures for Home Energy Rating Systems" as promulgated and maintained by the National Association of State Energy Officials (NASEO) and the Residential Energy Services Network (RESNET) and the "National Home Energy Rating Technical Guidelines" as promulgated and maintained by NASEO. Both guidelines are recognized by the mortgage industry.

201.1.2 Relationship to State Law. These standards specifically recognize the authority of each state that has a state law which requires certification or licensing of home energy rating Providers. To the extent that such state laws differ from these standards, state law shall govern.

201.2 Scope

These standards apply to the training and certification of energy Raters who will be accepted by nationally accredited home energy rating Providers. An energy rating identifies the energy features and estimates the energy performance of a home and does not identify structural or health and safety problems of a home.

202 DEFINITIONS AND ACRONYMS

See Appendix B.

203 TRAINING AND EDUCATION COMMITTEE

203.1 RESNET Training and Education Committee

203.1.1 Committee membership. The Training and Education Committee shall be chaired by a member of the RESNET Board of Directors. The Chair shall be approved by the RESNET Board. Nominations of Committee members shall be made by the Chair to the RESNET Board for approval.

203.1.2 Responsibilities. The RESNET Training and Education Committee shall review and approve the following:

203.1.2..1 Core competency examination questions;

203.1.2..2 Time limits for the core examination;

203.1.2..3 Passing scores for the core examination; and

203.1.2..4 Annual accreditation fee.

204 ACCREDITED TRAINING PROVIDERS

204.1 Requirements for Accredited Home Energy Training Providers

204.1.1 Duties and Responsibilities. In order to maintain their accreditation in good standing, all Training Providers shall fully discharge the following duties and responsibilities. Failure to properly discharge all of these duties and responsibilities shall constitute grounds for disciplinary action in accordance with Section 212 of this Standard.

204.1.1.1 Hold the national core competency questions of the national test administered by RESNET in the strictest confidence.

204.1.1.2 Maintain a record, for a period of three years, of all training materials and trainee data, including:

204.1.1.2.1 Historical records of all training schedules and curricula,

204.1.1.2.2 Historical records of all training attendance records,

204.1.1.2.3 Historical records of all examinations and individual examination results,

204.1.1.2.4 Historical records of all certifications issued to any individuals,

204.1.1.2.5 Copies of the most up-to-date instructor presentation materials, training manuals, user manuals, course handouts and any other training materials use for training purposes,

204.1.1.2.6 Copies of all current policies, standards, guidelines and procedures in use by the Training Provider.

204.1.1.3 Maintain acceptable accounting practices, suitable to satisfy the requirements of independent audit procedures.

204.1.1.4 Maintain up-to-date training materials and courseware and provide for adequate training facilities.

204.1.1.5 Maintain certified trainers, who have been certified by RESNET by passing the National Rater Trainer Competency Test, and who satisfy the minimum trainer competencies in accordance with Section 206.1 of this chapter.

204.1.2 Privileges and rights. All accredited Training Providers in good standing shall have certain privileges and rights, as follows:

204.1.2.1 The privilege to display the accreditation seal of the National Accreditation Body on any publications, displays, presentations or marketing materials published, authorized for publication or otherwise issued by the Training Provider.

204.1.2.2 The privilege to make and use any trademarked, copyrighted or otherwise restricted materials other than the national core test developed by RESNET for marketing Rater Training Courses or Training Providers or for recruiting Rater trainees, instructors or trainers.

204.1.2.3 Copies of all current policies, standards, guidelines and procedures in use by the Training Provider.

204.1.2.4 The right to present evidence, arguments and a vigorous defense in any action brought under these standards by any party against a Training Provider.

205 HOME ENERGY RATINGS

205.1 Home Energy Rating Knowledge Base and Skills Set

205.1.1 The following comprise a list of knowledge base and skills are necessary for home energy ratings. Training Providers shall use a certified trainer who has successfully passed the RESNET National Rater Training Competency Test and that their training curricula are sufficiently comprehensive to effectively teach these materials to prospective Home Energy Raters (See Section 6.1). Prospective Home Energy Raters, to become certified, shall demonstrate proficiency through passing the RESNET national core test and other training Provider written examinations and observations.

205.1.1.1 Building Energy Performance.

205.1.1.1.1 Basic energy principles.

205.1.1.1.1.1 Energy terminology, units and conversions.

205.1.1.1.1.2 Heat transfer principles

205.1.1.1.1.2.1 Conduction

205.1.1.1.1.2.1.1 R-values & U-values

205.1.1.1.1.2.1.2 UA concepts

205.1.1.1.1.2.1.3 Parallel paths

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205.1.2.1 Identify basic home construction types; ramifications of these for energy usage.

205.1.2.2 Produce a scaled and dimensioned sketch of a home.

205.1.2.3 Identification of insulation defects and ability to account for them in energy analysis tool inputs.

205.1.2.4 Identify and document the features of the rated home in accordance with the requirements of Section B.5. and Appendix A of the National Home Energy Rating Technical Guidelines.

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205.1.2.7.5 Dealing with clients

205.1.2.7.5.1 Understanding the business aspects of being a energy Rater

205.1.2.7.5.2 Cultivating builder, banker and real estate partners.

205.1.2.7.5.3 Knowing who the customer is.

205.1.2.7.5.4 Providing excellent service.

205.1.2.7.6 Ethics and disclosure

205.2 Rating Field Inspector Knowledge and Skills Set

205.2.1 The following comprise a list of knowledge base and skills necessary to be certified as a Rating Field Inspector:

205.2.1.1 Completion of Rating Field Inspector training by a RESNET accredited Rater Training Provider.

205.2.1.2 A rating Field Inspector candidate has the option of challenging the classroom training by passing the RESNET National Rating Field Inspector Test.

205.2.1.3 A Rating Field Inspector shall pass the National Field Inspector Test administered by RESNET. A candidate who passes the test must still comply with the training field testing requirement.

205.2.1.4 Upon passing the RESNET National Rating Field Inspector Test, the Rating Field Inspection candidate shall complete five probationary inspections, including basic performance tests under the direct supervision of a certified rater who has accurately completed twenty five (25) confirmed ratings. The rater's Quality Assurance Designeeshall certify that the rater has completed ratings on 25 houses and the files do not have substantial errors detected through quality assurance review process.

205.3 Senior Certified Rater Knowledge and Skills Set

205.3.1 The following comprise a list of knowledge base and skills necessary to be certified as a Senior Certified Rater:

205.3.1.1 Experience as a certified energy Rater for a period of at least one year.

205.3.1.2 Documentation having accurately completed ratings and performance tests of a minimum of 25 homes.

205.3.1.3 Certification in a minimum of two Rater Specialty Certifications.

205.3.1.4 Demonstrate the ability to complete a rating and all required performance testing, without the use of any reference material, in the presence of a Rater trainer or Quality Assurance Designee.

205.3.1.5 Passing the National Senior Rater Test administered by RESNET.

205.3.2 A National Senior Rater must also publicly demonstrate before a jury of 5, approved by the Technical Committee and composed of at least 3 of his/her peers and at least one Certified Trainer and at least one Quality Assurance Designee, that he or she is competent in all areas by passing an oral exam, designed to determine if the National Senior Rater candidate can successfully diagnose and discuss in detail the building science phenomena that underlie a complex home energy rating case study, approved by the Training and Certification Committee.

205.4 Rater Specialty Certification

205.4.1 RESNET will formally recognize Raters' optional specialty certification(s) by independent programs in closely related fields of building performance, above and beyond RESNET's Rater certification. In order to be recognized by RESNET the program must submit an application developed by the RESNET Training and Education Committee. The RESNET Training and Education Committee will select programs based upon the following criteria:

205.4.1.1 The organization offering the certification shall have a credible reputation.

205.4.1.2 The training and certification is conducted by competent and qualified instructors in the prescribed field of instruction.

205.4.1.3 The organization offering the certification shall have a credible training and testing process as part of their certification.

205.4.1.4 The organization shall have clear, effective, and documented independent quality assurance procedures.

205.4.1.5 The organization shall have a clear, effective and documented discipline process.

206 MINIMUM COMPETENCIES

206.1 Minimum Rater Trainer Competencies

206.1.1 A Rater Training Provider shall maintain certified trainers demonstrating the following skills:

206.1.1.1 Mastery of the Home Energy Rating System knowledge base and skills set given by Section 205.1 of this chapter. The certified trainers shall demonstrate these skills by passing the RESNET National Rater Training Competency Test.

206.1.1.2 Ability to communicate effectively with adults in a training setting. This shall be demonstrated through completion of, at a minimum, a sixteen (16) hour RESNET approved adult education program.

> **206.1.1.2.1** Rater trainers that are currently certified have three (3) years from the effective date of this amendment to complete this training requirement.

206.1.1.3 Understanding of the purposes and benefits of home energy ratings and ability to communicate these to students.

206.1.1.4 Understanding the basics of energy efficient mortgages, energy improvements mortgages and related products and ability to communicate these to students.

206.1.2 Minimum Rater Competencies. A Certified Rater shall pass examinations comprising, at a minimum, the national core test administered by RESNET and complete a

minimum of two ratings in the presence of a trainer. This examination may either follow training or it may be taken as a challenge examination. Specifically, a Certified Rater shall demonstrate the following skills:

206.1.2.1 Ability to accurately gather from building drawings and specification or from field inspections and product specification and nameplate information and/or determine through field performance testing all input data required by home energy rating software to produce accurate and fair home energy ratings in accordance with the National Home Energy Rating Technical Guidelines.

206.1.2.2 Understanding of the purposes and benefits of home energy ratings and ability to communicate these to potential customers.

206.1.2.3 Understanding the basics of energy efficient mortgages, energy improvement mortgages and related products and ability to communicate these to potential customers.

207 CERTIFIED TRAINING

207.1 Minimum Certified Training Requirements

207.1.1 The curriculum shall be designed to ensure that the Rater trainee is proficient as a Home Energy Rater as defined by Section 206.1.2, Minimum Rater Competencies, as given above.

207.1.2 Successful completion of Rater training requires that the Rater trainee pass a written examination comprising, at a minimum, the RESNET National Core Competency Test administered by RESNET and complete a minimum of two ratings in the presence of a trainer.

207.1.3 Rater certification by an Accredited Rating Provider shall be achieved within 1 year of successful completion of Rater training or training certification shall be null and void.

208 EXAMINATIONS

208.1 Certified Rater Trainer

208.1.1 Written examination. Examinations may be given at completion of classroom training or may be given in the form of a "challenge" exam to individuals who have not undergone classroom training.

208.1.1.1 National core competency test. RESNET shall directly administer the National Rater Training Competency Test to prospective Rater trainers seeking certification. The Rater training Provider seeking accreditation shall submit the names of certified Rater trainers it intends to use; and RESNET will verify whether they have passed the RESNET National Rater Training Competency Test.

208.1.1.1.1 RESNET National Rater Training Competency Test.

208.1.1.1.2 Overseen by a proctor. A proctor is an individual designated by RESNET to oversee the written National Rater Training Competency examination.

208.1.1.1.3 Time limited

208.1.2 Rater Candidates.

208.1.2.1 Written examination. Examinations may be given at completion of classroom training or may be given in the form of a "challenge" exam to individuals who have not undergone classroom training.

208.1.2.1.1 RESNET National Rater Training Competency Test

208.1.2.1.2 Open book (& student notes)

208.1.2.1.3 Overseen by a proctor. A proctor is an individual designated by the Accredited Training Provider to oversee the written examination.

208.1.2.1.4 Time limited

209 PROFESSIONAL DEVELOPMENT FOR RATER TRAINERS

209.1 Rater Trainers annually shall complete a two hour RESNET roundtable on current information and complete one of the following activities:

209.1.1 Document 12 hours of attendance at the RESNET Conference or

209.1.2 Complete 12 hours of RESNET approved CEU's, or

209.1.3 Instruct a minimum of ten (10) rater certification classes.

209.2 A person that is both a Rater Trainer and Quality Assurance Designee shall have to complete both the two hour RESNET roundtable for a Rater Trainer and the two hour roundtable for Quality Assurance Designees (see Section 904.7.3). Rater Trainers and QA Designees selecting the conference or CEU option need only comply with the 12 hour requirement one time, i.e. 12 hours is not required for each position.

210 PROVIDER ACCREDITATION CRITERIA

210.1 Minimum Standards for Rater Training Provider Accreditation
Rater Training Providers shall be accredited in accordance with the Accreditation Process specified in Chapter 9 of these Standards. A Rating Training Provider must specifically meet the following minimum standards for Accreditation:

210.1.1.1 Application Procedure.

210.1.1.1.1 Applicants shall demonstrate that their training meets the criteria established through this Standard. Documentation shall include:

210.1.1.1.1.1 Training curriculum

210.1.1.1.1.2 Training materials and manuals

210.1.1.1.1.3 Examination materials

210.1.1.1.1.4 Facilities description

210.1.1.1.1.5 Organization description

210.1.1.1.1.6 Principals and staff qualifications (detailed resumes)

211 RECIPROCITY

211.1 Nationally accredited Home Energy Rating Providers shall accept certified training provided by an accredited Training Provider as meeting the core competencies for a Home Energy Rater. Accredited Home Energy Rating Providers may add additional training requirements needed to address their specific program, climate, software or administrative requirements.

Chapter Three
RESNET Standards

300 NATIONAL ENERGY RATING TECHNICAL STANDARDS

301 GENERAL PROVISIONS

301.1 Purpose

The provisions of this document are intended to establish national residential energy rating Standards, consistent with the provisions of the Energy Policy Act of 1992, which any provider of home energy ratings may follow to produce uniform energy ratings for residential buildings.

301.1.1 Relationship to Other Standards. This Chapter is a companion Chapter to the "National Accreditation Procedures for Home Energy Rating Systems"(Chapter 1 of this Standard) and "National Rater Training and Certifying Standard (Chapter 2 of this Standard), as promulgated and maintained by the Residential Energy Services Network (RESNET) and recognized by the mortgage industry.

301.1.2 Relationship to State Law. These Standards specifically recognize the authority of each state that has a state law or regulation requiring certification, or licensing of home energy rating systems. To the extent that such state laws or regulations differ from these Standards, state law or regulation shall govern.

301.2 Scope

301.2.1 Application of Standards

These Standards apply to existing or proposed, site-constructed or manufactured, single- and multi-family residential buildings three stories or less in height excepting hotels and motels.

302 DEFINITIONS AND ACRONYMS

See Appendix B.

303 TECHNICAL REQUIREMENTS

303.1 Rating Procedures

303.1.1 To determine the energy rating of a home, all HERS providers shall–

303.1.1.1 If rating an existing home, visit the home to collect the data needed to calculate the rating;

303.1.1.2 If rating a new, to-be-built home, follow the procedures set forth in Section 303.7 and 303.8 of these Standards to collect the data needed to calculate the rating;

303.1.1.3 Use the collected data to estimate the annual purchased energy consumption for heating, cooling and water heating, lighting and appliances for both the Rated Home and the Reference Home as defined in Section 303.4 of these Standards.

303.1.1.4 If the energy efficiency rating is conducted to evaluate proposed energy conserving improvements to the home, calculate additional estimates of annual purchased energy consumption with the home reconfigured to include those improvements sufficient to consider interactions among improvement options.

303.1.1.5 If the Rated Home includes On-site Power Production (OPP), then OPP shall be calculated as the gross electric power produced minus the Equivalent Electric Power of any purchased fuels used to produce the electric power. The HERS Reference Home shall not include On-site Power Production.

For example, assume 1000 kWh (3413 kBtu or 3.413 MBtu) of gross electrical power is produced using 60 therms (6 MBtu) of natural gas to operate a high-efficiency fuel cell system. Using these assumptions, OPP = 3.413 MBtu - (6 MBtu * 0.4) = 1.0 MBtu.

303.1.2 Estimates completed by all HERS providers under Sections 303.1.1.3, 303.1.1.4 and 303.1.1.5 of this Standard must be–

303.1.2.1 Based on the minimum rated features set forth in Section 303.8 of these Standards.

303.1.2.2 Conducted using the standard operating assumptions established in Section 303.5 of these Standards.

303.1.2.3 Conducted using rating tool that has been certified for accuracy under Chapter 1, Section 102.2 of these Standards ("National Accreditation Procedures for Home Energy Rating Systems").

303.1.3 All HERS providers shall compare the estimates provided under Section 303.1.1 of this Standard to determine the energy rating of the home and, if applicable, the energy rating of the home with proposed conservation measures and On-site Power Production installed.

303.2 Rating Determination

303.2.1 HERS Index. The rating Index shall be a numerical integer value that is based on a linear scale constructed such that the HERS Reference Home has an Index value of 100 and a home that uses no net purchased energy has an Index value of 0 (zero). Each integer value on the scale shall represent a 1% change in the total energy use of the Rated home relative to the total energy use of the Reference home. Except in states or territories whose laws or regulations require a specific alternative method, which shall control, equations 1 and 2 shall be used in a 2 step process to calculate the HERS Index for the Rated Home, as follows:

Step (1) Calculate the individual normalized Modified End Use Loads (nMEUL) for heating, cooling, and hot water using equation 1:

$$nMEUL = REUL * (nEC\_x / EC\_r) \quad \text{(Eq. 1)}$$

where:

nMEUL = normalized Modified End Use Loads (for heating, cooling, or hot water) as computed using accredited simulation tools.

REUL = Reference Home End Use Loads (for heating, cooling or hot water) as computed using accredited simulation tools.

nEC_x = normalized Energy Consumption for Rated Home's end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using accredited simulation tools.

EC_r = estimated Energy Consumption for Reference Home's end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using accredited simulation tools.

and where:

$$nEC\_x = (a* EEC\_x - b)*(EC\_x * EC\_r * DSE\_r) / (EEC\_x * REUL)$$

where:

EC_x = estimated Energy Consumption for the Rated Home's end uses (for heating, including auxiliary electric consumption, cooling or hot water) as computed using accredited simulation tools.

EEC_x = Equipment Efficiency Coefficient for the Rated Home's equipment, such that EEC_x equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_x equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC_x equals 3.413 / MEPR for HSPF, EER or SEER ratings.

DSE_r = REUL/EC_r * EEC_r

For simplified system performance methods, DSE_r equals 0.80 for heating and cooling systems and 1.00 for hot water systems [see Table 303.4.1(1)]. However, for detailed modeling of heating and cooling systems, DSE_r may be less than 0.80 as a result of part load performance degradation, coil air flow degradation, improper system charge and auxiliary resistance heating for heat pumps. Except as otherwise provided by these Standards, where detailed systems modeling is employed, it must be applied equally to both the Reference and the Rated Homes.

EEC_r = Equipment Efficiency Coefficient for the Reference Home's equipment, such that EEC_r equals the energy consumption per unit load in like units as the load, and as derived from the Manufacturer's Equipment Performance Rating (MEPR) such that EEC_r equals 1.0 / MEPR for AFUE, COP or EF ratings, or such that EEC_r equals 3.413 / MEPR for HSPF, EER or SEER ratings and where the coefficients 'a' and 'b' are as defined by Table 303.2.2 below:

Table 303.2.2. Coefficients 'a' and 'b'

Fuel type and End Use	a	b
Electric space heating	2.2561	0
Fossil fuel* space heating	1.0943	0.4030
Biomass space heating	0.8850	0.4047
Electric air conditioning	3.8090	0
Electric water heating	0.9200	0
Fossil fuel* water heating	1.1877	1.0130

*Such as natural gas, LP, fuel oil

Step (2) Determine the HERS Index using equation 2:

HERS Index = PEfrac * (TnML / TRL) * 100 (Eq. 2)

where:

TnML = $nMEUL_{HEAT} + nMEUL_{COOL} + nMEUL_{HW} + EUL_{LA}$ (MBtu/yr).

TRL = $REUL_{HEAT} + REUL_{COOL} + REUL_{HW} + REUL_{LA}$ (MBtu/yr).

and where:

EUL_{LA} = Rated Home end use loads for lighting, appliances and MELs as defined by Section 303.4.1.7.2, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293 or (therms/yr)/10, as appropriate.

$REUL_{LA}$ = Reference Home end use loads for lighting, appliances and MELs as defined by Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293 or (therms/yr)/10, as appropriate.

and where:

PEfrac = (TEU - OPP) / TEU

TEU = Total energy use of the Rated Home including all rated and non-rated energy features where all fossil fuel site energy uses are converted to Equivalent Electric Energy by multiplying them by the Reference Electricity Production Efficiency of 40%

OPP = On-site Power Production as defined by Section 303.1.1.5

303.3 Rating Report

303.3.1 The Rated Home will be given a star rating between one and five-plus stars, determined by the numerical HERS Index and the corresponding number of stars depicted in Table 303.3.1:

TABLE 303.3.1. HERS Index, Star and Efficiency Scales for Rated Homes

HERS Index Range	Stars	Relative Energy Use (with respect to Reference Home)
=<500 and >401	✯	=<500% and >401%
=<400and >301	✯+	=<400% and >301%
=<300and >251	✯✯	=<300% and >251%
=<250 and >201	✯✯+	=<250% and >201%
=<200 and >151	✯✯✯	=<200% and >151%
=<150 and >101	✯✯✯+	=<150% and >1%
=<100 and >91	✯✯✯✯	=<0% and >-9%
=<90 and >86	✯✯✯✯+	=<-10% and >-14%
=<85 and >71	✯✯✯✯✯	=<-15% and >-29%
=<70 and >=0	✯✯✯✯✯+	=<-30% and >=-100%

303.3.2 For each rating conducted under this part, a report shall be prepared containing, at a minimum, the following information:

303.3.2.1 The numerical rating Index determined in accordance with Section 303.2.1 of these Standards;

303.3.2.2 The star rating determined in accordance with Section 303.3.1 of these Standards, except that all plus (+) ratings other than 5+ are optional;

303.3.2.3 The estimated annual purchased energy consumption for space heating, space cooling, domestic hot water, and all other energy use, and the total of these four estimates;

303.3.2.4 The estimated annual energy cost for space heating, space cooling, domestic hot water, and all other energy use, and the total of these four estimates;

303.3.2.5 The unique physical location (full street address or recorded real property identifier) of the Rated home;

303.3.2.6 The name of the individual conducting the rating;

303.3.2.7 The date the rating was conducted;

303.3.2.8 The rating tool (including version number) used to calculate the rating; and

303.3.2.9 The following statement in no less than 8 point font, "The Home Energy Rating Standard Disclosure for this home is available from the rating provider." At a minimum, this will include the Rating Provider's mailing address and phone number.

303.3.3 Economic Cost Effectiveness If ratings are conducted to evaluate energy saving improvements to the home for the purpose of an energy improvement loan or energy efficient mortgage, indicators of economic cost effectiveness shall use present value costs and benefits, which shall be calculated as follows:

LCC_E = P1*(1st Year Energy Costs) **Eqn 303.3.3-1**
LCC_I = P2*(1st Cost of Improvements) **Eqn 303.3.3-2**

where:
LCC_E = Present Value Life Cycle Cost of Energy
LCC_I = Present Value Life Cycle Cost of Improvements
P1 = Ratio of Life Cycle energy costs to the 1st year energy costs
P2 = Ratio of Life Cycle Improvement costs to the first cost of improvements

Present value life cycle energy cost savings shall be calculated as follows:

$LCC_S = LCC_{E,b} - LCC_{E,i}$ **Eqn 303.3.3-3**

where:
LCC_S = Present Value Life Cycle Energy Cost Savings
$LCC_{E,b}$ = Present Value LCC of energy for baseline home configuration
$LCC_{E,i}$ = Present Value LCC of energy for improved home configuration

Standard economic cost effectiveness indicators shall be calculated as follows:

SIR = (LCC_S) / (LCC_I) **Eqn 303.3.3-4**
NPV = LCC_S - LCC_I **Eqn 303.3.3-5**

where:
SIR = Present Value Savings to Investment Ratio
NPV = Net Present Value of Improvements

303.3.3.1 Calculation of P1 and P2. The ratios represented by P1 and P2 shall be calculated in accordance with the following methodology[1]:

P1 = 1/(DR-ER)*(1-((1+ER)/(1+DR))^nAP) **Eqn 303.3.3-6a**
or if DR = ER then
P1 = nAP / (1+DR) **Eqn 303.3.3-6b**

where:
P1 = Ratio of Present Value Life Cycle Energy Costs to the 1st year Energy Costs
DR = Discount Rate as prescribed in section 303.3.3.2
ER = Energy Inflation Rate as prescribed in section 303.3.3.2
nAP = number of years in Analysis Period as prescribed in section 303.3.3.2

P2 = DnPmt + $P2_A$ + $P2_B$ + $P2_C$ - $P2_D$ **Eqn 303.3.3-7**

where:
P2 = Ratio of Life Cycle Improvement costs to the first cost of improvements
DnPmt = Mortgage down payment rate as prescribed in section 303.3.3.2
$P2_A$ = Mortgage cost parameter
$P2_B$ = Operation & Maintenance cost parameter

$P2_C$ = Replacement cost parameter
$P2_D$ = Salvage value cost parameter

$P2_A$ = (1-DnPmt)*(PWFd/PWFi) **Eqn 303.3.3-8a**

where:
PWFd = Present Worth Factor for the discount rate = 1/DR*(1-(1/(1+DR)^nAP))
PWFi = Present Worth Factor for the mortgage rate = 1/MR*(1-(1/(1+MR)^nMP))
DR = Discount Rate as prescribed in section 303.3.3.2
MR = Mortgage interest Rate as prescribed in section 303.3.3.2
nAP = number of years of the Analysis Period as prescribed in section 303.3.3.2
nMP = number of years of the Mortgage Period

$P2_B$ = MFrac*PWinf **Eqn 303.3.3-8b**

where:
MFrac = annual O&M costs as a fraction of first cost of improvements[1]
PWinf = ratio of present worth discount rate to present worth general inflation rate
= 1/(DR-GR)*(1-(((1+GR)/(1+DR))^nAP))
or if DR = GR then
= nAP/(1+DR)
GR = General Inflation Rate as prescribed in section 303.3.3.2

$P2_C$ = Sum {1/((1+(DR-GR))^(Life*i))} for i=1, n **Eqn 303.3.3-8c**

where:
i = the i^{th} replacement of the improvement
Life = the expected service life of the improvement

$P2_D$ = RLFrac / ((1+DR)^nAP) **Eqn 303.3.3-8d**

where:
RLFrac = Remaining Life Fraction following the end of the analysis period

301.1.2.1 Determination of Economic Parameters. The following economic parameter values shall be determined by RESNET in accordance with this Section each January using the latest available specified data and published on the RESNET website.

- General Inflation Rate (GR)
- Discount Rate (DR)

[1] The maintenance fraction includes all incremental costs over and above the operating and maintenance cost of the "standard" measure. Where components of a system have various lifetimes, the longest lifetime may be used and the components with shorter lifetimes may be included as a maintenance cost at the present value of their future maintenance cost. The maintenance fraction may also be used to represent the degradation in performance of a given system. For example, photovoltaic (PV) systems have a performance degradation of about 0.5% per year and this value can be added to the maintenance fraction for PV systems to accurately represent this phenomenon in this cost calculation procedure.

- Mortgage Interest Rate (MR)
- Down Payment Rate (DnPmt)
- Energy Inflation Rate (ER)

The economic parameter values used in the cost effectiveness calculations specified in Section 303.3.3.1 shall be determined as follows:

301.1.2.1.1 General Inflation Rate (GR) shall be the greater of the 5-year and the 10-year Annual Compound Rate (ACR) of change in the Consumer Price Index for Urban Dwellers (CPI-U) as reported by the U.S. Bureau of Labor Statistics,[2] where ACR shall be calculated as follows:

ACR = ((endVal)/(startVal))^(1.0/((endYr)-(startYr)))-1.0 Eqn 303.3.3-9

where:
ACR = Annual Compound Rate of change
endVal = Value of parameter at end of period
startVal = Value of parameter at start of period
endYr = Year number at end of period
startYr = Year number at start of period

301.1.2.1.2 Discount Rate (DR) shall be equal to the General Inflation Rate plus 2%.

301.1.2.1.3 Mortgage Interest Rate (MR) shall be defaulted to the greater of the 5-year and the 10-year average of simple interest rate for fixed rate, 30-year mortgages computed from the Primary Mortgage Market Survey (PMMS) as reported by Freddie Mac unless the mortgage interest rate is specified by a program or mortgage lender, in which case the specified mortgage interest rate shall be used. The mortgage interest rate used in the cost effectiveness calculation shall be disclosed in reporting results.

301.1.2.1.4 Down Payment Rate (DnPmt) shall be defaulted to 10% of 1st cost of improvements unless the down payment rate is specified by a program or mortgage lender, in which case the specified down payment rate shall be used. The down payment rate used in the cost effectiveness calculation shall be disclosed in reporting results.

301.1.2.1.5 Energy Inflation Rate (ER) shall be the greater of the 5-year and the 10-year Annual Compound Rate (ACR) of change in the Bureau of Labor Statistics, Table 3A, Housing, Fuels and Utilities, Household Energy Index[3] as calculated using Equation 303.3.3-9.

301.1.2.1.6 Mortgage Period (nMP) shall be defaulted to 30 years unless a mortgage finance period is specified by a program or mortgage lender, in which case the specified mortgage period shall be used. The mortgage period used in the cost effectiveness calculation shall be disclosed in reporting results.

[2] http://www.bls.gov/CPI/#tables
[3] http://www.bls.gov/cpi/cpi_dr.htm

301.1.2.1.7 Analysis Period (nAP) shall be 30 years.

301.1.2.1.8 Remaining Life Fraction (RLFrac) shall be calculated as follows:

RLFrac = (nAP/Life) – (Integer (nAP/Life)) Eqn. 303.3.3-10

or if Life > nAP

RLFrac = (Life-nAP) / nAP

where:

Life = useful service life of the improvement(s)

301.1.2.1.9 Improvement Costs. The improvement cost for Energy Conservation Measures (ECMs) shall be included on the Economic Cost Effectiveness Report.

301.1.2.1.9.1 For New Homes the improvement costs shall be the full installed cost of the improvement(s) less the full installed cost of the minimum standard or code option less any financial incentives that accrue to the home purchaser.

301.1.2.1.9.2 **For Existing Homes** the improvement costs shall be the full installed cost of the improvement(s) less any financial incentives that accrue to the home purchaser.

301.1.2.1.10 Measure Lifetimes. The ECM service life shall be included on the Economic Cost Effectiveness Report. Appendix C of this standard provides informative guidelines for service lifetimes of a number of general categories of ECMs.

303.3.3.3 The annual energy cost savings for the Rated home shall be estimated by comparing the projected annual energy cost of the Rated home to the projected annual energy cost of a baseline home. For new homes, the most recent HERS Reference home shall be the baseline, except when an alternative reference home is specified by the lender or program underwriter. For existing homes, the unimproved home shall be used as the baseline.

303.3.3.4 The estimated monthly energy cost savings for the Rated home shall be equal to the annual energy cost savings divided by 12.

303.3.3.5 For Fannie Mae energy efficient mortgages the Net Present Value (NPV) of the improvements shall be as calculated by Equation 303.3.3-5.

303.3.3.4 For FHA and Freddie Mac energy mortgages, the present worth of energy savings shall be calculated in accordance with Equation 303.3.3-3 where the baseline home is as specified by the most current HUD Mortgage Letter.

303.3.3.5 Each rating report shall include:

303.3.3.5.1 The estimated monthly energy cost savings for the Rated home;

303.3.3.5.2 The Energy Value for the Rated Home;

303.3.3.5.3 For FHA and Freddie Mac energy mortgages, the present worth of energy savings;

303.3.3.5.4 The weighted lifetime of the measures that was used to determine the present value factor;

303.3.3.5.5 The prevailing mortgage rate (i.e. Assumed Rate) that was used to determine the present value factor;

303.3.3.5.6 The utility rates that were used to determine the estimated annual energy cost savings. The following units shall apply, as applicable to the fuel type(s) used by the Rated home: $ per kWh for electricity, $ per therm for natural gas, and $ per gallon for fuel oil;

303.3.3.5.7 The reference home from which annual energy cost savings were calculated (e.g., 1993 MEC, 2006 IECC, 2006 HERS);

303.3.3.5.8 A reference to the methodology used to calculate the values on the report. Specifically, the report shall reference "Section 303.3.3 of RESNET's 2006 Mortgage Industry National Homes Energy Rating Systems Standards".

3.3.4 If a Projected Rating conducted under Section 303.7.1 of these Standards, the Rating shall be prominently identified as a "Projected Rating."

303.3.5 For each rating conducted under these Standards, the following items are to be prominently displayed on all reports and labels:

303.3.5.1 Date of the rating;

303.3.5.2 Annual estimated energy costs for heating, cooling, water heating and all other uses;

303.3.5.3 Rating Index and;

303.3.5.4 Star rating;

303.3.5.5 At the request of the person for whom the rating is being conducted, as an alternative to reporting the rating Index and star rating, any home achieving a rating Index as defined by EPA Energy Star Homes guidelines, be labeled an ENERGY STAR® Home.

303.4 HERS Reference Home and Rated Home Configuration

303.4.1 Calculation Procedure

303.4.1.1 General. Except as specified by this Section, the HERS Reference Home and Rated Home shall be configured and analyzed using identical methods and techniques.

303.4.1.2 Residence Specifications. The HERS Reference Home and Rated Home shall be configured and analyzed as specified by Table 303.4.1(1).

Table 303.4.1(1) Specifications for the HERS Reference and Rated Homes

Building Component	HERS Reference Home	Rated Home
Above-grade walls:	Type: wood frame Gross area: same as Rated Home U-Factor: from Table 303.4.1(2) Solar absorptance = 0.75 Emittance = 0.90	Same as Rated Home Same as Rated Home Same as Rated Home Same as Rated Home Same as Rated Home
Conditioned Basement walls:	Type: same as Rated Home Gross area: same as Rated Home U-Factor: from Table 303.4.1(2) with the insulation layer on the interior side of walls	Same as Rated Home Same as Rated Home Same as Rated Home
Floors over unconditioned spaces:	Type: wood frame Gross area: same as Rated Home U-Factor: from Table 303.4.1(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Ceilings:	Type: wood frame Gross area: same as Rated Home U-Factor: from Table 303.4.1(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Roofs:	Type: composition shingle on wood sheathing Gross area: same as Rated Home Solar absorptance = 0.75 Emittance = 0.90	Same as Rated Home Same as Rated Home Values from Table 303.4.1.(4) shall be used to determine solar absorptance except where test data are provided for roof surface in accordance with ASTM methods E-903, C-1549, E-1918, or CRRC Method # 1. Emittance values provided by the roofing manufacturer in accordance with ASTM C-1371 shall be used when available. In cases where the appropriate data are not known, same as the Reference Home.
Attics:	Type: vented with aperture = 1ft^2 per 300 ft^2 ceiling area	Same as Rated Home
Foundations:	Type: same as Rated Home Gross Area: same as Rated Home U-Factor / R-value: from Table 303.4.1(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Crawlspaces:	Type: vented with net free vent	Same as the Rated Home, but

Table 303.4.1(1) Specifications for the HERS Reference and Rated Homes

Building Component	HERS Reference Home	Rated Home
	aperture = 1ft^2 per 150 ft^2 of crawlspace floor area. U-factor: from Table 303.4.1(2) for floors over unconditioned spaces.	not less net free ventilation area than the Reference Home unless an approved ground cover in accordance with IRC 408.1 is used, in which case, the same net free ventilation area as the Rated Home down to a minimum net free vent area of 1ft^2 per 1,500 ft^2 of crawlspace floor area. Same as Rated Home
Doors:	Area: 40 ft^2 Orientation: North U-factor: same as fenestration from Table 303.4.1(2)	Same as Rated Home Same as Rated Home Same as Rated Home
Glazing: [a]	Total area [b] =18% of conditioned floor area Orientation: equally distributed to four (4) cardinal compass orientations (N,E,S,&W) U-factor: from Table 303.4.1(2) SHGC: from Table 303.4.1(2) Interior shade coefficient: Summer = 0.70 Winter = 0.85 External shading: none	Same as Rated Home Same as Rated Home Same as Rated Home Same as Rated Home Same as HERS Reference Home [c] Same as Rated Home
Skylights	None	Same as Rated Home
Thermally isolated sunrooms	None	Same as Rated Home
Air exchange rate	Specific Leakage Area (SLA) [d] = 0.00048 (assuming no energy recovery)	For residences that are not tested, the same as the HERS Reference Home For residences without mechanical ventilation systems that are tested in accordance with ASHRAE Standard 119, Section 5.1, the measured air exchange rate [e] but not less than 0.35 ach For residences with mechanical ventilation systems that are tested in accordance with ASHRAE

Table 303.4.1(1) Specifications for the HERS Reference and Rated Homes

Building Component	HERS Reference Home	Rated Home
		Standard 119, Section 5.1, the measured air exchange rate [e] combined with the mechanical ventilation rate,[f] which shall not be less than 0.01 x CFA + 7.5 x (Nbr+1) cfm
Mechanical ventilation:	None, except where a mechanical ventilation system is specified by the Rated Home, in which case: Annual vent fan energy use: kWh/yr = 0.03942*CFA + 29.565*(N_{br}+1) (per dwelling unit) where: CFA = conditioned floor area N_{br} = number of bedrooms	Same as Rated Home Same as Rated Home
Internal gains:	As specified by Table 303.4.1(3)	Same as HERS Reference Home, except as provided by Section 303.4.1.7.2
Internal mass:	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as HERS Reference Home, plus any additional mass specifically designed as a Thermal Storage Element [g] but not integral to the building envelope or structure
Structural mass:	For masonry floor slabs, 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air For masonry basement walls, same as Rated Home, but with insulation required by Table 303.4.1(2) located on the interior side of the walls For other walls, for ceilings, floors, and interior walls, wood frame construction	Same as Rated Home Same as Rated Home Same as Rated Home
Heating systems [h],[i]	Fuel type: same as Rated Home Efficiencies: Electric: air source heat pump with prevailing federal minimum efficiency	Same as Rated Home [i] Same as Rated Home

Table 303.4.1(1) Specifications for the HERS Reference and Rated Homes

Building Component	HERS Reference Home	Rated Home
	Non-electric furnaces: natural gas furnace with prevailing federal minimum efficiency	Same as Rated Home
	Non-electric boilers: natural gas boiler with prevailing federal minimum efficiency	Same as Rated Home
	Capacity: sized in accordance with Section 303.5.1.4 of this Standard.	Same as Rated Home
Cooling systems [h),(k)]	Fuel type: Electric	Same as Rated Home [(k)]
	Efficiency: in accordance with prevailing federal minimum standards	Same as Rated Home
	Capacity: sized in accordance with Section 303.5.1.4 of this Standard.	Same as Rated Home
Service water heating systems [(h) (m)]	Fuel type: same as Rated Home	Same as Rated Home [(m)]
	Efficiency: in accordance with prevailing federal minimum standards	Same as Rated Home
	Use (gal/day): $30*N_{du} + 10*N_{br}$ where N_{du} = number of dwelling units	Same as HERS Reference Home
	Tank temperature: 120 F	Same as HERS Reference Home
Thermal distribution systems:	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies.	As specified by Table 303.4.1(4), except when tested in accordance with ASHRAE Standard 152-2004[(n)], and then either calculated through hourly simulation or calculated in accordance with ASHRAE Standard 152-2004
Thermostat	Type: manual	Type: Same as Rated Home
	Temperature setpoints: cooling temperature set point = 78 F; heating temperature set point = 68 F	Temperature setpoints: same as the HERS Reference Home, except as required by Section 303.5.1.2

Table 303.4.1(1) Notes:

(a) Glazing shall be defined as sunlight-transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight-transmitting fenestration assemblies in walls bounding conditioned basements.

For doors where the sunlight-transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area shall be used. For all other doors, the glazing area is the rough frame opening area for the door, including the door and the frame.

(b)For homes with conditioned basements and for multi-family attached homes the following formula shall be used to determine total window area:
AF = 0.18 x AFL x FA x F

where:

AF = Total fenestration area
AFL = Total floor area of directly conditioned space
FA = (Above-grade thermal boundary gross wall area) / (above-grade boundary wall area + 0.5 x below-grade boundary wall area)
F = 1- 0.44* (Common Wall Area) / (above-grade thermal boundary wall area + common wall area)

and where:

Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions
Above-grade thermal boundary wall is any portion of a thermal boundary wall not in contact with soil.

Below-grade boundary wall is any portion of a thermal boundary wall in soil contact

Common wall is the total wall area of walls adjacent to another conditioned living unit, not including foundation walls.

(c) For fenestrations facing within 15 degrees of due south that are directly coupled to thermal storage mass, the winter interior shade coefficient shall be permitted to increase to 0.95 in the Rated Home.

(d)Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE Standard 119 and where SLA = L / CFA (where L and CFA are in the same units).
Either hourly calculations using the procedures given in the 2001 ASHRAE Handbook of Fundamentals, Chapter 26, page 26.21, equation 40 (Sherman-Grimsrud model) or calculations yielding equivalent results shall be used to determine the energy loads resulting from air exchange.

(e) Tested envelope leakage shall be determined and documented by a Certified Rater using the on-site inspection protocol as specified in Appendix A under “Blower Door Test.” Either hourly calculations using the procedures given in the 2001 ASHRAE Handbook of Fundamentals, Chapter 26, page 26.21, equation 40 (Sherman-Grimsrud model) or calculations yielding equivalent results shall be used to determine the energy loads resulting from air exchange.

(f) The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with equation 43 of 2001 ASHRAE Handbook of Fundamentals page 26.24 in combination with the" Whole-house Ventilation" provisions of 2001 ASHRAE Handbook of Fundamentals, page 26.19 for intermittent mechanical ventilation.

(g)Thermal storage element shall mean a component not normally part of the floors, walls, or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees of due south, or must be connected to such a room with pipes or ducts that allow the element to be actively charged.

(h)For a Rated Home with multiple heating, cooling, or water heating systems using different fuel types, the applicable system capacities and fuel types shall be weighted in accordance with the loads distribution (as calculated by accepted engineering practice for that equipment and fuel type) of the subject multiple systems. For the HERS Reference Home, the prevailing federal minimum efficiency shall be assumed except that the efficiencies given in Table 303.4.1(1)(a) below will be assumed when:

1) A type of device not covered by NAECA is found in the Rated Home;

2) The Rated Home is heated by electricity using a device other than an air source heat pump; or

3) The Rated Home does not contain one or more of the required HVAC equipment systems.

Table 303.4.1(1)(a). Default HERS Reference Home Heating and Cooling Equipment Efficiencies (i) (k) (m) (n)

Rated Home Fuel	Function	Reference Home Device
Electric	Heating	7.7 HSPF air source heat pump
Non-electric warm air furnace or space heater	Heating	78% AFUE gas furnace
Non-electric boiler	Heating	80% AFUE gas boiler
Any type	Cooling	13 SEER electric air conditioner
Biomass System (1)	Heating	63% Efficiency

Table 303.4.1(1)(a) Notes:

(1)Biomass fuel systems should not be included in ratings when they are considered "supplemental systems", i.e. where an automatic system, sized to meet the load of the house exists. Biomass systems should only be included in the rating in those situations where the automatic heating system is not large enough to meet the load of the house, and a biomass fuel system is in place to meet the balance of the load, or where there is only a biomass fuel system in place. In the situation where there are two systems that together meet the load, the biomass system shall be assigned only that part of the load that cannot be met by the automatic system.

(i) For a Rated Home without a proposed heating system, a heating system with the prevailing federal minimum efficiency shall be assumed for both the HERS Reference Home and Rated Home. For electric heating systems, the prevailing federal minimum efficiency air-source heat pump shall be selected.

(k)For a Rated Home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the HERS Reference Home and the Rated Home.

(m) For a Rated Home with a non-storage type water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency and with the same fuel as the proposed water heater shall be assumed for the HERS Reference Home. For a Rated Home without a proposed water heater, a 40-gallon storage-type water heater with the prevailing federal minimum efficiency with the same fuel as the predominant heating fuel type shall be assumed for both the Rated and HERS Reference Homes.

(n)Tested duct leakage shall be determined and documented by a Certified Rater using the on-site inspection protocol as specified in Appendix A under "Air leakage (ducts)".

Table 303.4.1(2). Component Heat Transfer Characteristics for HERS Reference Home [a]

Climate Zone [b]	Fenestration and Opaque Door U-Factor	Glazed Fenestration Assembly SHGC	Ceiling U-Factor	Frame Wall U-Factor	Floor Over Unconditioned Space U-Factor	Basement Wall U-Factor [c]	Slab-on-Grade [d,e] R-Value & Depth
1	1.20	0.40	0.035	0.082	0.064	0.360	0
2	0.75	0.40	0.035	0.082	0.064	0.360	0
3	0.65	0.40	0.035	0.082	0.047	0.360	0
4 except Marine	0.40	0.55	0.030	0.082	0.047	0.059	10, 2 ft.
5 and Marine 4	0.35	0.55	0.030	0.060	0.033	0.059	10, 2 ft.
6	0.35	0.55	0.026	0.060	0.033	0.059	10, 4 ft.
7 and 8	0.35	0.55	0.026	0.057	0.033	0.059	10, 4 ft.

Table 303.4.1(2). Component Heat Transfer Characteristics for HERS Reference Home [a]

Climate Zone [b]	Fenestration and Opaque Door U-Factor	Glazed Fenestration Assembly SHGC	Ceiling U-Factor	Frame Wall U-Factor	Floor Over Unconditioned Space U-Factor	Basement Wall U-Factor [c]	Slab-on-Grade [d,e] R-Value & Depth

Notes:

a Non-fenestration U-Factors shall be obtained from measurement, calculation, or an approved source.

b. Climates zones shall be as specified by the 2004 Supplement to the International Energy Conservation Code.

c. For basements where the conditioned space boundary comprises the basement walls.

d. R-5 shall be added to the required R-value for slabs with embedded heating.

e. Insulation shall extend downward from the top of the slab vertically to the depth indicated.

Table 303.4.1(3). Internal Gains for HERS Reference Homes [a]

End Use / Component	Sensible Gains (Btu/day)			Latent Gains (Btu/day)		
	a	b	c	a	b	c
Residual MELs		7.27			0.38	
Interior lighting	4,253	7.48				
Refrigerator	5,955		168			
TVs	3,861		645			
Range/Oven (elec) [b]	2,228		262	248		29
Range/Oven (gas) [b]	3,934		470	1,020		122
Clothes Dryer (elec) [b]	661		188	73		21
Clothes Dryer (gas) [b]	685		194	85		24
Dish Washer	219		87	219		87
Clothes Washer	95		26	11		3
Gen water use	-1227		-409	1,245		415
Occupants [c]			3716			2,884

Notes for Table 303.4.1(3)

(a) Table values are coefficients for the following general equation:
Gains = a + b*CFA + c*Nbr
where CFA = Conditioned Floor Area and Nbr = Number of bedrooms.

(b) For Rated Homes with electric appliance use (elec) values and for Rated homes with natural gas-fired appliance use (gas) values

(c) Software tools shall use either the occupant gains provided above or similar temperature dependent values generated by the software where number of occupants equals the number of bedrooms and occupants are present in home 16.5 hours per day.

Table 303.4.1(4). Default Distribution System Efficiencies for Inspected Systems [a]

Distribution System Configuration and Condition:	Forced Air Systems	Hydronic Systems [b]
Distribution system components located in unconditioned space	0.80	0.95
Distribution systems entirely located in conditioned space [c]	0.88	1.00
Proposed "reduced leakage" with entire air distribution system located in the conditioned space [d]	0.96	
Proposed "reduced leakage" air distribution system with components located in the unconditioned space[d]	0.88	
"Ductless" systems [e]	1.00	

Table 303.4.1(4) Notes:

(a) Default values given by this table are for distribution systems as rated, which meet minimum IECC 2000 requirements for duct system insulation.

(b) Hydronic Systems shall mean those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced air flows to maintain space temperatures.

(c) Entire system in conditioned space shall mean that no component of the distribution system, including the air handler unit or boiler, is located outside of the conditioned space boundary.

(d) Proposed "reduced leakage" shall mean substantially leak free to be leakage of not greater than 3 cfm to outdoors per 100 square feet of conditioned floor area and not greater than 9 cfm total air leakage per 100 square feet of conditioned floor area at a pressure differential of 25 Pascal across the entire system, including the manufacturer's air handler enclosure. Total air leakage of not greater than 3 cfm per 100 square feet of conditioned floor area at a pressure difference of 25 Pascal across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of air leakage to outdoors. This rated condition shall be specified as the required performance in the construction documents and requires confirmation through field-testing of installed systems as documented by a Certified Rater.

(e) Ductless systems may have forced airflow across a coil but shall not have any ducted airflows external to the manufacturer's air handler enclosure.

Table 303.4.1(5).

Default Solar Absorptance for Various Roofing Surfaces	
Roof Materials	**Absorptance**
White Composition Shingles	0.80
White Tile (including concrete)	0.60
White Metal	0.50

Default Solar Absorptance for Various Roofing Surfaces	
All others	0.92

303.4.1.3 All enclosure elements shall use framing fractions that are consistent with and representative of reality. Default enclosure framing fractions are provided by Table 303.4.1.3.

Table 303.4.1.3. Default Framing Fractions for Enclosure Elements

Enclosure Element	Frame Spacing (in o.c.)	Default Frame Fraction (% area)
Walls (standard):		
@16" o.c.	16	23%
@24" o.c.	24	20%
Walls (advanced):		
@16" o.c.	16	19%
@24" o.c.	24	16%
Structural.Insulated.Panels	48	10%
Floors (standard):		
@16" o.c.	16	13%
@24" o.c.	24	10%
Floors (advanced):		
@16" o.c.	16	11%
@24" o.c.	24	8%
Ceilings (standard trusses):		
@16" o.c.	16	14%
@24" o.c.	24	11%
Ceilings (advanced trusses – "raised heel"):		
@16" o.c.	16	10%
@24" o.c.	24	7%
Ceilings (conventional framing):		
@16" o.c.	16	13%
@24" o.c.	24	9%

303.4.1.4 Insulation Inspections: All enclosure elements for the Rated Home shall have their insulation assessed in accordance with this Standard. Installed cavity insulation shall be rated as Grade I, II, or III in accordance with the on-site inspection procedures of Appendix A.

303.4.1.4.1 The HERS Reference Home enclosure elements shall be modeled assuming Grade I insulation. Default values for Rated Home insulation that is not inspected according to the procedures of Appendix A shall be in accordance with the requirements of Grade III as given in Section 303.4.1.4.2 and shall be recorded as "not inspected" in the rating information.

Exceptions:

(a) Modular and manufactured housing using IPIA (In-Plant Inspection Agent) inspections may be substituted for the HERS inspection. However, housing manufacturer shall include RESNET insulation inspection details and requirements in their "DAPIA" (Design Approval Primary Inspection Agency) packages submitted to HUD which are used by IPIA's for their factory inspections.

(b) Structural Insulated Panels (SIP's), Insulated Concrete Forms (ICF's), and other similar insulated manufactured assemblies. Note that manufacturer's claims of "equivalent" R-values based on reduced air leakage or other secondary effects may not be used; only the thermal resistance values for the actual materials as found in ASHRAE Fundamentals may be used.

(c) A RESNET-approved, third-party audited installer certification program may be substituted under the conditions specified in the RESNET approval process.

303.4.1.4.2 Insulation Assessment: Insulated surfaces categorized as "Grade I" shall be modeled such that the insulation R-value within the cavity is considered at its measured (for loose fill) or labeled value, including other adjustments such as compression, and cavity fill versus continuous, for the insulated surface area (not including framing or other structural materials which shall be accounted for separately). Insulated surfaces categorized as "Grade II" shall be modeled such that there is no insulation R-value for 2% of the insulated surface area and its measured or labeled value, including other adjustments such as compression and cavity fill versus continuous, for the remainder of the insulated surface area (not including framing or other structural materials). Insulated surfaces categorized as "Grade III" shall be modeled such that there is no insulation R-value for 5% of the insulated surface area and its measured or labeled value, including other adjustments such as compression and cavity fill versus continuous, for the remainder of the insulated surface area (not including framing or other structural materials). Other building materials, including framing, sheathing, and air films shall be assigned aged or settled -values according to ASHRAE Fundamentals. In addition, the following accepted conventions shall be used in modeling Rated Home insulation enclosures:

303.4.1.4.2.1 Insulation that does not cover framing members shall not be modeled as if it covers the framing. Insulated surfaces that have continuous insulation (i.e. rigid foam, fibrous batts, loose fill, or sprayed insulation) covering the framing members shall be assessed and modeled according to Section 303.4.1.4 and combined with the cavity insulation, framing and other materials to determine the overall assembly R-value.

303.4.1.4.2.2 Compression: for modeling purposes, the base R-value of fibrous insulation that is compressed to less than its full rated thickness in a completely enclosed cavity shall be assessed according to the manufacturer's documentation; in the absence of such documentation, use R-value correction factor (CF) for Compressed Batt or Blanket from Manual J, 8th edition Table A5-1, Section 7-d.

303.4.1.4.2.3 Where large areas of insulation that is missing, or has a different R-value from the rest of an assembly exist, these areas shall be modeled with the appropriate R-value and assembly description separately from the rest of the assembly. Insulation R-values may not be averaged according to coverage area. For example, if 50 square feet of a wall area has no cavity fill insulation at all, that 50 square feet shall be recorded as a

separate building component with no cavity insulation, but with the existing structural components.

303.4.1.4.2.4 Steel framing in insulated assemblies: calculations for the overall thermal properties of steel-framed walls, ceilings and floors shall be based on the "Thermal Design Guide for Exterior Walls, Publication RG-9405, American Iron and Steel Institute; the "Zone Method" from 2001 ASHRAE Handbook of Fundamentals (P 25.10-11); or equivalent.

303.4.1.5 Renewable energy systems, using solar, wind or other renewable energy sources, which offset the energy consumption requirements of the Rated Home, shall not be included in the Reference Home.

303.4.1.6 For non-electric warm furnaces and non-electric boilers, the values in Table 303.4.1.5 shall be used for auxiliary electric (Eae) in the Reference Home.

Table 303.4.1.5

System Type	EAE
Oil boiler	330
Gas boiler	170
Oil furnace	439 + 5.5*Capacity (kBtu/h)
Gas furnace	149 + 10.3*Capacity (kBtu/h)

303.4.1.7 Lighting, Appliances and Miscellaneous Electric Loads (MELs)

303.4.1.7.1 HERS Reference Home. Lighting, appliance and miscellaneous electric loads in the HERS Reference Home shall be determined in accordance with the values provided in Table 303.4.1.7.1(1) and Table 303.4.1.7.1(2), as appropriate, and equation 3:

kWh (or therms) per year = a + b*CFA + c*Nbr (Eq. 3)

where:

'a', 'b', and 'c' are values provided in Table 303.4.1.7.1(1) and Table 303.4.1.7.1(2)

CFA = conditioned floor area

Nbr = number of bedrooms

303.4.1.7.1.1 Electric Reference Homes. Where the Rated Home has electric appliances, the HERS Reference Home lighting, appliance and miscellaneous loads shall be determined in accordance with the values given in Tables 303.4.1.7.1(1).

Table 303.4.1.7.1(1). Lighting, Appliance and Miscellaneous Electric Loads (kWh/yr) in electric HERS Reference Homes

End Use Component[(a)]	Equation Coefficients		
	a	b	c
Residual MELs		0.91	
Interior lighting	455	0.80	
Exterior lighting	100	0.05	
Refrigerator	637		18
Televisions	413		69
Range/Oven	331		39
Clothes Dryer	524		149
Dish Washer	78		31
Clothes Washer	38		10

Table 303.4.1.7.1(1) Notes:

(a) For homes with garages, an additional 100 kWh per year shall be added to the HERS Reference home for garage lighting.

303.4.1.7.1.2 Reference Homes with Natural Gas Appliances. Where the Rated Home is equipped with natural gas cooking or clothes drying appliances, the Reference Home cooking and clothes drying loads defined above in Table 303.4.1.7(1) shall be replaced by the natural gas and electric appliance loads provided below in Table 303.4.1.7(2), as applicable.

Table 303.4.1.7(2). Natural Gas Appliance Loads (therms/yr) for HERS Reference Homes with gas appliances

End Use Component[(a)]	Equation Coefficients		
	a	b	c
Range/Oven (therms)	22.6		2.7
Range/Oven (kWh)	22.6		2.7
Clothes Dryer (therms)	18.8		5.3
Clothes Dryer (kWh)	41		11.7

Table 303.4.1.7(2) Notes:

(a) Both the natural gas and the electric components shall be included in determining the HERS Reference Home annual energy use for the above appliances.

303.4.1.7.1.3 Garage Lighting. Where the Rated Home includes an enclosed garage, 100 kWh/yr shall be added to the energy use of the Reference Home to account for garage lighting.

303.4.1.7.1.4 Mechanical Ventilation. Where mechanical ventilation is provided in the Rated home, $REUL_{LA}$ shall be modified for the Reference Home by adding [0.03942*CFA + 29.565*(N_{br}+1)] kWh/yr for ventilation fan operation, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293.

303.4.1.7.1.5 Ceiling Fans. Where ceiling fans are included in the Rated Home they shall also be included in the Reference Home in accordance with the provisions of Section 303.4.1.7.2.11 of this Standard.

303.4.1.7.2 Rated Homes. For Rated homes, the following procedures shall be used to determine lighting, appliance and residual miscellaneous electric load energy consumption.

303.4.1.7.2.1 Residual MELs. Residual miscellaneous electric loads in the Rated Home shall be the same as in the HERS Reference Home and shall be calculated as 0.91*CFA, where CFA is the conditioned floor area.

303.4.1.7.2.2 Interior Lighting. Interior lighting in the Rated home is calculated using equation 5:

$$kWh/yr = 0.8*[(4 - 3*qFF_{IL})/3.7]*(445 + 0.8*CFA) + 0.2*(455 + 0.8*CFA) \quad \text{(Eq. 5)}$$

where:

CFA = Conditioned floor area

qFF_{IL} = the ratio of the Qualifying interior Light Fixtures to all interior light fixtures in Qualifying interior Light Fixture Locations.

For rating purposes, the Rated Home shall not have qFF_{IL} less than 0.10 (10%).

(Informative Note: When qFF_{IL} = 0.10 (10%), the above equation reduces to the standard interior lighting equation of: kWh/yr = 455 + 0.8*CFA.)

For the purpose of adjusting the annual interior lighting energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{IL}, which shall be calculated as the annual interior lighting energy use derived by the procedures in this section minus the annual interior lighting energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293.

For Interior lighting, internal gains in the Rated home shall be modified by 100% of the interior lighting ΔEUL_{IL} converted to Btu/day as follows: $\Delta EUL_{IL} * 10^6 / 365$.

303.4.1.7.2.3 Exterior Lighting. Exterior lighting in the Rated home shall be determined using equation 6:

$$kWh/yr = (100 + 0.05*CFA)*(1-FF_{EL}) + 0.25*(100 + 0\ .05*CFA)*FF_{EL} \quad \text{(Eq. 6)}$$

where

CFA = Conditioned floor area

FF_{EL} = Fraction of exterior fixtures that are Qualifying Light Fixtures

For the purpose of adjusting the annual exterior lighting energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{EL}, which shall be calculated as the annual exterior lighting energy use derived by the procedures in this section minus the annual exterior lighting energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293.

Internal gains in the Rated Home shall not be modified as a result of reductions in exterior lighting energy use.

303.4.1.7.2.4 Garage Lighting. For Rated homes with garages, garage lighting in the Rated home shall be determined using equation 7:

$$kWh = 100*(1-FF_{GL}) + 25*FF_{GL} \quad \text{(Eq. 7)}$$

where:

FF_{GL} = Fraction of garage fixtures that are Qualifying Light Fixtures

For the purpose of adjusting the annual garage lighting energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{GL}, which shall be calculated as the annual garage lighting energy use derived by the procedures in this section minus the annual garage lighting energy use derived for the HERS Reference Home in Section 303.4.1.7.1 (i.e. 100 kWh/yr), converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293.

Internal gains in the Rated Home shall not be modified as a result of reductions in garage lighting energy use.

303.4.1.7.2.5 Refrigerators. Refrigerator energy use for the Rated Home shall be determined from either Refrigerator Energy Guide Labels or from age-based defaults provided in Table 303.4.1.7.2.5(1).

Table 303.4.1.7.2.5(1) Age-based Refrigerator Defaults

Refrigerator/Freezer Type	Annual kWh Equation
Single-door refrigerator only	(13.5*AV + 299)*VR
Single-door refrigerator/freezer	(13.5*AV + 299)*VR
Refrigerator with top freezer	(16.0*AV + 355)*VR
with TDI	(17.6*AV + 391)*VR
Refrigerator with side-by-side freezer	(11.8*AV + 501)*VR
with TDI	(16.3*AV + 527)*VR
Refrigerator with bottom freezer	(16.6*AV + 367)*VR
Upright freezer only manual defrost	(10.3*AV + 264)*VR
Upright freezer only auto defrost	(14.0*AV + 391)*VR
Chest freezer only	(11.0*AV + 160)*VR
where: AV = Adjusted Volume = (refrigerator compartment volume) + 1.63*(freezer compartment volume) TDI = Through the door ice VR = Vintage Ratio from Table 303.4.1.7.2.5(2)	

Table 303.4.1.7.2.5(2) Age-based Vintage Ratios

Refrigerator Vintage	Vintage Ratio
1972 or before	2.50
1980	1.82
1984	1.64
1988	1.39
1990	1.30
1993	1.00
2001 forward	0.77

For the purposes of determining adjusted volume (AV), the following defaults may be used:

Table 303.4.1.7.2.5(3) Default Adjusted Volume Equations

Model Type	Default Equation
Single door refrigerator only	AV = 1.00 * nominal volume
Single door refrigerator/freezer	AV = 1.01 * nominal volume
Bottom Freezer	AV = 1.19 * nominal volume
Top Freezer	AV = 1.16 * nominal volume
Side by Side	AV = 1.24 * nominal volume
Freezer only	AV = 1.73 * nominal volume

For the purpose of adjusting the annual refrigerator energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{FRIG}, which shall be calculated as the annual refrigerator energy use derived by the procedures in this section minus the annual refrigerator energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr)/293.

For refrigerator energy use, internal gains in the Rated home shall be modified by 100% of the refrigerator ΔEUL_{FRIG} converted to Btu/day as follows: $\Delta EUL_{FRIG} * 10^6 / 365$. Internal gains shall not be modified for refrigerators located in unconditioned spaces (e.g. unconditioned garages, etc.)

303.4.1.7.2.6 Televisions. Television energy use in the Rated Home shall be the same as television energy use in the HERS Reference Home and shall be calculated as TVkWh/yr = 413 + 69*Nbr, where Nbr is the number of bedrooms in the Rated Home.

303.4.1.7.2.7 Range/Oven. Range/Oven (cooking) energy use for the Rated Home shall be determined as follows:

1) For electric cooking:
   kWh/yr = BEF * OEF * (331 + 39*Nbr) (Eq. 12a)
2) For natural gas cooking:
   Therms/yr = OEF*(22.6 + 2.7*Nbr) (Eq. 12b)

plus:

   kWh/yr = 22.6 + 2.7*Nbr (Eq. 12c)

where:

BEF= Burner Energy Factor = 0.91 for induction ranges and 1.0 otherwise.

OEF = Oven Energy Factor = 0.95 for convection types and 1.0 otherwise
Nbr = Number of bedrooms

For the purpose of adjusting the annual Range/Oven energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{RO}, which shall be calculated as the annual Range/Oven energy use derived by the procedures in this section minus the annual Range/Oven energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr) / 293 or (therms/yr) / 10, whichever is applicable.

For Range/Oven energy use, internal gains in the Rated Home shall be modified by 80% of the Range/Oven ΔEUL_{RO} converted to Btu/day as follows: $\Delta EUL_{RO} * 10^6 / 365$. Of this total amount, internal gains shall be apportioned as follows, depending on fuel type:

a) For electric Range/Ovens, 90% sensible internal gains and 10% latent internal gains
b) For gas Range/Ovens, 80% sensible internal gains and 20% latent internal gains.

303.4.1.7.2.8 Clothes Dryers. Clothes Dryer energy use for the Rated Home shall be determined by the following equation.

kWh/yr = 12.5*(164+46.5*Nbr)*FU/EFdry*(CAPw/MEF - LER/392)/(0.2184*(CAPw*4.08+0.24)) **(Eq. 13)**

where:

Nbr = Number of bedrooms in home
FU = Field Utilization factor =1.18 for timer controls **or** 1.04 for moisture sensing
EFdry = Efficiency Factor of clothes dryer (lbs dry clothes/kWh) from the CEC database [4] or use following electric clothes dryer default: 3.01
CAPw = Capacity of clothes washer (ft^3) from the manufacturer's data or the CEC database **or** the EPA Energy Star website [5] **or** use default of 2.874 ft^3
MEF[6] = Modified Energy Factor of clothes washer from Energy Guide Label **or** use default of 0.817
LER[37] = Labeled Energy Rating of clothes washer (kWh/yr) from Energy Guide Label **or** use default of 704

For natural gas clothes dryers the following equations shall be used:

Therms/yr = (result of Eq. 13)*3412*(1-0.07)*(3.01/EFdry-g)/100000 (Eq. 13a)
kWh/yr = (result of Eq. 13)*0.07*(3.01/EFdry-g) (Eq. 13b)

[4] http://www.energy.ca.gov/appliances/database/excel_based_files/
[5] http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers
[6] This value must be determined from the energy rating for clothes washer as it determines the amount of moisture remaining in the clothes after the washer cycle is completed.

where:

EFdry-g = Efficiency Factor for gas clothes dryer from the CEC database[1] or use the following gas clothes dryer default: 2.67.

For the purpose of adjusting the annual Clothes Dryer energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{CD}, which shall be calculated as the annual Clothes Dryer energy use derived by the procedures in this section minus the annual Clothes Dryer energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr) / 293 or (therms/yr) / 10, whichever is applicable.

For Clothes Dryer energy use, total internal gains in the Rated Home shall be modified by 15% of the Cloths Dryer ΔEUL_{CD} converted to Btu/day as follows: $\Delta EUL_{CD} * 10^6 / 365$. Of this total amount, 90% shall be apportioned to sensible internal gains and 10% to latent internal gains. Internal gains shall not be modified for Clothes Dryers located in unconditioned spaces (e.g. unconditioned garages, etc.)

303.4.1.7.2.9 Dishwashers. Dishwasher energy use for the Rated Home shall be determined using the following equation.

kWh/yr = [(86.3 + 47.73/EF)/215]*dWcpy **(Eq. 14a)**

where:

EF = Labeled dishwasher energy factor

or

EF = 215/(labeled kWh/year)

dWcpy = (88.4 + 34.9*Nbr)*12/dWcap

where:

dWcap = Dishwasher place setting capacity; Default = 12 settings for standard sized dishwashers and 8 place settings for compact dishwashers

And the change (Δ) in daily hot water use (GPD – gallons per day) for dishwashers shall be calculated as follows:[7]

$$\Delta GPD_{DW} = [(88.4+34.9*Nbr)*8.16 - (88.4+34.9*Nbr)*12/dWcap*(4.6415*(1/EF) - 1.9295)]/365 \quad \textbf{(Eq. 14b)}$$

For the purpose of adjusting the annual Dishwasher energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{DW}, which shall be calculated as the annual Dishwasher energy use derived by the procedures in this section minus the annual Clothes Dishwasher energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr) / 293 or (therms/yr) / 10, whichever is applicable.

[7] http://www1.eere.energy.gov/buildings/appliance_standards/residential/docs/lcc_dishwasher.xls

For the purpose of adjusting the daily hot water use for calculating the rating, the daily hot water use change shall be 'ΔGPD_{DW}' as calculated above.

For Dishwasher energy use, total internal gains in the Rated Home shall be modified by 60% of the Dishwasher ΔEUL_{DW} converted to Btu/day as follows: $\Delta EUL_{DW} * 10^6$ / 365. Of this total amount, 50% shall be apportioned to sensible internal gains and 50% to latent internal gains.

303.4.1.7.2.10 Clothes Washers. Clothes Washer annual energy use and daily hot water use for the Rated Home shall be determined as follows.

Annual energy use shall be calculated using the following equation:

kWh/yr = ((LER/392)-((LER*($/kWh)-AGC)/(21.9825*($/kWh) - ($/therm))/392)*21.9825)*ACY **(Eq. 15a)**

where:
LER = Label Energy Rating (kWh/yr) from Energy Guide Label
$/kWh = Electric Rate from Energy Guide Label
AGC = Annual Gas Cost from Energy Guide Label
$/therm = Gas Rate from Energy Guide Label
ACY = Adjusted Cycles per Year

and where:
ACY = NCY * ((3.0*2.08+1.59)/(CAPw*2.08+1.59))

where:
NCY = (3.0/2.847) * (164 + Nbr*45.6)
CAPw = washer capacity in cubic feet from the manufacturer's data or the CEC database[8] **or** the EPA Energy Star website [9] **or** use default of 2.874 ft^3

And daily hot water use shall be calculated as follows:

DHWgpd = 120.5* therms/cyc * ACY / 365 **(Eq. 15b)**

where:
therms/cyc = (LER * $/kWh - AGC) / (21.9825 * $/kWh - $/therm) / 392

For the purpose of adjusting the annual Clothes Washer energy consumption for calculating the rating, EUL_{LA} shall be adjusted by ΔEUL_{CW}, which shall be calculated as the annual Clothes Washer energy use derived by the procedures in this section minus the annual Clothes Washer energy use derived for the HERS Reference Home in Section 303.4.1.7.1, converted to MBtu/yr, where MBtu/yr = (kWh/yr) / 293 **or** (therms/yr) / 10, whichever is applicable.

For the purpose of adjusting the daily hot water use for calculating the rating, the daily hot water use change shall be calculated as the daily hot water use derived by the

[8] http://www.energy.ca.gov/appliances/database/excel_based_files/
[9] http://www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers

procedures in this section minus 7.94 gallons per day for the reference standard clothes washer.

For Clothes Washer energy use, total internal gains in the Rated Home shall be modified by 30% of the Clothes Washer ΔEUL_{CW} converted to Btu/day as follows: $\Delta EUL_{CW} * 10^6 / 365$. Of this total amount, 90% shall be apportioned to sensible internal gains and 10% to latent internal gains. Internal gains shall not be modified for Clothes Washers located in unconditioned spaces (e.g. unconditioned garages, etc.)

Rating and label data on clothes washer may be found at the following web sites:

EPA: www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers
CEC: www.energy.ca.gov/appliances/database/excel_based_files/Clothes_Washers/

303.4.1.7.2.11 Ceiling Fans. If ceiling fans are included in the Rated home, they shall also be included in the Reference home. The number of bedrooms plus one (Nbr+1) ceiling fans shall be assumed in both the Reference Home and the Rated Home. A daily ceiling fan operating schedule equal to 10.5 full-load hours shall be assumed in both the Reference Home and the Rated Home during periods when ceiling fans are operational. Ceiling fans shall be assumed to operate only during the cooling season, which may be estimated to be all months with an average temperature greater than 63 ^{o}F. The cooling thermostat (but not the heating thermostat) shall be set up by 0.5 ^{o}F in both the Reference and Rated Home during periods when ceiling fans are assumed to operate.

The Reference Home shall use number of bedrooms plus one (Nbr+1) Standard Ceiling Fans of 42.6 watts each. The Rated Home shall use the Labeled Ceiling Fan Standardized Watts (LCFSW), also multiplied by number of bedrooms plus one (Nbr+1) fans to obtain total ceiling fan wattage for the Rated Home. The Rated Home LCFSW shall be calculated as follows:

LCFSW = (3000cfm) / (cfm/watt as labeled at medium speed)

Where installed ceiling fans in the Rated Home have different values of LCFSW, the average LCFSW shall be used for calculating ceiling fan energy use in the Rated Home.

During periods of fan operation, the fan wattage, at 100% internal gain fraction, shall be added to internal gains for both the Reference and Rated Homes. In addition, annual ceiling fan energy use, in MBtu/yr [(kWh/yr)/293], for both the Rated and Reference homes shall be added to the lighting and appliance end use loads (EUL_{LA} and $REUL_{LA}$, as appropriate) as specified by Equation 2, Section 303.2.1 of this Chapter.

303.4.1.7.2.12 Mechanical Ventilation System Fans. If ventilation fans are present in the Rated Home, EUL_{LA} shall be adjusted by adding total annual kWh energy consumption of the ventilation system in the Rated Home, converted to MBtu/yr, where MBtu/yr = (kWh/yr) / 293.

303.4.1.8 If the Rated Home includes On-site Power Production, the Purchased Energy Fraction for the Rated Home (see Section 303.2.2) shall be used to determine the impact of the On-site Power Production on the HERS Index.

303.5 Operating Condition Assumptions

303.5.1 All HERS providers shall estimate the annual purchased energy consumption for heating, cooling and hot water for both the Rated Home and the Reference Home using the following assumptions–

303.5.1.1 Where programmable offsets are available in the Rated Home, 2 ^{o}F temperature control point offsets with an 11 p.m. to 5:59 a.m. schedule for heating and a 9 a.m. to 2:59 p.m. schedule for cooling, and with no offsets assumed for the Reference Home;

303.5.1.2 When calculating annual purchased energy for cooling, internal latent gains assumed as 0.20 times sensible internal heat gains;

303.5.1.3 The climatologically most representative TMY or equivalent climate data, which may be interpolated between climate sites if interpolation is established or approved by the accrediting body and consistent for all HERS providers operating within a state.

303.5.1.4 Manufacturer's Equipment Performance Ratings (e.g., HSPF, SEER, AFUE) shall be corrected for local climate conditions and mis-sizing of equipment. To determine equipment mis-sizing, the capacity of heating and cooling vapor compression equipment shall be calculated in accordance with ACCA Manual J, Eighth Edition, ASHRAE 2001 Handbook of Fundamentals, or an equivalent computation procedure, using the following assumptions:

303.5.1.4.1 HERS Reference Home:

303.5.1.4.1.1 Indoor temperatures shall be 75 F for cooling and 70 F for heating.

303.5.1.4.1.2 Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the city where the home is located or the most representative city for which design temperature data are available.

303.5.1.4.1.3 Infiltration rate in air changes per hour (ach) shall be:

(a) For summer: 1.2 * nL * W
(b) For winter: 1.6 * nL * W
(c) Where: nL = 0.48
(d) W = Weather factor from W Tables in ASHRAE Standard 136

303.5.1.4.1.4 Mechanical ventilation shall be zero.

303.5.1.4.1.5 All windows shall have blinds/draperies that are positioned in a manner that gives an Internal Shade Coefficient (ISC) of 0.70 in the summer and an ISC of 0.85

in the winter. These values are represented in ACCA Manual J Eighth Edition as "dark closed blinds" in the summer and "dark, fully drawn roller shades" in the winter.

303.5.1.4.1.6 Internal heat gains shall be 1,600 Btu/hr sensible for appliances plus 230 Btu/hr sensible and 200 Btu/hr latent per occupant, with the number of occupants equal to the number of bedrooms plus one.

303.5.1.4.1.7 Heat pump equipment shall be sized to equal the larger of the heating and cooling season calculations in accordance with these procedures.

303.5.1.4.1.8 Systems shall be smaller than the size calculated using this procedure plus 100 Btu/hr.

303.5.1.4.2 The Rated Home:

303.5.1.4.2.1 Indoor temperatures shall be 75 F for cooling and 70 F for heating.

303.5.1.4.2.2 Outdoor temperatures shall be the 99.0% and 1.0% design temperatures as published in the ASHRAE Handbook of Fundamentals for the city where the home is located or the most representative city for which design temperature data are available.

303.5.1.4.2.3 Infiltration rate shall be either the measured envelope leakage area converted to equivalent natural air changes per hour (ach,nat) or the default value derived above for the Reference Home modified as follows:

(a) For summer: either 1.2 * ach,nat or 1.2 * nL * W
(b) For winter: either 1.6 * ach,nat or 1.6 * nL * W
(c) Where: nL = 0.48
(d) W = Weather factor from W Tables in ASHRAE Standard 136

303.5.1.4.2.4 Mechanical ventilation shall only be included for systems that are controlled to run every hour or every time the HVAC system operates. Standard bathroom and kitchen ventilation may not be considered as ventilation for sizing purposes.

303.5.1.4.2.5 Combined infiltration and ventilation may not be less than the ventilation rates required by ASHRAE Standard 62.2-2004, nor greater than nL * W * 1.2 in summer and nL * W * 1.6 in winter.

303.5.1.4.2.6 Windows shall include observed blinds/draperies. For new homes, all windows shall assume blinds/draperies that are positioned in a manner that gives an Internal Shade Coefficient (ISC) of 0.70 in the summer and an ISC of 0.85 in the winter. (These values are represented in ACCA Manual J Eighth Edition as "dark closed blinds" in the summer and "dark fully drawn roller shades" in the winter.)

303.5.1.4.2.7 Internal heat gains shall be 1,600 Btu/hr sensible plus 230 Btu/hr sensible and 200 Btu/hr latent per occupant, with the number of occupants equal to the number of bedrooms plus one.

303.5.1.4.2.8 Heat pump equipment shall be sized to equal the larger of the heating and cooling season calculations in accordance with these procedures.

303.5.1.4.2.9 To the degree that the installed equipment for the Rated Home exceeds properly sized equipment in accordance with the above procedures, the manufacturer's equipment performance rating shall be reduced accordingly.

303.5.1.5 For heat pumps and air conditioners where a detailed, hourly HVAC simulation is used to separately model the compressor and evaporator energy (including part-load performance), the back-up heating energy, the distribution fan or blower energy and crank case heating energy, the Manufacturer's Equipment Performance Rating (HSPF and SEER) shall be modified as follows to represent the performance of the compressor and evaporator components alone: HSPF, corr = HSPF, mfg / 0.582 and SEER, corr = SEER, mfg / 0.941. The energy uses of all components (i.e. compressor and distribution fan/blower; and crank case heater) shall then be added together to obtain the total energy uses for heating and cooling.

303.5.1.6 For ground-loop and ground-water heat pumps, the Auxiliary Electric Consumption shall be determined as follows:

GSHP Auxiliary Electric Consumption (kWh/yr) = $GSHP_{pump}$ + $GSHP_{fan}$

Where:

$GSHP_{pump}$ in watts is the observed pump nameplate data (Volts *Amps) for all hours of heat pump operation. Amps may be taken from nameplate as Run Load Amps (RLA) or Full Load Amps (FLA). Alternatively, pumping energy that is measured on-site with a watt-hour meter, or using measured V*A may be substituted. Such measured pumping energy may be further adjusted for on-site measured duty cycle during heat pump operation, when pumping is intermittent during continuous heat pump operation.
$GSHP_{fan}$: If ducts are attached to the system to deliver heating or cooling, the external fan energy in watts, $GSHP_{fan}$ = (air flow in CFM * 0.5 CFM per watt), shall be added for all hours of heat pump operation. The air flow in CFM shall be (360 * rated cooling btu/h / 12,000), where 360 is the air flow in CFM per ton (12 kbtu/h) of capacity

303.5.1.7 Natural ventilation shall be assumed in both the Reference and Rated Homes during hours when natural ventilation will reduce annual cooling energy use.

303.5.1.8 When a whole-house fan is present in the Rated Home, it shall operate during hours of favorable outdoor conditions, and no whole-house fan shall be assumed in the Reference Home. The fan energy associated with the whole-house fan shall be included in the normalized Energy Consumption for the Rated Home's cooling end-use (nEC_x).

303.5.1.9 Local residential energy or utility rates that–
(a) Are revenue-based and include customer service and fuel charges;
(b) Are updated at least annually; and
(c) Are confirmed by the accrediting body.

303.6 Standardized Existing Home Retrofit Savings

Standardized energy savings for existing home retrofits shall be determined by comparing a Baseline Home with an Improved Home in accordance with the provisions of this section.

303.6.1 Baseline Home. The Baseline Home model for the purposes of determining the energy savings of an existing home retrofit shall be the original configuration of the existing home, including the full complement of lighting, appliances and residual miscellaneous energy use as specified by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2). The energy use of these end uses in the Baseline Home shall be based on the original home configuration following the provision of Section 303.4.1.7.2.

303.6.1.1 Where multiple appliances of the same type exist in the original configuration of the existing home, the same number of those appliance types shall be included in the Baseline Home model.

303.6.1.2 Where a standard appliance as defined by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2) does not exist in the original configuration of the existing home, the standard default energy use and internal gains as specified by Table 303.4.1(3) for that appliance shall be included in the Baseline Home model.

303.6.2 Improved Home. The improved home model for the purpose of determining the energy savings of an existing home retrofit shall be the existing home's configuration including all energy improvements to the original home and including the full complement of lighting, appliances and residual miscellaneous energy use contained in the home after all energy improvements have been implemented.

303.6.2.1 Where an appliance has been upgraded but the existing appliance is not removed from the existing home property, both the new and existing appliance shall be included in the Improved Home model.[10]

303.6.2.2 Where a standard appliance as defined by Tables 303.4.1.7.1(1) and 303.4.1.7.1(2) does not exist in the improved configuration of the existing home, the standard default energy use and internal gains as specified by Table 303.4.1(3) for that appliance shall be included in the Improved Home model.

303.6.2.3 Improvements in lighting and appliance energy use in the Improved Home model shall be calculated in accordance with Section 303.4.1.7.2.

303.6.3 Standard Operating Conditions.

303.6.3.1 Both the Baseline Home and Improved Home shall be configured and modeled in accordance with the Rated Home specifications of Table 303.4.1(1) except that the Baseline Home shall not violate the input constraints specified in Table 303.6.3(1) below.

[10] For example, if a refrigerator is upgraded to a more efficient model and the original refrigerator is kept on property for potential use as a second refrigerator; both refrigerators shall be included in the Improved Home energy model.

Table 303.6.3(1) Baseline Home Input Constraints

Equipment Constraints*	**Minimum Value**
Forced-air furnace, AFUE	72%
Hot water / steam boiler, AFUE	60%
Heat Pump, HSPF	6.5
Heat Pump, SEER	9.0
Central air conditioner, SEER	9.0
Room air conditioner, EER	8.0
Gas-fired storage water heater, EF	0.50
Oil-fired storage water heater, EF	0.45
Electric storage water heater, EF	0.86
Enclosure Constraints (including air film conductances)	**Maximum U-factor**
Wood-frame wall	0.222
Masonry wall	0.250
Wood-frame ceiling with attic (interior to attic space)	0.286
Unfinished roof	0.400
Wood-frame floor	0.222
Single-pane window, wood frame	0.714
Single-pane window, metal frame	0.833

*** Exception:** Where the labeled equipment efficiency exists for the specified piece of existing equipment, the labeled or measured steady state efficiency shall be used in lieu of the these minimum input constraints.

303.6.3.2 Air Distribution Systems

303.6.3.2.1 In cases where the air distribution system leakage is not measured in the original Baseline Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled in both the Baseline Home and the Improved Home as 0.10 times the conditioned floor area of the home split equally between the supply and return side of the air distribution system with the leakage distributed evenly across the duct system.

Exception: If the air handler unit and a minimum of 75% of its duct system are entirely inside the conditioned space boundary, the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled in both the Baseline Home and the Improved Home as 0.05 times the conditioned floor area of the home split equally between the supply and return side of the air distribution system with the leakage distributed evenly across the duct system.

303.6.3.2.2 In cases where the air distribution system leakage is measured:

303.6.3.2.2.1 For the Baseline Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be modeled as the lesser of the measured air distribution system leakage to outdoors at 25 Pascal pressure difference in the original Baseline

Home or 0.24 times the conditioned floor area of the home, either split evenly between the supply and return side of the air distribution system or as measured separately with the leakage distributed evenly across the duct system.

303.6.3.2.2.2 For the Improved Home, the ducts shall be modeled in the spaces in which they are located and the air distribution system leakage to outdoors at 25 Pascal pressure difference shall be set equal to the measured air distribution system leakage to outdoors at 25 Pascal pressure difference in the Improved Home, either split evenly between the supply or return side of the air distribution system or as measured separately with the leakage distributed evenly across the duct system.

303.6.3.3 Both the Baseline Home and the Improved Home shall be subjected to the operating conditions specified by Section 303.5.1.4.2.

303.6.4 Total Energy Savings Calculation.

303.6.4.1 Energy units used in the calculation of energy savings shall be units of Equivalent Electric Energy using the Reference Electricity Production Efficiency for fossil fuels. Equivalent electric energy use shall be calculated using Equation 303.6.4-1.

$$kWh_{eq} = kWh_{elec} + \frac{Btu_{fossil} * 0.40}{3412} \qquad \text{(Eqn. 303.6.4-1)}$$

303.6.4.2 Energy savings shall be calculated as the difference between the whole-house projected equivalent electric energy use of the Baseline Home and the whole-house projected equivalent electric energy use of the Improved Home.

303.6.4.3 The energy savings percentage of the retrofit shall be calculated as the whole-house equivalent electric energy savings as determined by Section 303.6.4.2 above divided by the whole-house equivalent electric energy use of the Baseline Home.

303.7 Projected and Confirmed Ratings

303.7.1 A HERS provider may calculate the Projected Rating of a to-be-built or to-be-improved home based on architectural drawings with material, mechanical and electrical specifications for a to-be-built home, or based on a site audit for a to-be-improved home; and by:

303.7.1.1 Using either the envelope leakage rate specified as the required performance by the construction documents, the site-measured envelope leakage rate, or a default value as specified for the Reference home in Table 303.4.1(1).

303.7.1.2 Using either the distribution system efficiency specified as the required performance by the construction documents, the site-measured distribution system efficiency, or a default distribution system efficiency value from Table 303.4.1(1); and

303.7.1.3 Using the planned location and orientation of the proposed home, or if the proposed orientation is unknown, calculating ratings for the home facing each of the four

cardinal directions, north, south, east and west, and using the largest HERS Index as the "worst case" Projected Rating.

303.7.2 Upon completion of construction and verification of the proposed specifications, all rated features of the home shall be confirmed using site inspections and envelope air leakage rates and distribution system efficiencies derived from on-site diagnostic tests conducted in accordance with Section 303.8.1 of this Standard, and the actual orientation of the home.

303.7.3 Rating tools accredited under Section 303.8 of this Standard must be retested and re-certified if a new version of the tool is released that includes changes to the engineering algorithms.

303.8 Minimum Rated Features

303.8.1 All HERS providers shall calculate the estimated annual purchased energy consumption for heating, cooling, water heating and lighting and appliances set forth in Section 303.1 of this Standard using the energy loss and gain associated with the minimum rated features as set forth in Table 303.8.1(1),

303.8.1.1 For existing homes, the envelope thermal characteristics of building elements 1 through 7 set forth in Table 303.8.1(1) are determined by site observation.

303.8.1.2 If data for the minimum rated features set forth in Section 303.8.1.1 of this Standard cannot be obtained by observation or without destructive disassembly of the home, default values shall be used. The default values are determined from the following sources listed in the preferential order of use:

(a) For manufactured homes, available manufacturer's data:
(b) Current and historical local building practices; or
(c) Current and historical local building codes.

303.8.1.3 For existing homes, the determination of air leakage and duct leakage values set forth as building elements 10 and 11 in Table 303.8.1(1) are determined by data collected on site using the following procedures listed in preferential order of use:

303.8.1.3.1 Current on-site diagnostic tests conduced in accordance with the requirements set forth in Table 303.4.1(1); or

303.8.1.3.2 Observations of the condition of the building and duct system made by a Certified Rater. Based on these observations, values from Tables 303.4.1(3)shall be used.

303.8.1.3.3 The energy efficiency of the mechanical equipment set forth as building elements 12 through 14 in Table 303.8.1(1) is determined by data collected on site using the following sources listed in preferential order of use:

(a) Current on-site diagnostic test data as corrected using the following equation:

Eff,rated = Eff,listed * Es,measured / Es,listed

where:

Eff,rated = annual efficiency to use as input to the rating
Eff,listed = listed annual efficiency by manufacturer or directory
Es,measured = measured steady state efficiency of system
Es,listed = manufacturer's listed steady state efficiency, under the same operating conditions found during measurement

(b) Name plate data;
(c) Manufacturer's data sheet; or
(d) Equipment directories.

303.8.1.4 When information on the energy efficiency of mechanical equipment cannot be determined from the sources listed in paragraph 303.8.1.3.3 of this Standard, the values set forth in Tables 303.8.1(2); 303.8.1(3); 303.8.1(4) and 303.8.1(5) shall be used.

303.8.1.5 Any HERS provider may base annual purchased energy consumption estimates for the Rated Home on additional features if the HERS provider's energy analysis tool is capable of doing so.

Table 303.8.1(1) Minimum Rated Features

Building element	**Minimum Rated Feature**
1. Floor/Foundation Assembly.	Construction type (slab-on-grade, crawl space; basement), insulation value (edge, under slab, cavity, sheathing), framing material and on-center spacing, insulation installation (Grade I, II, or III), vented or unvented (crawl space), capacitance (if slab or basement receives appreciable solar gain).
2. Walls	Construction type, insulation value (cavity, sheathing), framing material and on-center spacing insulation installation (Grade I, II, or III) capacitance, color (light, medium, or dark).
3. Roof/Ceiling Assembly	Construction type, insulation value (cavity, sheathing), framing material and on-center spacing insulation installation (Grade I, II, or III), framing covered by insulation or exposed, roof color (light, medium, or dark).
4. Rim Joist	Insulation value (cavity, sheathing).
5. Doors	Construction type, insulation value.
6. Windows	Construction type, orientation, U-value (of complete assembly), solar heat gain coefficient, shading.
7. Skylights	Construction type, orientation, tilt, U-value (of complete assembly), heat gain coefficient, shading.
8. Passive Solar System (Direct Gain system)	Solar type, collector type and area, orientation, tilt efficiency, storage tank size, pipe insulation value.

Table 303.8.1(1) Minimum Rated Features

Building element	Minimum Rated Feature
9. Solar Domestic Hot Water Equipment	System type, collector type and area, orientation, tilt, efficiency, storage tank size, pipe insulation value.
10. Air Leakage	Air leakage measurement type (default estimate, blower door test, tracer gas test), volume of conditioned space.
11. Distribution System	System type, location, insulation value (duct and pipe), air leakage measurement type (default estimate, duct pressurization).
12. Heating Equipment	Equipment type, location, efficiency (AFUE, HSPF), auxiliary electric (Eae); power consumption of ground fluid circulating pump(s) for ground-loop and ground-water heat pumps.
13. Cooling Equipment	Equipment type, location, efficiency (SEER, COP).
14. Domestic Hot Water Equipment	Equipment type, location, energy factor or seasonal efficiency, extra tank insulation value, pipe insulation value.
15. Control Systems	Thermostat type.
16. Light fixtures	Number of qualifying and non-qualifying light fixtures in qualifying locations (i.e. kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole (excluding landscape lighting)).
17. Refrigerator(s)	Total annual energy consumption (kWh) for all units from: California Energy Commission: Appliance Database at http://www.energy.ca.gov/appliances/appliance/index.html or Association of Home Appliance Manufacturers (AHAM) directories
18. Dishwasher(s)	Energy factor (cycles/kWh) for all units from: the Federal Trade Commission's " Dishwasher Energy Data" posted at http://www.ftc.gov/bcp/conline/edcams/eande/appliances/data/2004/dwasher/brand.htm
19. Ceiling Fans	Labeled cfm, Watts and cfm/Watt at medium fan speed from EPA ENERGY STAR ceiling fan label.
20. Mechanical Ventilation System(s)	Equipment type, daily run hours, and wattage (may be listed in the Certified Home Ventilating Products Directory available from the Heating and Ventilation Institute (HVI).
21. On-site Power Generation	Total annual kWh generation and total site fuel used in the production of on-site power generation as derived from manufacturer's performance ratings.

Table 303.8.1(2) Default Solid Fuel Combustion Seasonal Efficiencies for Space Heating

Type	Location	Seasonal Efficiency	Notes
EPA-Listed Stove, Furnace, or Boiler	Conditioned space	Contained in the EPA publication "Certified Wood Heaters" and posted at http://www.epa.gov/compliance/resources/publications/monitoring/programs/woodstoves/certifiedwood.pdf	
EPA-Listed Stove, Furnace or Boiler	Unconditioned space	0.85 of EPA listing	
EPA Stove – Not Listed	Conditioned space	60%	For stoves with documented EPA compliance, but not found on EPA's Web site list of certified stoves
EPA Stove – Not Listed	Unconditioned space	50%	For stoves with documented EPA compliance, but not found on EPA's Web site list of certified stoves
EPA-Listed Stove Insert	Enclosed, such as in fireplace	Subtract 10% from listed seasonal efficiency	
Non-EPA Stove	Conditioned space	50%	Not tested or listed by EPA
Non-EPA Stove	Unconditioned space	40%	Not tested or listed by EPA
Biomass Fuel Furnace or Boiler with Distribution System	Conditioned space	50%	Not tested or listed by EPA Distribution system efficiency shall also be considered
Biomass Fuel Furnace or Boiler with Distribution System	Unconditioned space	40%	Not tested or listed by EPA Distribution system efficiency shall also be considered

Table 303.8.1(2) Default Solid Fuel Combustion Seasonal Efficiencies for Space Heating

Type	Location	Seasonal Efficiency	Notes
Biomass Fuel Furnace or Boiler with Distribution System	Outside	30%	Not tested or listed by EPA Distribution system efficiency shall also be considered
Solid Fuel Furnace or Boiler – Independently Tested	Central with ducted or hydronic distribution	0.85 of tested listing	Only permitted with documentation of independent testing lab documentation Distribution system efficiency shall also be considered

Table 303.8.1(3) Default Values for Mechanical System Efficiency (Age-based)*

Mechanical Systems	Units	Pre-1960	1960-1969	1970-1974	1975-1983	1984-1987	1988-1991	1992 to present
Heating:								
Gas Furnace	AFUE	0.72	0.72	0.72	0.72	0.72	0.76	0.78
Gas Boiler	AFUE	0.60	0.60	0.65	0.65	0.70	0.77	0.80
Oil Furnace or Boiler	AFUE	0.60	0.65	0.72	0.75	0.80	0.80	0.80
Air-Source Heat Pump	HSPF	6.5	6.5	6.5	6.5	6.5	6.80	6.80
Ground-Water Geothermal Heat pump	COP	2.70	2.70	2.70	3.00	3.10	3.20	3.50
Ground-Coupled Geothermal Heat Pump	COP	2.30	2.30	2.30	2.50	2.60	2.70	3.00
Cooling:								
Air-Source Heat Pump	SEER	9.0	9.0	9.0	9.0	9.0	9.40	10.00
Ground-Water Geothermal Heat Pump	EER	10.00	10.00	10.00	13.00	13.00	14.00	16.00
Ground-Coupled Geothermal Heat Pump	EER	8.00	8.00	8.00	11.00	11.00	12.00	14.00
Central Air Conditioner	SEER	9.0	9.0	9.0	9.0	9.0	9.40	10.00
Room Air Conditioner	EER	8.0	8.0	8.0	8.0	8.0	8.10	8.50
Water Heating:								
Storage Gas	EF	0.50	0.50	0.50	0.50	0.55	0.56	0.56
Storage Oil	EF	0.47	0.47	0.47	0.48	0.49	0.54	0.56

Table 303.8.1(3) Default Values for Mechanical System Efficiency (Age-based)*

Mechanical Systems	**Units**	**Pre-1960**	**1960-1969**	**1970-1974**	**1975-1983**	**1984-1987**	**1988-1991**	**1992 to present**
Storage Electric	EF	0.86	0.86	0.86	0.86	0.86	0.87	0.88

*** Exception:** Where the labeled equipment efficiency exists for the specific piece of existing equipment, the labeled efficiency shall be used in lieu of these minimum input constraints.

TABLE 303.8.1(4) Default Values for Mechanical System Efficiency (not Age-based)*

	Units	Rating
Heating:		
Gas Wall Heater (Gravity)	AFUE	0.72
Gas Floor Furnace	AFUE	0.72
Gas Water Heater (Space Heating).	AFUE	0.75
Electric Furnace	HSPF	3.413
Electric Radiant	HSPF	3.413
Heat Pump Water Heater (Space)	HSPF	5.11
Electric Water Heater (Space)	HSPF	2.73
Cooling:		
Electric Evaporative Cooling	EER	30
Gas Absorption Cooler	COP	0.40
Water Heating:		
Heat Pump	COP	2.00
Instantaneous Electric	EF	0.87
Instantaneous Gas	EF	0.75
Solar (Use SRCC Adjustment Procedures)	EF	2.00

*** Exception:** Where the labeled equipment efficiency exists for the specific piece of existing equipment, the labeled efficiency shall be used in lieu of these minimum input constraints.

Table 303.8.1(5) Default EAE Values

System Type	EAE
Oil boiler	330
Gas boiler	170
Oil furnace	439 + 5.5 * Capacity (kBtu/h)
Gas furnace	149 + 10.3 * Capacity (kBtu/h)

303.9 Software Rating Tools

303.9.1 Minimum capabilities. Calculation procedures used to comply with this Standard shall be computer-based rating software tools capable of calculating the annual energy consumption and HERS Index of all building elements that differ between the HERS Reference Home and the Rated Homes and shall include the following capabilities:

303.9.1.1 Compliance with the rating provisions of Section 303.1 of this Standard

303.9.1.2 Computer generation of HERS Index and star ratings in accordance with the provisions of Section 303.2 of this Standard

303.9.1.3 Automated computer generation of the HERS Reference Home using only the input for the Rated Home

303.9.1.4 The software tool shall not allow the user to directly modify the building component characteristics of the HERS Reference Home

303.9.1.5 Calculation of whole-building, single-zone sizing for the heating and cooling equipment in the HERS Reference Home residence in accordance with Section 303.5.1.4 of this Standard.

303.9.1.6 Calculations that account for the indoor and outdoor temperature dependencies and the part-load performance of heating, ventilating, and air conditioning equipment based on climate and equipment sizing

303.9.1.7 Printed rating report in accordance with Section 303.3 of this Standard

303.9.2 Approved tools. Rating software tools shall be accredited by RESNET through compliance with the "RESNET Rating Software Testing and Verification Procedures" posted on the RESNET web site at www.natresnet.org (see also Chapter 1, Section 102.2.1).

303.10 Innovative Design Request

303.10.1 HERS providers can petition RESNET for adjustment to the HERS Index for a Rated Home with features or technologies not addressed by approved software tools and/or this Standard. Innovative Design Requests (IDRs) to RESNET shall include, at a minimum, the following:

303.10.1.1 A Rating generated from approved rating software tool for Rated Home without feature(s) that cannot be modeled in the software tool.

303.10.1.2 Written description of feature(s) not included in Rating generated from software.

303.10.1.3 Manufacturer's technical and/or performance specifications for feature(s) not included in the Rating generated from the approved software tool.

303.10.1.4 Estimated energy impact. Calculations or simulation results estimating the energy impact of feature(s) not included in the Rating generated from an approved software tool and documentation to support the calculation methodology and/or describe the modeling approach used.

303.10.1.5 Estimated adjustment to HERS Index. Calculations shall follow procedures of Sections 303.1 and 303.2.

303.10.2 Upon review of an IDR, RESNET Standing Technical Committee shall request additional supporting documentation for further consideration or provide a recommendation with justification to the Board as follows: a) is approved, b) is denied, or c) is approved with modifications. The RESNET Board of Directors shall accept or reject the recommendation of Technical Committee or request further information from the Technical Committee.

303.10.3 IDRs shall be approved on a case by case basis. RESNET shall assign a unique identifier to each IDR and maintain a database of IDRs. If RESNET approves the IDR, the HERS provider may issue a supplemental report that adjusts the HERS Index as approved.

Chapter Four
RESNET Standards

400 NATIONAL STANDARD FOR BUILDER OPTION PACKAGES

401 BACKGROUND

The following procedures for accrediting Building Option Package (BOP) Providers have been developed and adopted by the Residential Energy Services Network (RESNET). BOPs were developed by the U.S. Environmental Protection Agency (EPA), can be used by builders to demonstrate compliance to the ENERGY STAR® Homes Program standard. The BOPs have been demonstrated to meet the Home Energy Rating score threshold adopted by the Environmental Protection Agency under "worse case" scenarios and involve the same building performance inspection as a home energy rating.

401.1 Purpose

The purpose of this procedure is to ensure that accurate and consistent BOPs are implemented by accredited BOP Providers nationwide to increase the credibility of BOPs and the ENERGY STAR® Homes program

401.2 Scope

401.2.1 This document sets out the procedures for the accreditation of BOP Providers so their results will be acceptable to the housing industry and consumers.

401.2.2 There may be instances in which state laws or regulations will have additional requirements to those specified in this document.

402 DEFINITIONS

See Appendix B.

403 ACCREDITATION CRITERIA

403.1 Minimum Standards for BOP Provider Accreditation

BOP Providers shall be accredited in accordance with the Accreditation Process specified in Chapter 9 of these Standards. A BOP Provider must specifically meet the following minimum standards for Accreditation:

403.1.1 Minimum BOP Inspector Training Standards:

403.1.1.1 A BOP Provider must provide for BOP inspector certification by requiring inspectors to successfully complete a RESNET accredited home energy Rater training

courses and to demonstrate competence in completing BOP performance inspections in the field. The following elements must be included in its BOP inspector training:

403.1.1.1.1 Basics of building science

403.1.1.1.2 Thermal resistance of insulating materials

403.1.1.1.3 Space heating/cooling equipment efficiency

403.1.1.1.4 Blower door testing procedures

403.1.1.1.5 Duct leakage and testing procedures

403.1.1.1.6 Determining the efficiency of windows

403.1.1.1.7 Basic principles of BOPs

403.1.1.1.8 BOP Provider's policies and procedures for inspectors

403.1.1.1.9 Quality assurance procedures

403.1.2 Certification Standards

403.1.2.1 Certification and recertification of BOP inspectors shall be through a RESNET accredited home energy Rater training Provider, which shall include the following provisions:

403.1.2.1.1 Initial classroom and/or field training.

403.1.2.1.2 Performance evaluation of ability to perform accurate BOP inspections including passing the national RESNET test.

403.1.2.1.3 Continuing Education - 12 hours of education and training approved by the BOP Provider during the three years of certification. Ten hours of the training shall be training approved by RESNET.

403.1.2.1.4 Recertification of BOP inspectors no less than every three years

403.1.3 Minimum Standards For BOP Provider's Operation Policies and Procedures must be written and provide for the following:

403.1.3.1 Field inspection of all homes for verifying technical specifications.

403.1.3.2 Blower Door Test completed on all homes claiming credit for reduced air infiltration lower than the default value.

403.1.3.3 Duct testing completed on all homes claiming credit for reduced air distribution system leakage lower than the default value.

403.1.3.4 Written BOP inspector discipline procedures that includes progressive discipline involving Probation - Suspension - Termination

403.1.3.5 Quality Assurance by BOP Providers

403.1.3.5.1 BOP Providers that are not already Rating Providers must have a written Quality Assurance Process that conforms to Chapter 9 of these Standards.

403.1.3.5.2 Have a Quality Assurance Designee that oversees the Provider's compliance with the requirement of this Chapter and Chapter 9 of these Standards.

403.1.3.5.3 BOP Inspection Recordkeeping. Providers and/or their certified BOP inspectors shall maintain records for each BOP inspection.

403.1.3.5.3.1 The quality assurance record for each home shall contain at a minimum the electronic copy of the inspection file.

403.1.3.5.3.2 The record for each inspection shall be maintained for a minimum of three years.

403.1.3.5.4 BOP Inspector Registry

403.1.3.5.4.1 The Provider shall maintain a registry of all their certified BOP inspectors. The Provider will also keep on file the names and contact information for all, including company name, mailing address, voice phone number, fax number, and email address. Upon request the Provider shall provide to RESNET its registry of certified Raters.

403.1.3.5.5 Complaint Response System.

403.1.3.5.5.1 Each Provider shall have a system for receiving complaints. The Provider shall respond to and resolve complaints related to BOP inspections and field verification and diagnostic testing services and reports. Providers shall ensure that inspectors inform purchasers and recipients of ratings and field verifications about the complaint system. Each Provider shall retain records of complaints received and responses to complaints for a minimum of three years after the date of the complaint.

403.1.3.6 Knowledge of other EPA methods for labeling a home as ENERGY STAR®.

403.1.3.7 Written conflict of interest provisions that prohibit undisclosed conflicts of interest but allow waiver with advanced disclosure. The "Home Energy Rating Standard Disclosure" form adopted by the RESNET Board of Directors shall be completed for each home that receives a BOP inspection and shall be provided to the rating client and made available to the home owner/buyer. Each form shall include, at a minimum, the name of the community/ subdivision and city and state where the home is located. Each form shall accurately reflect the proper disclosure for the home that it is rated (i.e. it should reflect the

BOP inspector's involvement with the home at the time the final ENERGY STAR® certificate is issued). For the purposes of completing this Disclosure, "Rater's employer" is defined as including any affiliate entities. Recognizing that a number of different relationships may occur between the inspector or the inspector's employer and the rating client and/or homeowner and/or the marketplace in general, the BOP Provider shall ensure that all disclosures are adequately addressed by the Provider's quality assurance plan, in accordance with the relevant Quality Assurance provisions of the Standards.

403.1.4 Technical Requirements for BOPs

403.1.4.1 The BOP Provider can only use BOPs approved by the EPA ENERGY STAR Homes Program.

403.1.4.2 Monthly Energy Savings. For a Fannie Mae energy efficient mortgage, the BOP Provider shall calculate the monthly energy savings that the BOP achieves over the HERS Reference Home in accordance with the provisions of 303.3.3.3.2.2 of Chapter 3 of this standard.

403.1.4.3 Energy Value. For a Fannie Mae energy efficient mortgage, the BOP Provider shall calculate the energy savings value of the BOP in accordance with the provisions of 303.3.3.2.1 of Chapter 3 of this standard.

403.1.4.4 Specialized requirements. Where specific BOPS approved by EPA have technical requirements that are outside the normal range of BOP inspector skills, specialized training shall be provided to inspectors by the BOP Provider to inspect for compliance with those BOPs.

404 SUNSET PROVISION

Chapter 4 of these Standards, and any references to the provisions in Chapter 4 made elsewhere in these Standards, shall sunset on January 1, 2012.

Chapter Five
RESNET Standards

500 REVISION OF STANDARDS

501 REVISIONS AND AMENDMENTS

From time to time it may become necessary to revise or amend the standards set forth in this document. Circumstances that may lead to such revision or amendment include but are not limited to the following:

501.1 Periodic Reviews

To respond to periodic reviews by the promulgating bodies;

501.2 Changes in Law

To respond to changes in law;

501.3 Technical Innovations

To respond to technological innovations; and

501.4 Proposals for Change

To respond to proposals for change from interested parties.

501.4.1 Continuous review of standards

501.4.1.1 RESNET will accept on an on-going proposals to change the standards. RESNET has formed the following standing committees to consider proposals submitted: Quality Assurance and Ethics Committee, Technical Committee, and Training and Education Committee. After considering proposals the appropriate committee can submit proposals to amendment the standard.

501.4.2 Process for submitting proposals to change standards:

501.4.2.1 Proposals to change these standards may be submitted in writing, at any time, to RESNET.

501.4.2.2 All proposals to change that meet the criteria set forth in this section of these procedures shall be accepted for consideration and evaluation.

501.4.2.3 Proposals to change these standards shall include the following:

501.4.2.3.1 Identification of the proposal to change, including the following minimum information:

501.4.2.3.1.1 Proponent(s) full name(s),

501.4.2.3.1.2 Organizational affiliation(s) or representation(s),

501.4.2.3.1.3 Full mailing address(es),

501.4.2.3.1.4 Daytime phone number(s),

501.4.2.3.1.5 Signature of primary proponent, and

501.4.2.3.1.6 Date

501.4.2.3.2 Specific revisions to the standards in a format that clearly identifies the manner in which the standards are to be altered (ie. underline/strikeout format or equivalent). Any proposal to change that does not include proposed alteration(s) shall be rejected and returned to the proponent.

501.4.2.3.3 Substantive reason(s) or justification for each proposed change. The lack of substantive justification for a proposed change may result in the return of the proposals to change to the proponent(s).

501.4.2.3.4 Supporting documentation that may be needed for the reasoned evaluation of the proposal.

501.4.2.4 Proposals to change these standards shall be considered and evaluated at least annually.

501.4.3 Standards Revision Process.

501.4.3.1 Revision to these standards shall occur only after the relevant proposals to change have been subjected to public scrutiny and comment using the following review process:

501.4.3.1.1 RESNET shall appoint a standing Standards Committee. The RESNET Standards Committee shall be responsible for conducting the periodic evaluation and the annual evaluation of proposals to change through a consensus process, whereby both consenting and the non-consenting opinions are documented and incorporated as comments into each report or proposal to change..

501.4.3.1.2 Following initial evaluation by the RESNET Standards Committee, proposals to change shall be posted on the RESNET website for a period of not less than 30 days during which public comment shall be accepted.

501.4.3.1.3 Following the public comment period, the appropriate RESNET Committee shall meet to reconcile public comments with the initial proposed amendment of the RESNET Standards Committee and, if changes are determined necessary, a final set of recommended changes with consensus comments that considers public comments shall be prepared on each proposal for change. The proposed changes to the amendment shall then be forwarded to the RESNET Standards Committee for approval.

501.4.3.1.4 Proposals for change receiving a simple majority support from the RESNET Standards Committee after public comment shall be incorporated into a set of proposed revised amendments that will be submitted to the RESNET Board of Directors for final approval.

501.4.3.1.5 Proposed revisions from the RESNET Standards Committee shall be approved by a simple majority of the RESNET Board of Directors. Rejection of proposals from the RESNET Standards Committee shall require a two-thirds majority of the RESNET Board of Directors. Upon approval by the RESNET Board of Directors, the changes shall be incorporated into a set of revised Standards. If a proposed revision fails to receive either a simple majority vote for approval or a two-thirds majority vote for rejection, it will be referred back to the RESNET Standards Committee for further consideration.

501.4.3.2 The revised accreditation procedures shall be published on the RESNET Web Page not later than the end of September each year in which changes are recommended.

Chapter Six
RESNET Standards

600 RESNET NATIONAL STANDARD FOR SAMPLED RATINGS

601 GENERAL PROVISIONS

601.1 Purpose
Sampling is intended to provide certification that a group of new homes meets a particular threshold such as ENERGY STAR®, energy code compliance, or qualification for an energy efficiency lending program. It is based on pre-analysis of building plans meeting the intended qualification (e.g. a HERS Index threshold), and subsequent random testing and inspections of a sample set of the homes as-built. Certifying a group of homes by sampling entitles the customer to documentation certifying that the homes meet the desired threshold; it does not constitute a confirmed HERS rating on any home.

601.2 Scope
This chapter sets out the procedures for the accreditation of Sampling Providers. Accredited Sampling Providers shall assume all warranties and liabilities associated with the sampling of homes. RESNET does not provide any warranty, either explicit or implied, that sampled homes will meet or exceed the threshold specifications for the sample set. There may be instances in which state laws or regulations differ from these Standards. In such instances, state law or regulation shall take precedence over this standard.

602 DEFINITIONS AND ACRONYMS

See Appendix B.

603 TECHNICAL REQUIREMENTS FOR SAMPLING

603.1 Compliance Requirements
The testing and inspection of homes for minimum rated features shall be conducted in compliance with the procedures for conducting home energy ratings and Builder Option Packages (BOPs) contained in this Standard.

603.2 Homes Eligible to be Sampled
The homes being sampled shall be of the same construction type using the same envelope systems.

603.3 Analysis of Homes
A worst-case analysis shall be performed on each home plan, considering worst-case orientation, all known option packages, and applicable site location(s). If an option or change in the design of the structure is made that differs from those used in the initial

analysis in a way that would require more stringent threshold specifications, then that home must be individually rated. At a minimum, a certified Rater shall oversee this process.

603.4 Labeling of Homes

603.4.1 Every home plan within a given sample set shall be assigned the same HERS Index as determined by the threshold specification for that floor plan.

603.4.2 Every home subjected to this sampling Standard shall be provided with a label in accordance with Section 303.3 of these standards, which contains the following statement: "This home has been certified using a sampling protocol in accordance with Chapter 6 of the RESNET Standards (see *http://resnet.us.standards/* . This label shall be located on the electrical panel and the font shall be a minimum of 10 points.

603.5 Sample Set of Homes

Sampling controls may be applied to any sample set of homes within the same subdivision or metropolitan area and climate zone (as specified in the most current edition of the IECC), provided the criteria in Item 603.2 are met and:

603.5.1 Each sample set is made up of homes at the same stage of construction (e.g. pre-drywall, final);

603.5.2 For each stage of construction, each sample set will be comprised of homes eligible for the applicable sampling controls within a 30 calendar day period. For example: a sample set that is defined for a pre-drywall inspection must include homes that are eligible for that pre-drywall inspection within a given 30-day period. If fewer than seven (7) homes are available for that phase of inspection, the sample set must be cut off at the number of homes that are available within that 30-day period. This sample set need not be carried through to final inspection; in fact, a whole new sample set may be defined for the final inspection phase based on the homes available for that phase within a new, 30-day period applied to that phase of tests and inspections.

603.5.3 Each home subject to sampling is required to be part of an identified set of sampling controls for each test or inspection that is sampled;

603.5.4 Each participating subdivision within a metropolitan area is subject to sampling controls on at least one home in any 90 calendar day period;

603.5.5 Each participating subdivision within a metropolitan area must start a minimum of one home in any 90 calendar day period.

603.6 Application of Sampling

The application of the sampling controls in this standard are only required for those tests and inspections that are not conducted on every home. Sampling controls shall be conducted for any tests and inspections not conducted on every home, according to the field testing and inspection requirements of 303.6.2.

603.7 Sampling Controls

603.7.1 A complete set of Sampling Controls shall be performed at a minimum ratio of one (1) test or inspection per seven (7) homes within a given sample set. At a minimum, a certified Rater shall oversee this process.

603.7.2 Sampling Providers may complete the sampling controls collectively on a single home or distribute the tests and inspections across several homes within a given sample set, provided the total number of individual tests and inspections meets or exceeds the minimum ratio set forth in 603.7.1.

603.7.3 To qualify for sampling in a metropolitan area, a builder shall first complete, without any incidence of failure, a complete set of sampling controls on at least seven (7) consecutive homes in that metropolitan area. For this initial phase of testing and inspections, the complete set of sampling controls shall be performed on each of the seven (7) homes.

603.7.3.1 Exception: A builder who has been implementing a sampling process for certifying homes in a specific metropolitan area under the EPA's ENERGY STAR® for Homes program as of January 1, 2008, will be allowed a one time exception to 603.7.3 for that metropolitan area.

603.7.3.2: For each newly started subdivision, sampling may begin only after three (3) consecutive homes have been completed without any incidence of failure.

603.7.4 Having successfully met the requirements of 603.7.3, a Sampling Provider may complete sampling controls for a builder indefinitely until a "failure" occurs or any of the criteria set forth in 603.2 are no longer met.

603.7.5 A complete set of sampling controls, whether performed on a single home or spread across several homes, must be completed whether or not one or more failure(s) are found.

603.7.6 When an "initial failure" occurs, the failed item(s) shall be tested or inspected in two (2) additional homes selected from the same sample set. Testing and/or inspections for any item(s) that may become inaccessible during the construction process, (e.g. wall insulation) must be timed so additional testing and/or inspections can occur on other homes in the sample set before they become inaccessible for inspection or testing.

603.7.7 When an "additional failure" occurs, in one or more of the two (2) additional homes, the failed item(s) shall be tested or inspected in the remaining four (4) homes selected for the same sample set.

603.7.8 Until the failure is corrected in all identified (failed) homes in the sample set, none of the homes shall be deemed to meet the threshold or labeling criteria.

603.8 Multiple "Additional Failures"

Action is required if three (3) "additional failures" occur within a ninety (90) calendar day period. The required action depends on whether those "additional failures" apply to the same failed item or various failed items.

603.8.1 If the multiple "additional failures" all apply to the same failed item, the builder shall submit to 100% inspection of that failed item, for a minimum of seven (7) homes, before resuming sampling of that item. Remaining unrelated sampling controls may be conducted on a sampled basis throughout this process.

603.8.2 If the multiple "additional failures" apply to various failed items, or additional failed items are found during testing and inspection of additional homes, the builder must begin again and complete 603.7.3 at a minimum, before continuing with sampling.

603.8.3 Exception: If a builder conducts a "root cause analysis" on an item or items covered under 603.8.1 or 603.8.2, and submits it in writing to the sampling Provider, sampling may resume as soon as the Provider deems that the solution has been implemented. The "root cause analysis" report shall contain at a minimum:

603.8.3.1 A written description of the problem(s) covered by the analysis;

603.8.3.2 A written explanation of the underlying reason(s) that the problem(s) occurred (e.g. inadequate training of subcontractor(s) or site supervisors, insufficient information or inadequate detail in the plans or specifications, etc);

603.8.3.3 A written description of a clearly defined process to correct the underlying cause(s);

603.8.3.4 A written description of when and how that process has been carried out;

603.8.3.5 A copy of the root cause analysis report shall be kept by the sampling Provider as part of the QA file, for a period of time of three (3) years, consistent with the requirements of 102.1.4.8.2.

603.9 Quality Assurance by Sampling Providers

603.9.1 The Sampling Provider's Rating Provider QA Designee shall be responsible for monitoring compliance with the sampling process and maintaining records in accordance with the requirements of Chapter 9.

603.9.2 In addition to the Quality Assurance requirements specified in Chapter 9 for Home Energy Rating Providers, a Sampling Provider's QUALITY assurance process shall include, at a minimum, the following:

603.9.2.1 All homes that are qualified by the use of sampling shall be considered to be rated homes. QA file review and field monitoring shall be conducted on a percentage of all the homes certified or qualified under sampling, rather than the percentage of tested and inspected homes.

603.9.2.2 The field QA required in Chapter 9 may be conducted on any of the qualified or certified homes within the sample sets, and shall not be limited to the tested and inspected homes.

604 PROVIDER ACCREDITATION CRITERIA

604.1 Minimum Standards for Home Energy Rating Sampling Provider Accreditation Home Energy Rating Sampling Providers shall be accredited in accordance with the Accreditation Process specified in Chapter 9 of these Standards. A Sampling Provider must specifically meet the following minimum standards for Accreditation.

604.1.1 All Sampling Providers shall be accredited by RESNET as a Home Energy Rating Providers and maintain their accreditation in good standing.

604.1.2 A Sampling Provider's accreditation must be renewed annually by RESNET.

604.1.3 In order to be eligible to be a Sampling Provider, the RESNET accredited rating Provider shall complete a minimum of twenty-five (25) confirmed ratings that have been documented to be accurate by the Rating Provider's Quality assurance designee.

604.1.4 The Sampling Provider shall demonstrate to RESNET a minimum insurance coverage of $1,000,000 in general liability coverage and $1,000,000 in professional liability coverage.

604.1.5 Builders cannot use the sampling standard to certify or qualify homes in which they have a financial interest.

604.2 Responsibilities of Accredited Sampling Providers

604.2.1 Sampling Providers are responsible for ensuring that all of the Sampling inspections conducted and issued by their sampling program are in compliance with all of the criteria by which the system was accredited.

604.2.2 Sampling Providers are responsible for ensuring that the specifications for the minimum rated features for the sampled homes be communicated to the personnel or trades responsible for completing the work.

604.2.3 Minimum Standards For Sampling Provider's Operation Policies and Procedures must be written and provide for the following:

604.2.3.1 Field inspections and tracking of all homes in the sample set for verifying threshold technical specifications and tracking failures and re-inspections;

604.2.3.2 Blower Door Testing completed for sample sets in which the threshold specifications include credit for reduced air infiltration lower than the default value;

604.2.3.3 Duct testing completed for sample sets in which the threshold specifications include credit for reduced air distribution system leakage lower than the default value;

604.2.3.4 Sampling Inspector discipline procedures that include progressive discipline involving Probation - Suspension – Termination.

605 EFFECTIVE DATES

605.1 Quality Assurance

July 1, 2007 – Section 603.9 shall be implemented by all sampling Raters and Providers.

605.2 Effective Date of Standard

January 1, 2008 – The remainder of Chapter 6 shall be implemented by all sampling Raters and Providers

Chapter Seven
RESNET Standards

700 RESNET NATIONAL STANDARD FOR HOME ENERGY AUDITS

701 GENERAL PROVISIONS

701.1 Purpose

The provisions of this standard are intended to define a framework for a home energy audit process. A certified auditor, an accredited Provider and/or a program will apply this standard to improve the energy performance of existing homes through uniform, comprehensive home energy surveys, audits and ratings for existing residential buildings. This standard is intended to encourage investments by building owners that produce the following outcomes:

- Increase the energy efficiency of homes;
- Increase the comfort of homes;
- Increase the durability of homes;
- Reduce the risk that energy improvement recommendations will contribute to health, safety, or building durability problems;
- Reduce waste and pollution, protecting the environment; and
- Ensure that the recommendations are within the community standards (e.g. historic districts, flood zones, subdivision covenance).

And to ensure that throughout the process, energy improvement recommendations are portrayed with reasonable and consistent projections of energy savings.

701.2 National Standard for Home Energy Audits.

There are 3 categories of home performance assessments defined in this standard, listed in order of increasing accuracy and completeness:

1. Home Energy Survey (HES)
    a. On-Line Home Energy Survey
    b. Professional Home Energy Survey
2. Building Performance Audit (BPA)
3. Comprehensive HERS Rating (CHER)

Visual examination and measurement of the home as built are the first steps for any audit process; BPA and CHER exceed HES since they require performance testing. All steps produce a list of recommended improvements, but BPA and CHER include a formalized work scope. A CHER exceeds a BPA only in that a CHER also includes a formal Home Energy Rating.

701.3 Relationship to Other Standards

This Chapter is a companion Chapter to the 2006 RESNET Mortgage Industry National Home Energy Rating System Standard as promulgated and maintained by the Residential Energy Services Network (RESNET) and recognized by the mortgage industry and programs promoting the improved energy performance of buildings.

701.4 Relationship to State Law
This standard specifically recognizes that some state laws or regulations have additional requirements to those specified in this document. To the extent that such state laws or regulations differ from these Standards, state law or regulation shall govern.

701.5 Scope
This Home Energy Audit Standard will address RESNET Providers for each area of home inspection, applicable procedures, types of home inspections, certifications of the inspectors, summary of requirements for each type of inspection, and the reports to accompany each type of inspection.

701.5.1 Application of Standards
This standard applies to existing site-constructed or manufactured, single- or multi-family, residential buildings three stories or less in height.

702 DEFINITIONS AND ACRONYMS

See Appendix B.

703 HOME ENERGY AUDIT PROVIDER ACCREDITATION CRITERIA

703.1 Minimum Standards for Home Energy Audit (HEA) Provider Accreditation
Home Energy Audit Providers shall be accredited in accordance with the Accreditation Process specified in Chapter 9 of these Standards. An HEA Provider shall specifically meet the following minimum standards for Accreditation.

703.1.1 Home Energy Survey Professional and Building Performance Auditor Certification Standard. Home Energy Survey Professionals (HESPs) and Building Performance Auditors (BPAs) shall be certified (and recertified) by RESNET-accredited HEA Providers, who shall abide by the following provisions:

703.1.1.1 HEA Providers shall provide documentation that the HESPs and/or BPAs under their Providership meet the following certification requirements:

703.1.1.1.1 Performance Evaluation. HESPs and BPAs shall pass a performance evaluation of their ability to perform accurate Home Energy Surveys and/or Building Performance Audits in accordance with sections 704 and 705. Each HESP and BPA shall complete a probationary period where close supervision is provided by the HEA Provider's QA Designee (as defined in Chapter 9 of these Standards). The probationary period covers a minimum of three Home Energy Surveys and/or Building Performance Audits (as applicable) after which the QA Designee shall determine if additional training is needed.

703.1.1.1.2 Professional Development for HESPs and BPAs. HESPs and BPAs shall complete one of the below three options:

703.1.1.1.2.1 Complete 18 hours of professional development every three years. The 18 hours shall include completion of 18 hours of refresher course(s) offered by a RESNET Accredited HEA Training Provider; or

703.1.1.1.2.2 Documentation of 18 hours of attendance at a RESNET Conference every three (3) years; or

703.1.1.1.2.3 Pass the HESP online test every three years.

703.1.1.1.3 Testing. All certified HESPs shall pass the national Home Energy Survey Professional (HESP) online test administered by RESNET with a score of at least 75 percent. Each certified BPA shall pass the national Building Performance Auditor (BPA) online test administered by RESNET with a score of at least 80 percent, and pass any additional field evaluations to determine competency to perform building air leakage and duct pressurization tests, and combustion safety procedures as required in Chapter Eight of these Standards.

703.1.1.1.4 Recertification of individuals by the HEA Provider shall occur every three (3) years.

703.1.1.1.5 Agreements. As a condition of certification, each HEA Provider shall ensure that each certified individual enters into a written agreement with the Provider to provide the applicable field verification services in compliance with these Standards. An unexecuted copy of the written agreement shall be provided to RESNET with the Provider's accreditation application, and again within 60 days of making changes to the agreement. The written agreement shall, at a minimum require Auditors to:

703.1.1.1.5.1 Provide audit verification services in compliance with these Standards;

703.1.1.1.5.2 Provide accurate and fair Professional Surveys or Audits; and

703.1.1.1.5.3 Comply with the RESNET Code of Ethics. The RESNET Code of Ethics shall be attached to the written agreement.

703.1.2 Minimum Standards for HEA Provider Operation Policies and Procedures shall be submitted in written form to RESNET for approval, and shall at a minimum provide for the following:

703.1.2.1 Written conflict of interest provisions that prohibit undisclosed conflicts of interest, but may allow waiver with advanced disclosure. The "Standard Disclosure" form adopted by the RESNET Board of Directors shall be completed for each home that receives a Home Energy Survey or Building Performance Audit and shall be provided to the client and made available to the homeowner. Each form shall accurately reflect the proper disclosure for the home that it represents. For the purpose of completing this disclosure, "Auditor's employer" includes any affiliate entities. Recognizing that a number of different relationships may exist among the auditor or the auditor's employer, other contractors that may complete work on the home, and the survey client and/or homeowner, the HEA Provider shall ensure that all disclosures are adequately addressed

by the Provider's quality assurance plan, in accordance with the relevant quality assurance provisions of these Standards.

703.1.2.2 Written Auditor discipline procedures that include progressive discipline for probation, suspension, and decertification.

703.1.2.3 In accordance with the minimum requirements set forth in Chapter 9 for quality assurance, a written audit Quality Assurance Plan and designation of a Quality Assurance Designee.

703.1.2.4 Auditor Registry. The HEA Provider shall maintain a registry of all of its certified Auditors. The specified Provider shall also keep on file the names and contact information for all certified Auditors, including company name, mailing address, voice phone number, fax number, and email address. Upon request, the HEA Provider shall provide to RESNET its registry of certified Auditors.

703.1.2.5 Complaint Response Process. Each HEA Provider shall have a publicly accessible system for receiving complaints. HEA Providers shall ensure that Auditors inform clients about the complaint process by publicizing the web address of the complaint resolution process. Each HEA Provider shall retain records of complaints received and responses to complaints for a minimum of three (3) years after the date of the complaint.

703.1.3 Additional HEA Provider Duties Related to Oversight of Building Performance Auditors (BPAs)

703.1.3.1 Certification of Performance Testing Proficiency. The HEA Provider is responsible for certifying that each BPA has successfully completed the following:

703.1.3.1.1 Passing the RESNET BPA online exam in accordance with Section 703.1.1.1.3.

703.1.3.1.1.1 BPA candidates who have NOT previously passed the 50 question RESNET HESP exam shall pass the 50 question BPA exam with a minimum score of 80%.

703.1.3.1.1.2 BPA candidates who have previously taken and passed the 50 question RESNET HESP online exam with a minimum score of 75%, shall pass an abbreviated 25 question BPA exam and pass with a minimum score of 80%.

703.1.3.1.2 BPA candidates shall complete a combined total of twenty (20) hours of RESNET approved training in Pressure Diagnostics, Combustion Appliance Zone (CAZ) Testing and Work Scope Requirements which includes field training and a field proficiency demonstration as defined in the *RESNET Guidelines for Combustion Appliance Testing and Writing Work Scopes* (hereinafter "RESNET interim guidelines") and chapter 8 of these Standards.

704 NATIONAL HOME ENERGY AUDIT PROCEDURES

704.1 Home Energy Survey

The purpose of the Home Energy Survey is to assess the general condition of the home with respect to energy performance. The Home Energy Survey shall include a report that shows a general range of a home's energy efficiency based on minimum specific criteria (e.g. insulation, equipment age, general condition, energy usage and costs) and a lookup matrix based on regional norms and climate, as approved by RESNET. The Home Energy Survey is not required if the homeowner wishes to directly pursue a Building Performance Audit or a Comprehensive HERS Rating. The Home Energy Survey will take one of two forms: a DOE- or RESNET- approved computerized On-Line Home Energy Survey performed by the owner or occupant, or a Professional Home Energy Survey conducted by a certified Home Energy Survey Professional.

704.1.1 On-Line Home Energy Survey. The On-Line Home Energy Survey shall collect substantially the same data and information and shall be subject to the same limitations as the Professional Home Energy Survey. On-line Home Energy Survey software shall be hosted by a RESNET accredited HEA Provider or another organization approved by RESNET and the on-line program report shall be approved by RESNET.

704.1.2 Professional Home Energy Survey. The Professional Home Energy Survey shall include on-site visual inspection of the energy features of the dwelling unit, and documentation of its general condition, including envelope features and ages; equipment types, characteristics and ages; appliance and lighting characteristics; and likely anticipated remediation issues such as moisture or combustion appliance problems. Where available, the Professional Home Energy Survey shall include a review of utility use and billing history. The Home Energy Survey is a visual inspection only and does not include diagnostic testing. Home Energy Survey Professionals may also use home energy survey and labeling software programs approved by RESNET or the U.S. Department of Energy. A homeowner is not required to have a Professional Home Energy Survey prior to having a Building Performance Audit or Comprehensive HERS Rating.

704.1.2.1 The Home Energy Survey Professional (HESP) shall interview the homeowner regarding energy, comfort problems and related durability issues. The HESP shall review the goals listed in 701.1 of these Standard, and provide an explanation of the home energy audit process and potential availability of incentive programs that maybe accessed by the homeowner. The interview shall include, but is not limited to, the following subject areas:

704.1.2.1.1 Comfort complaints, including areas of the home that are too hot or too cold.

704.1.2.1.2 Energy billing concerns.

704.1.2.1.3 Durability issues, including water intrusion, ice damming, etc.

704.1.2.1.4 The potential for the homeowner to follow up with a Building Performance Audit or Comprehensive HERS Rating.

704.1.2.1.5 Interest in potential home energy performance improvements.

704.1.2.2 The HESP shall inform the homeowner of low cost/no cost improvements that can be implemented by the homeowner.

704.1.2.3 The HESP shall request copies of utility bills and/or written permission to obtain past energy use information from the utility supplier(s), for the purpose of estimating generalized end-use consumption (base, heating, and cooling). If the customer declines, the HESP shall explain the reason for the request and the potential effect on the home energy survey.

704.1.2.4 The HESP shall advise the homeowner on where to locate qualified individuals (including the RESNET website) to conduct a Building Performance Audit, a Comprehensive HERS Rating, and/or RESNET Qualified Contractors to complete the work on the home.

704.1.2.5. Minimum Procedures for a Professional Home Energy Survey:

704.1.2.5.1 The Home Energy Survey Professional (HESP) shall complete a RESNET-approved survey form. The survey form will require the HESP to visually review the home to determine, measure or estimate the following features:

704.1.2.5.1.1 R-values and location of wall/ceiling/floor insulation;

704.1.2.5.1.2 Square footage and approximate age of home;

704.1.2.5.1.3 Glazing type(s), frame material(s), and permanently installed shading devices such as screens or applied films;

704.1.2.5.1.4 Type, model number, efficiency (if available), and location of heating/cooling system(s);

704.1.2.5.1.5 Type of ductwork, location and R-value of duct insulation, visual assessment of obvious duct leakage, and any indications of previous duct sealing;

704.1.2.5.1.6 Type of foundation is crawl space, basement, or slab, along with venting and insulation locations;

704.1.2.5.1.7 Type of attic, approximate age, type and color of roofing material and presence and type of venting.

704.1.2.5.1.8 Checklist of common air-leakage sites; indicating likely opportunities for leakage reduction;

704.1.2.5.1.9 Estimated age and efficiency (if available), condition, number and location of major appliances such as dishwashers, refrigerators, freezers and washing machines;

704.1.2.5.1.10 Number, type, and controls of indoor and outdoor light fixtures and portable lamps that are suitable for energy efficient re-lamping;

704.1.2.5.1.11 Durability issues such as visual indications of common moisture problems, including condensation, roof leaks, foundation leaks, ground-water intrusion, ice damming, and plumbing leaks, as well as signs of mold, mildew, insect damage, efflorescence, and stains;

704.1.2.5.1.12 Presence, size, and location of exhaust fans, and determination of whether they are vented to the outdoors;

704.1.2.5.1.13 Number, type, and flow rate of water fixtures (e.g. faucets, showerheads), presence and control of hot water recirculation loop/pump;

704.1.2.5.1.14 Presence and type(s) of combustion equipment; visually identifiable evidence of flame rollout, blocked chimney, rust and corrosion; missing or damaged vent connectors;

704.1.2.5.1.15 Mechanical systems that are likely to cause or contribute to excess infiltration or pressure imbalances, such as attic fans or bedrooms with no return air or transfer grilles.

704.1.2.5.1.16 Any identified potential combustion appliance safety hazards related to energy retrofit work.

704.1.2.5.2 The following elements are outside the scope of a Professional Home Energy Survey:

704.1.2.5.2.1 The use of blower doors, duct leakage test equipment or an infrared camera.

704.1.2.5.2.2 Any other diagnostic testing of the home

704.1.2.5.2.3 Quantification of any levels of air tightness, duct tightness, or ventilation amounts.

704.1.2.5.2.4 Combustion Appliance Zone (CAZ) testing

704.1.2.5.3 Energy savings estimates will only be generalized and presented along with the qualification that a Building Performance Audit or Comprehensive HERS Rating shall be obtained to calculate more detailed energy savings estimates.

704.1.2.6 Minimum Professional Home Energy Survey Report Documentation

704.1.2.6.1 At the completion of the Professional Home Energy Survey the Home Energy Survey Professional shall provide the homeowner a standardized report using a format approved by RESNET, signed and dated by the HESP. The report at a minimum

shall provide information to the homeowner that addresses:

704.1.2.6.1.1 All data collected in accordance with Section 704.1.2.5.1, above;

704.1.2.6.1.2 Whole-house solutions overview of how the home works as a system and how to prioritize actions;

704.1.2.6.1.3 The quality of installation of HVAC equipment including general information on proper sizing of equipment, duct sealing, insulation and general condition of the ductwork, and the importance of proper refrigerant charge and air flow;

704.1.2.6.1.4 The quality of the building envelope air sealing and proper levels of insulation;

704.1.2.6.1.5 An overview of potentially appropriate ENERGY STAR or better products and appliances;

704.1.2.6.1.6 Information regarding access to a Building Performance Audit or Comprehensive HERS Rating;

704.1.2.6.1.7 Potential non-energy benefits of improving the energy efficiency of the home including reduction of carbon emissions, improved comfort and air quality;

704.1.2.6.1.8 General statement regarding opportunities to improve the thermal envelope, mechanical equipment, lighting and appliances in the home;

704.1.2.6.1.9 General discussion of observations and concerns regarding combustion appliance operation;

704.1.2.6.1.10 A safety notification form adopted by RESNET that is filled out and presented to the homeowner identifying potential hazards such as lead paint, asbestos, mold, and radon that are outside the scope of the Home Energy Survey. ;

704.1.2.6.1.11. Information on available rebate, financing, and/or tax incentive programs that will help the homeowner

704.1.2.7 Limitations. Unless certified by RESNET as a Building Performance Auditor or Comprehensive HERS Rater, (or another certification that is recognized by RESNET as equivalent), the Home Energy Survey Professional shall not produce a detailed written work scope for improvements as part of a Professional Home Energy Survey.

704.2 Building Performance Audit

The purpose of the Building Performance Audit is to identify building performance deficiencies and provide a work scope sufficient for improvements to be made to the audited home. The Building Performance Audit includes an evaluation, performance testing, computer software analysis using software that is accredited by RESNET or approved by

DOE for this purpose, and reporting of proposed treatments for improvement of an existing home. The evaluation shall include a review of the data collected from any previous energy audit or survey, any further required measurement and performance testing, and combustion appliance testing. The Auditor shall determine the appropriate work scope for the home. A homeowner may elect to go through this process with or without a prior Professional Home Energy Survey. A Building Performance Audit includes all of the provisions of the Professional Home Energy Survey (Section 704.1.2.5), plus the performance of diagnostic testing and reporting requirements as follows:

704.2.1. Evaluate building shell air leakage in CFM50

At a minimum, a single point (50 Pa) blower door depressurization test shall be performed in accordance with the envelope testing protocols contained in chapter 8 of these Standards and the results thereof shall be included in the audit report.

704.2.2. Evaluate duct leakage.

704.2.2.1 The Auditor shall perform a duct leakage test in accordance with the protocols in chapter 8 of these Standards, and/or specify a duct leakage test in accordance with RESNET standards prior to beginning any duct-sealing work.

704.2.3 Conduct CAZ Depressurization, Spillage and CO testing

704.2.3.1 The auditor must perform a worst-case depressurization, spillage, and CO test in accordance with the RESNET interim guidelines.

704.2.4 Prepare a Detailed Retrofit Work Scope

A BPA Report shall include a retrofit work scope in accordance with the RESNET interim guidelines.

704.2.4.1 The work scopes for recommended improvements shall be determined by the Auditor based upon the findings of the assessment and the client's budget and objectives. The recommendations shall be presented to the homeowner in order of priority based on cost effectiveness and priorities for remediation of combustion appliance deficiencies. At a minimum, five (5) of the most cost-effective measures must be recommended regardless of the client's budget.

704.3 Minimum Building Performance Audit Report Documentation

704.3.1 Upon completion of the audit, provide the client with a written record (physical or electronic) of the audit and resulting recommendations within five (5) business days. It shall include:

704.3.1.1 General findings of audit as defined in Section 704.1.2.6

704.3.1.2 General recommendations for improvements

704.3.1.3 The results of the combustion appliance testing.

704.3.1.4 Work scopes for suggested improvements

704.3.1.5 Cost-effectiveness estimates based on analysis

704.3.1.6 Information on where to locate qualified individuals (including the RESNET website) to conduct a Comprehensive HERS Rating and/or RESNET Qualified Contractors or other contractors suitable to complete the work on the home.

704.4 Comprehensive HERS Rating

The Comprehensive HERS Rating is the most in-depth performance audit. It includes evaluation, performance testing, reporting of the proposed work scope for improvement of an existing home in accordance with section 704.2, and a HERS Rating in accordance with Chapter 3 of these Standards. A homeowner is not required to have a Professional Home Energy Survey or Building Performance Audit prior to having a Comprehensive HERS Rating.

705 REQUIRED SKILLS FOR CERTIFICATION

705.1 Minimum skills and knowledge base required to conduct a Professional Home Energy Survey

705.1.1 Basics of heat transfer concepts

705.1.2 Basics of building performance testing

705.1.3 Basics of air distribution leakage

705.1.4 Calculating gross and net areas

705.1.5 Definitions/energy terminology

705.1.6 Basic combustion appliance concerns

705.1.7 Basics of envelope leakage, thermal bypass, thermal bridging

705.1.8 Determining envelope insulation

705.1.8.1 Presence/absence of insulation and when observable, the quality of its installation

705.1.8.2 Recommended levels of insulation by climate zone

705.1.9 HVAC – determining equipment efficiencies from model numbers or default tables

705.1.9.1 HVAC pros/cons, drivers and sensitivities of major system types

705.1.10 Household appliances – estimate efficiency from model numbers or vintage

705.1.11 Energy, power, moisture, heat-conductivity/resistance, and temperature units and key conversion factors

705.1.12 Measuring building dimensions

705.1.13 Identification and documentation of energy survey inspected features of the home

705.1.14 Basics of specifications

705.1.15 Determining window and door efficiency

705.1.16 Determining building orientation and shading characteristics

705.1.17 Defining the thermal boundary, and appropriate recommendations for changing the thermal boundary

705.1.18 Basics of measure interaction, expected life, and bundling for optimal performance considering the house as a system and the emerging need for deep savings.

705.2 Minimum skills and knowledge base required for an individual to conduct a Building Performance Audit

705.2.1 The skills and knowledge required for an individual to conduct a Home Energy Survey in accordance with section 705.1 of these Standards.

705.2.2 Ability to perform building envelope leakage testing in accordance with the envelope testing protocols in chapter 8 of these Standards.

705.2.3 Ability to perform duct leakage testing in accordance with the duct testing protocols contained in chapter 8 of these Standards.

705.2.4 Ability to perform CAZ, spillage, and CO testing in accordance with Worst-Case Depressurization and Combustion Appliance Testing protocols contained in the RESNET interim guidelines.

705.2.5 Understanding of pressure influences and remediation of the following conditions

705.2.5.1 Room and zone pressure imbalances caused by lack of ducted return air or pressure relief mechanisms such as transfer grilles or jumper ducts.

705.2.5.2 CAZ depressurization or combustion appliance spillage caused by return leaks in the CAZ zone, supply leaks outside the house pressure boundary, zonal pressure imbalances, and/or exhaust appliances including other combustion equipment.

705.2.5.3 Pressure differential diagnostics in intermediate buffer zones including (but

not limited to) attics, garages, or crawlspaces.

705.2.6 Ability to prepare a detailed work scope in accordance with protocols contained in the RESNET interim guidelines.

705.2.7 Familiarity with local climate conditions, housing stock, and climate specific practices.

705.3 Minimum skills and knowledge base required for an individual to conduct a Comprehensive HERS Rating

705.3.1 The skills and knowledge required for an individual to conduct a Building Performance Audit in accordance with section 705.1 and 705.2 of these Standards;

705.3.2 The Home Energy Rating Knowledge Base and Skills Set found in section 205.1 of these Standards and the Minimum Rater Competencies found in section 206.1.2 of these Standards.

705.3.3 Ability to conduct building simulation and performance analysis and provide HERS Ratings in accordance with the requirements in Chapter 3 and Chapter 8 of these Standards.

706 GENERAL LIMITATIONS AND EXCLUSIONS

706.1 Limitations

706.1.1 The energy use information contained in reports resulting from Professional Home Energy Surveys, Building Performance Audits or Comprehensive HERS Ratings do not constitute any warranty of energy cost or savings.

706.1.2 Surveys, Audits and Ratings that are performed in accordance with these standards:

706.1.2.1 Are not technically exhaustive.

706.1.2.2 Will not identify concealed conditions or latent defects.

706.1.3 Neither the Building Performance Audit nor the Comprehensive HERS Rating is intended to be an inspection of the structural soundness of the home or any other attributes of the home other than the home's energy features and safety issues related directly to proposed work scopes.

706.1.4 The Professional Home Energy Survey is not applicable to building design and construction features except those listed in section 704.1.2.5.

707 HOME ENERGY AUDIT TRAINING PROVIDER ACCREDITATION

707.1 Requirements for Accredited HEA-Training Providers

707.1.1 Duties and Responsibilities. In order to maintain their accreditation in good standing for providing HESP and/or BPA training courses, all HEA-Training Providers shall fully discharge the following duties and responsibilities.

707.1.1.1 Hold the national core competency questions of the national HESP and BPA test administered by RESNET in the strictest confidence.

707.1.1.2 Submit to RESNET for approval, copies of the HESP and BPA course presentation materials, training manuals, user manuals, course handouts and any other training materials used for training purposes,

707.1.1.3 Submit for approval, **c**opies of all policies, standards, guidelines and procedures to be used by the HEA-Training Provider.

707.1.1.4 Maintain a record, for a period of three years, of all training materials and trainee data, including:

707.1.1.4.1 Historical records of all training schedules and curricula,

707.1.1.4.2 Historical records of all training attendance records,

707.1.1.4.3 Historical records of all examinations and individual examination results,

707.1.1.4.4 Historical records of all certifications issued to any individuals,

707.1.1.4.5 Copies of all current policies, standards, guidelines and procedures in use by the HEA-Training Provider.

707.1.1.5 Maintain acceptable accounting practices, suitable to satisfy the requirements of independent audit procedures.

707.1.1.6 Maintain up-to-date training materials and provide adequate training facilities.

707.1.1.7 Only utilize RESNET Certified BPA Trainers who have at a minimum been certified by RESNET as having passed the 100-question BPA Trainer's Exam with a minimum score of 90%.

707.1.2 Privileges and rights. All accredited HEA-Training Providers in good standing shall have certain privileges and rights, as follows:

707.1.2.1 The privilege to display the accreditation seal of RESNET on any publications, displays, presentations or marketing materials published, authorized for publication or otherwise issued by the HEA-Training Provider.

707.1.2.2 The privilege to make and use RESNET designated trademarked, copyrighted or otherwise restricted materials for marketing both HESP and BPA Training Courses.

707.1.2.3 The right to present evidence, arguments and a vigorous defense in any action brought under these standards by any party against a HEA-Training Provider.

708 MINIMUM HOME ENERGY AUDIT TRAINER COMPETENCIES

708.1 Required HEA Trainer Competencies

708.1.1 To teach either HESP or BPA training curriculum, a HEA-Training Provider shall maintain RESNET Certified HEA Trainer(s) demonstrating the following skills:

708.1.1.1 Mastery of the Home Energy Audit Standards knowledge base and skills set given in this chapter. The trainers shall demonstrate these skills by passing the 100-question RESNET HEA Trainer's Exam with a minimum score of 90%.

708.1.1.2 Ability to communicate effectively the methods, procedures, knowledge and skills to produce accurate and fair Home Energy Audits from building investigation and performance testing and combustion safety in accordance with this Chapter and RESNET interim guidelines.

708.1.1.3 Understanding of the purposes and benefits of home energy surveys and audits and ability to communicate these to students.

708.1.1.4 Understanding the basics of cost-effective energy improvements, preparing a work scope and the ability to communicate these to students.

Chapter Eight
RESNET Standards

Effective Date
This chapter goes into effect on January 3, 2012

800 RESNET Standard for Performance Testing and Work Scope: Enclosure and Air Distribution Leakage Testing

801 Background
This Standard will present a step-by-step approach for how to measure:

- enclosure air leakage for the inspection of low rise, three stories or less, residential and light commercial buildings, and
- duct leakage associated with HVAC systems
- air flows for ventilation systems, and
- work scope and combustion safety procedures

802 Procedures for Building Enclosure Airtightness Testing
The purpose of this test procedure is to determine the airtightness of a building enclosure measured in cubic feet per minute at a 50 Pa pressure difference (*CFM50).*

802.1 ON-SITE INSPECTION PROTOCOL
There are three acceptable airtightness test procedures:

802.1.1 Single-point test: Measuring air leakage one time at a single pressure difference as described in section 802.5

802.1.2 Multi-point test: Measuring air leakage at multiple induced pressures differences as described in section 802.6

802.1.3 Repeated single-point test: The test is similar to the single point test, but the test is done multiple times for improved accuracy and estimating uncertainty as described in section 802.7

The building may be tested by applying a positive or negative pressure. Follow all manufacturers' instructions for set up and operation of all equipment. If certain requirements of this standard cannot be met, then all deviations from the standard shall be recorded and reported.

Note: Use caution when deciding how and whether to test homes with potential airborne contaminants (e.g. fireplace ash, mold or asbestos) and refer to local, state and national protocols/standards for methods to deal with these and other contaminants.

802.2 Protocol for Preparing the Building Enclosure for Testing

802.2.1 Doors and windows that are part of the conditioned space boundary shall be closed and latched.

802.2.2 Attached garages: All exterior garage doors and windows shall be closed and latched unless the blower door is installed between the house and the garage, in which case the garage shall be opened to outside by opening at least one exterior garage door.

802.2.3 Crawlspaces: If a crawlspace is inside the conditioned space boundary, interior access doors and hatches between the house and the crawlspace shall be opened and exterior crawlspace access doors, vents and hatches shall be closed. If a crawlspace is outside the conditioned space boundary, interior access doors and hatches shall be closed. For compliance testing purposes, crawl-space vents shall be open.

802.2.4 Attics: If an attic is inside the conditioned space boundary, interior access doors and hatches between the house and the conditioned attic shall be opened; and attic exterior access doors and windows shall be closed. If an attic is outside the conditioned space boundary, interior access doors and hatches shall be closed and exterior access doors, dampers or vents shall be left in their as found position and their position during testing shall be recorded on the test report.

802.2.5 Interior Doors: Shall be open within the Conditioned Space Boundary. See the definition of "Conditioned Space Boundary" for clarification.

802.2.6 Chimney dampers and combustion-air inlets on solid fuel appliances: Dampers shall be closed. Take precautions to prevent ashes or soot from entering the house during testing. Although the general intent of this standard is to test the building in its normal operating condition, it may be necessary to temporarily seal openings to avoid drawing soot or ashes into the house. Any temporary sealing shall be noted in the test report.

802.2.7 Combustion appliance flue gas vents: Shall be left in their normal appliance-off condition.

802.2.8 Fans: Any fan or appliance capable of inducing airflow across the building enclosure shall be turned off including, but not limited to, clothes dryers, attic fans, kitchen and bathroom exhaust fans, outdoor air ventilation fans, air handlers, and crawl space and attic ventilation fans. Continuously operating ventilation systems shall be turned off and the air openings sealed, preferably at the exterior terminations.

802.2.9 Non-motorized dampers which connect the conditioned space to the exterior or to unconditioned spaces: Dampers shall be left as found. If the damper will be forced open or closed by the induced test pressure, that fact shall be reported in the test report. Clothes dryer exhaust openings should not be sealed off even if there is no dryer attached but this fact should be noted in the test report.

802.2.10 Motorized dampers which connect the conditioned space to the exterior (or to unconditioned spaces): The damper shall be placed in its closed position and shall not be further sealed.

802.2.11 Un-dampered or fixed-damper intentional openings between conditioned space and the exterior or unconditioned spaces: Shall be left open or fixed position, however, temporary blocking shall be removed. For example: fixed-damper ducts supplying outdoor air for intermittent ventilation systems (including central-fan-integrated distribution systems) shall be left in their fixed-damper position. *Exception:* Un-dampered supply-air or exhaust-air openings of *continuously operating* mechanical ventilation systems shall be sealed (preferably seal at the exterior of enclosure) and ventilation fans shall be turned off as specified above.

802.2.12 Whole building fan louvers/shutters: Shall be closed. If there is a seasonal cover, install it.

802.2.13 Evaporative coolers: The opening to the exterior shall be placed in its off condition. If there is a seasonal cover, install it.

802.2.14 Operable window trickle-vents and through-the-wall vents: Shall be closed.

802.2.15 Supply registers and return grilles: Shall be left open and uncovered.

802.2.16 Plumbing drains with p-traps: Shall be sealed or filled with water, if empty.

802.2.17 Combustion appliances: Shall remain off during the test.

Maintain the above conditions throughout the test. If during the test, induced pressures affect operable dampers, seasonal covers, etc. then reestablish the set-up and consider reversing direction of fan flow.

After testing is complete, return the building to its as found conditions prior to the test. For example, make sure that any combustion appliance pilots that were on prior to testing remain lit after testing.

802.3 Accuracy Levels for Enclosure Leakage Testing
This standard defines two levels of accuracy:

802.3.1 ***Standard level of accuracy***: level of accuracy that produces test results that can be used in the modeling software or to assess compliance with a performance standard, energy code, or specific program requirement. This is the level of accuracy that is normally attained unless there are adverse testing conditions such as high winds, an extremely leaky building or very large baseline pressure adjustments.

802.3.2 ***Reduced level of accuracy***: during adverse testing conditions or in certain applications where testing time and costs are a factor, a test with a reduced level of accuracy may be used. Such applications may include demonstrating compliance with a performance standard, energy code, or specific program requirement. However, measurements made with a reduced level of accuracy may require surpassing the threshold value by an amount which will account for the added uncertainty as defined in

the sections below. RESNET accredited software that uses test results with a reduced level of accuracy shall internally adjust the calculations in accordance with this chapter.

802.4 Installation of the Blower Door Airtightness Testing System

802.4.1 Install the blower door system in an exterior doorway or window that has unrestricted access to the building and no obstructions to airflow within five feet of the fan inlet and two feet of the fan outlet. Avoid installing the system in a doorway or window exposed to the wind.

802.4.1.1 It is permissible to use a doorway or window between the conditioned space and unconditioned space as long as the unconditioned space has an unrestricted air pathway to the outdoors. For example, an attached garage or porch can be used as the unconditioned space; in that case, be sure to open all exterior windows and doors of the unconditioned space to the outdoors.

802.4.2 Install the pressure gauge(s), fans and tubing connections according to equipment manufacturer's instructions.

802.4.3 Record the indoor and outdoor temperatures in degrees F to an accuracy of 10 degrees F.

802.4.4 Record the elevation of the building site with an accuracy of 2000 feet; this may be omitted at elevations less than 5000 feet above sea level.

802.4.5 If ***ACH50***, i.e., air changes per hour @ 50 Pa, will be calculated, record the ***building volume*** (the volume enclosed by the conditioned space boundary)**.**

802.5 Procedure for Conducting a One-Point Airtightness Test (if a multi-point test will be conducted, skip to section 802.6)

802.5.1 Choose and record a ***time averaging period*** of at least 10 seconds to be used for measuring pressures. With the blower door fan sealed and off, measure and record 5, independent, ***average baseline building pressure readings*** with respect to outside to a resolution of 0.1 Pa.

802.5.2 Subtract the smallest baseline measurement from the largest recorded in Step 802.5.1 and record this as the ***baseline range***.

802.5.3 Airtightness tests with a baseline range less than 5.0 Pa, will be considered a ***Standard Level of Accuracy*** Test. Airtightness tests with a baseline range between 5.0 Pa and 10.0 Pa will be considered a ***Reduced Level of Accuracy*** Test and the results will be adjusted using Section 802.8. A one point test cannot be performed under this standard if the baseline range is greater than 10.0 Pa. Record the level of accuracy for the test as ***standard*** or ***reduced***, as appropriate**.** The baseline test may be repeated employing a longer time averaging period in order to meet the desired level of accuracy.

802.5.4 Re-measure the baseline building pressure using the same time averaging period recorded in Step 802.5.1 or use the average of the baseline pressures measured in step 802.5.1. This measurement is defined as the ***Pre-Test Baseline Building Pressure***. If desired for greater accuracy, a longer time averaging period may be used. Record the ***Pre-Test Baseline Building Pressure***.

802.5.5 Unseal the blower door fan. Turn on and adjust the fan to create an induced building pressure of approximately 50 Pa. Induced building pressure shall be defined as the (unadjusted) building pressure minus the pre-test baseline building pressure. If a 50 Pa induced building pressure cannot be achieved because the blower door fan does not have sufficient flow capacity, then achieve the highest induced building pressure possible with the equipment available.

802.5.6 A one-point test may only be performed if the maximum induced building pressure is at least 15 Pa and greater than four times the baseline pressure. If the maximum induced building pressure is less than 15 Pa, recheck that the house set up is correct and determine if any basic repairs are needed prior to further testing or modeling of the building. A multi-point test may be attempted, or multiple fans may be used. If using multiple fans, follow the manufacturer's instruction for measurement procedures.

802.5.7 Measure and record the unadjusted building pressure and nominal (not temperature and altitude corrected) fan flow using the same averaging period used in Step 802.5.4. Record the unadjusted building pressure (with 0.1 Pa resolution), nominal fan flow (with 1 CFM resolution), fan configuration (rings, pressurization or depressurization, etc), fan and manometer models and serial numbers.

802.5.8 Turn off the fan.

802.5.9 If your pressure gauge has the capability to display the induced building pressure (i.e. "baseline adjustment" feature) and adjust the fan flow value to an induced building pressure of 50 Pa (i.e. "@50 Pa" feature), then follow the manometer manufacturer's procedures for calculating the results of a one-point test and record the following values: induced building pressure, nominal CFM50, fan configuration, fan and manometer models and serial numbers. If needed calculate the following values:

- ***induced building pressure*** =
  measured building pressure minus the ***Pre-Test Baseline Building Pressure***

  Note: If a "baseline adjustment" feature of the manometer was used, then the induced building pressure is displayed on the pressure gauge.

- ***nominal CFM50*** = (50 / induced building pressure) $^{0.65}$ x recorded fan flow

  Note: If both a "baseline adjustment" feature and an "@50 Pa" feature were used, the nominal CFM50 is displayed directly on the pressure gauge.

If the altitude is above 5,000 feet or the difference between the inside and outside temperature is more than 30 degrees Fahrenheit then calculate the corrected CFM50 as defined below:

- ***corrected CFM50*** =
  nominal CFM50 x altitude correction factor x temperature correction factor

  where:
  altitude correction factor = 1 + .000006 x altitude, altitude is in feet
  temperature correction factors are listed in Table 802.1

802.6 Procedure for Conducting a Multi-Point Airtightness Test

802.6.1 Equipment that can automatically perform a multi-point test may be used to perform the steps below.

802.6.2 With the blower door fan sealed and off, measure and record the pre-test baseline building pressure reading with respect to outside. This measurement shall be taken over a time-averaging period of at least 10 seconds and shall have a resolution of 0.1 Pa. Record the pre-test baseline building pressure measurement.

802.6.3 Unseal the blower door fan. Turn on and adjust the fan to create an induced building pressure of approximately 60 Pa. If a 60 Pa induced building pressure cannot be achieved because the blower door fan does not have sufficient flow capacity, then adjust the fan to achieve the highest induced building pressure possible.

802.6.4 Measure the ***unadjusted building pressure*** (not baseline adjusted) and nominal fan flow (neither temperature nor altitude corrected) using the same time-averaging period used in Step 802.6.2. Record the unadjusted building pressure (with 0.1 Pa resolution), nominal fan flow (with 1 CFM resolution), fan configuration, fan model and fan serial number. Assure that the fan is being operated according to the manufacturer's instructions.

Note: since both pre- and post-test baseline measurements are required, do not use any baseline-adjustment feature of the manometer. In addition, do not use an "@50 Pa" feature because the nominal fan flow shall be recorded.

802.6.5 Take and record a minimum of 7 additional unadjusted building pressure and nominal fan flow measurements at ***target induced pressures*** which are approximately equally-spaced between 60 Pa (or the highest achievable induced building pressure) and 15 Pa. In very leaky buildings, the low end of this range may be reduced to as little as 4 Pa plus the absolute value of the baseline pressure.

802.6.6 Turn off and seal the blower door fan.

802.6.7 Measure and record the ***post-test baseline building pressure*** reading with respect to outside. This measurement shall be taken over the same time-averaging

period used in Step 802.6.2 and shall have a resolution of 0.1 Pa. Record the post-test baseline building pressure measurement.

802.6.8 Enter the recorded test values, temperatures and altitude into software that can perform the necessary calculations in accordance with ASTM E779-10, Section 9.

The software program shall calculate and report: corrected CFM50 and the percent uncertainty in the corrected CFM50, at the 95% confidence level, as defined in ASTM E779-10, Section 9.

Although ACH50 may be reported, this calculation may be omitted if the ACH50 metric is not needed.

Note: To avoid a higher percent uncertainty than desired, the testing technician may choose a larger, time-averaging period and start over at Step 802.6.2.

802.6.9 If the reported uncertainty in the corrected CFM50 is less than or equal to 10.0%, then the airtightness test shall be classified as a ***Standard Level of Accuracy*** test. If the reported uncertainly in the corrected CFM50 is greater than 10.0%, the airtightness test shall be classified as a ***Reduced Level of Accuracy*** test and the results will be adjusted using Section 802.8.

802.7 Procedure for Conducting a Repeated Single Point Test

802.7.1 With the blower door fan sealed and off, measure and record the pre-test baseline building pressure reading with respect to outside. This measurement shall be taken over a time-averaging period of at least 10 seconds and shall have a resolution of 0.1 Pa. Record this value as the pre-test baseline building pressure measurement.

802.7.2 Unseal the blower door fan. Turn on and adjust the fan to create an induced building pressure of approximately 50 Pa. If a 50 Pa induced building pressure can not be achieved because the blower door fan does not have sufficient flow capacity, then achieve the highest induced building pressure possible with the equipment available.

802.7.3 If during any single repeat of this test, the induced building pressure is less than 15 Pa, recheck that the house set up is correct and determine if any basic repairs are needed prior to further testing or modeling of the building. Following any repairs or changes to the set up, the test shall be restarted from the beginning. If you can not reach at least 15 Pa every time, then use the procedures in sections 802.5 or 802.6.

802.7.4 Measure and record the unadjusted building pressure and nominal (not temperature and altitude corrected) fan flow using the same time-averaging period used in Step 802.6.2. Record the unadjusted building pressure (with 0.1 Pa resolution), nominal fan flow (with 1 CFM resolution), fan configuration (rings, pressurization or depressurization, etc), fan model and fan serial number.

Note: If your pressure gauge has the capability to display the induced building pressure (i.e. baseline adjustment feature) and the capability to adjust the fan flow

value to an induced building pressure of 50 Pa (i.e. "@50 Pa" feature), then follow the manufacturer's procedures for calculating the results of a one-point test and record the following values: induced building pressure, nominal CFM50, fan configuration, fan model and fan serial number.

802.7.5 Turn off the fan.

802.7.6 Calculate the following values:

- ***induced building pressure*** = unadjusted building pressure (Pa) minus pre-test baseline building pressure (Pa).

  Note: If a baseline adjustment feature was used, then the induced building pressure is displayed on the pressure gauge.

- nominal CFM50 = (50 Pa / Induced building pressure) $^{0.65}$ x nominal fan flow.

  Note: If both a baseline adjustment feature and an "@50 Pa" feature were used, the nominal CFM50 is displayed directly on the pressure gauge.

802.7.7 Repeat Steps 802.7.1 through 802.7.1 until a minimum of 5 nominal CFM50 estimates have been recorded. The same fan configuration shall be used for each repeat.

802.7.8 Calculate the ***Average Nominal CFM50*** by summing the individual nominal CFM50 readings and dividing by the number of readings.

802.7.9 If the altitude is above 5,000 feet or the difference between the inside and outside temperature is more than 30 degrees Fahrenheit then calculate the corrected CFM50 as defined below:

Calculate the ***Average Corrected CFM50*** =

Average Nominal CFM50 x altitude correction factor x temperature correction factor

where:

altitude correction factor = 1 + .000006 x altitude, altitude is in feet

temperature correction factors are listed in Table 802.1

Table 802.1 Temperature Correction Factors for Pressurization and Depressurization Testing- Calculated according to ASTM E779-10

Correction Factors for Pressurization Testing

OUTSIDE TEMP (F) \ INSIDE TEMPERATURE (F)	50	55	60	65	70	75	80	85	90
-20	1.062	1.072	1.081	1.090	1.099	1.108	1.117	1.127	1.136
-15	1.056	1.066	1.075	1.084	1.093	1.102	1.111	1.120	1.129
-10	1.051	1.060	1.069	1.078	1.087	1.096	1.105	1.114	1.123
-5	1.045	1.054	1.063	1.072	1.081	1.090	1.099	1.108	1.117
0	1.039	1.048	1.057	1.066	1.075	1.084	1.093	1.102	1.111
5	1.033	1.042	1.051	1.060	1.069	1.078	1.087	1.096	1.105
10	1.028	1.037	1.046	1.055	1.064	1.072	1.081	1.090	1.099
15	1.023	1.031	1.040	1.049	1.058	1.067	1.076	1.084	1.093
20	1.017	1.026	1.035	1.044	1.052	1.061	1.070	1.079	1.087
25	1.012	1.021	1.029	1.038	1.047	1.056	1.064	1.073	1.082
30	1.007	1.015	1.024	1.033	1.041	1.050	1.059	1.067	1.076
35	1.002	1.010	1.019	1.028	1.036	1.045	1.054	1.062	1.071
40	0.997	1.005	1.014	1.023	1.031	1.040	1.048	1.057	1.065
45	0.992	1.000	1.009	1.017	1.026	1.035	1.043	1.051	1.060
50	0.987	0.995	1.004	1.012	1.021	1.029	1.038	1.046	1.055
55	0.982	0.990	0.999	1.008	1.016	1.024	1.033	1.041	1.050
60	0.977	0.986	0.994	1.003	1.011	1.019	1.028	1.036	1.045
65	0.973	0.981	0.989	0.998	1.006	1.015	1.023	1.031	1.040
70	0.968	0.976	0.985	0.993	1.001	1.010	1.018	1.026	1.035
75	0.963	0.972	0.980	0.988	0.997	1.005	1.013	1.022	1.030
80	0.959	0.967	0.976	0.984	0.992	1.000	1.009	1.017	1.025
85	0.955	0.963	0.971	0.979	0.988	0.996	1.004	1.012	1.020
90	0.950	0.958	0.967	0.975	0.983	0.991	0.999	1.008	1.016
95	0.946	0.954	0.962	0.970	0.979	0.987	0.995	1.003	1.011
100	0.942	0.950	0.958	0.966	0.970	0.982	0.990	0.998	1.007
105	0.938	0.946	0.954	0.962	0.970	0.978	0.986	0.994	1.002
110	0.933	0.942	0.950	0.952	0.966	0.974	0.982	0.990	0.998

Correction Factors for Depressurization Testing

OUTSIDE TEMP (F) \ INSIDE TEMPERATURE (F)	50	55	60	65	70	75	80	85	90
-20	0.865	0.861	0.857	0.853	0.849	0.845	0.841	0.837	0.833
-15	0.874	0.870	0.866	0.862	0.858	0.854	0.850	0.846	0.842
-10	0.883	0.879	0.874	0.870	0.866	0.862	0.858	0.854	0.850
-5	0.892	0.887	0.883	0.879	0.875	0.871	0.867	0.863	0.859
0	0.900	0.896	0.892	0.887	0.883	0.879	0.875	0.871	0.867
5	0.909	0.905	0.900	0.896	0.892	0.888	0.883	0.879	0.875
10	0.918	0.913	0.909	0.905	0.900	0.896	0.892	0.888	0.884
15	0.927	0.922	0.918	0.913	0.909	0.905	0.900	0.896	0.892
20	0.935	0.931	0.926	0.922	0.917	0.913	0.909	0.905	0.900
25	0.944	0.939	0.935	0.930	0.926	0.922	0.917	0.913	0.909
30	0.952	0.948	0.943	0.939	0.934	0.930	0.926	0.921	0.917
35	0.961	0.956	0.952	0.947	0.943	0.938	0.934	0.930	0.925
40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
45	0.978	0.974	0.969	0.964	0.960	0.955	0.951	0.946	0.942
50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955	0.950
55	0.995	0.990	0.986	0.981	0.976	0.972	0.967	0.963	0.958
60	1.004	0.999	0.994	0.989	0.985	0.980	0.976	0.971	0.967
65	1.012	1.008	1.003	0.998	0.993	0.988	0.984	0.979	0.975
70	1.021	1.016	1.011	1.006	1.001	0.997	0.992	0.988	0.983
75	1.029	1.024	1.019	1.015	1.010	1.005	1.000	0.996	0.991
80	1.038	1.033	1.028	1.023	1.018	1.013	1.009	1.004	0.999
85	1.046	1.041	1.036	1.031	1.026	1.022	1.017	1.012	1.008
90	1.055	1.050	1.045	1.040	1.035	1.030	1.025	1.020	1.016
95	1.063	1.058	1.053	1.048	1.043	1.038	1.033	1.028	1.024
100	1.072	1.066	1.061	1.056	1.051	1.046	1.041	1.037	1.032
105	1.080	1.075	1.070	1.064	1.059	1.054	1.050	1.045	1.040
110	1.088	1.083	1.078	1.073	1.068	1.063	1.058	1.053	1.048

802.7.10 Estimate the precision uncertainty using one of the two following methods

802.7.10.1 Standard Statistical Process – Use a calculator or computer to compute the Standard Deviation of the repeated Nominal CFM50 readings. Divide this Standard Deviation by the square root of the number of readings. Multiply the result by the t-statistic in table 802.2 corresponding to the number of readings taken. Convert this result to a percentage of the Average Nominal CFM50.

Table 802.2 Precision Uncertainty: Values of t-statistic	
Number of readings	t-statistic
5	2.78
6	2.57
7	2.45
8	2.37
9	2.31

802.7.11 If a software program is used, it shall at a minimum calculate and report:

802.7.11.1 Average CFM50, corrected for altitude and temperature

802.7.11.2 The percent uncertainty in the CFM50, at the 95% confidence level, as calculated in 802.7.10.

802.7.11.3 ACH50 (air changes per hour @ 50 Pa) = (CFM50 x 60) / building volume (in cubic feet). This calculation may be omitted if the ACH50 metric is not needed.

802.7.12 If the reported uncertainty in the CFM50 is less than or equal to 10.0%, then the airtightness test shall be classified as a Standard Level of Accuracy test as defined in section 802.3. If the reported uncertainly in the CFM50 is greater than 10.0%, the airtightness test shall be classified as a Reduced Level of Accuracy test as defined in section 802.3.

802.8 Application of Results

802.8.1 Adjusting CFM50 for Tests with a Reduced Level of Accuracy. When using results classified as having a Reduced Level of Accuracy, an adjustment shall be used in certain situations. The adjustment is done to improve the probability that the tested building meets the required performance threshold. The adjusted CFM50 in these situations is defined as:

adjusted CFM50 = extending factor x corrected CFM50,
where:

For a One-point Test, classified as Reduced Level of Accuracy:
extending factor = 1 + 0.1 x (50 / the induced pressure)

For a Multi-point Test, classified as Reduced Level of Accuracy:
extending factor = 1 + (% uncertainty / 100)

adjusted CFM50 value shall be used when:

- determining whether or not a building meets an airtightness threshold, and
- conducting a Home Energy Rating for the purpose of compliance with any standard, energy code or program.

adjusted CFM50 value shall NOT be used when:

- calculating the expected energy savings from retrofit,
- conducting an energy audit, or
- assessing the relative airtightness of a group of buildings.

802.8.2 Other Leakage Metrics:
ELA may be calculated by: ***ELA*** = 0.055 x CFM50
Where ELA is in square inches

ACH50 = corrected CFM50 x 60 / building volume (in cubic feet)

Specific Leakage Area may be calculated by:
SLA = 69.4 x ELA/ building floor area (square feet)
Where ELA is in square inches

Normalized Leakage Area may be calculated by:
NLA = SLA x $(S)^{0.3}$, where S is the number of stories above grade

802.9 Equipment Accuracy and Requirements
Blower door fans used for building air leakage testing shall measure airflow (after making any necessary air density corrections) with an accuracy of +/- 5%. Pressure gauges shall measure pressure differences with a resolution of 0.1 Pa and have an accuracy of +/- 1% of reading or 0.5Pa, whichever is greater.

Blower door and associated pressure testing instruments shall be tested annually for calibration by the HERS Rating Provider or Certified Rater. The provider shall use a standard for field testing of calibration provided by the equipment manufacturer. Magnehelic Gauges cannot be field tested and shall be recalibrated by the Blower Door manufacturer annually. Field check the fan and flow measuring systems for defects and maintain them according to manufacturers recommendations. The HERS Rating Provider or Certified Rater shall maintain a written log of the annual calibration check to verify all equipment accuracy for a period of three (3) years. These records shall be made available within 3 business days to the RESNET Quality Assurance Administrator upon request.

803 On-site Inspection Procedures for Duct Leakage Testing
The purpose of these test procedures is to make a determination of the amount of leakage of a duct system, either total system leakage or leakage to outside of the conditioned space. Because total duct leakage (to both inside and outside the conditioned space) at 25 Pascals should always be greater than the leakage to outside, the total leakage may be used instead of leakage to outside for determining that a system meets a required threshold. The total leakage value may be entered into software as if it were leakage to the outside for this purpose. However, total leakage should not be substituted for leakage to outside when conducting an energy audit or predicting savings from retrofits, except as indicated. Table 803.1 summarizes the test methods approved for use in the RESNET Standards.

803.1 Air Handler Flow
For the purposes of determining if a total duct leakage test method may be used (see table 803.1), the Air handler flow can be measured in accordance with ASHRAE Standard152-2004, ASTM E1554-2007, or by using the following default values: 400 CFM per ton of air conditioner or heat pump capacity or 200 CFM per 12,000 Btu/h of furnace (output) capacity whichever is greater.

Table 803.1- Duct Leakage Test Methods

Test Method	Test pressure	Conversion to operating pressure	Supply/Return	Notes
Leakage to the Outside Tests				
RESNET Standard Section 803.7	25 Pa	No conversion	Assume ½ supply and ½ return	
ASHRAE 152 Annex B	25 Pa	½ plenum pressure for supply and return individually	Separate	
ASTM E1554-07 Method A: "DeltaQ"	Normal Operation	n/a	Separate	Can be used for energy auditing but not compliance testing. To limit precision errors this test is only allowed in this RESNET Standard if the Building Enclosure Leakage is less than 2500 cfm @ 50 Pa
ASTM E1554 Method B	25 Pa	½ plenum pressure for supply and return individually	Separate	
Total Duct Leakage Tests				The total leakage may be used instead of leakage to outside for compliance testing. It may be used for energy audits or savings estimates if the total leakage is less than 10% of air handler flow**.**
RESNET Standard Section 803.5	25 Pa	No conversion	Assume ½ supply and ½ return	
ASHRAE 152 Annex C	25 Pa	½ plenum pressure or assume 62.5 Pa	Assumes ½ supply and ½ return	2.5% of air handler flow added if testing done without air handler. 2.5% added if testing done without registers/grilles.

803.2 RESNET Simplified Test Procedures

For purposes of this chapter, duct leakage may be measured by either pressurizing or depressurizing the duct system. Tests measure either total leakage or leakage to the outside. Total leakage includes all leaks in the air distribution system and leakage to the outside only refers to leaks to outside the conditioned space. The following text mentions only pressurization, but depressurization may also be used.

Testing of the duct system(s) of a building is accomplished by use of a duct leakage testing device and, when testing leakage to outside, a blower door. For total duct leakage, the duct

leakage tester is attached and used to pressurize the duct system to 25 Pa. This test measures all duct leakage including leakage between the ducts and the conditioned space and leakage between the ducts and any unconditioned space or outside.
When performing a duct leakage to outside test, a blower door is also used to pressurize the building to 25 Pa while the duct leakage tester is used to equalize the pressure inside the duct system with the building pressure induced by the blower door (e.g 25 Pa). Multiple blower doors may be used if the conditioned space can't be uniformly pressurized with a single blower door (for example- a conditioned crawlspace). Because the ducts and the conditioned space of the building are theoretically at the same pressure, little or no air flows through leaks between the ducts and the conditioned space and the duct leakage tester only measures the leakage between the ducts and spaces outside the conditioned space. When ducts are entirely within the conditioned space boundary, 100% of the system is visible at the time of testing and the system is fully ducted (i.e., no building cavities are used to transport air) the ducts do not have to be tested and the ducts may be assumed to have no leakage to outside the conditioned space.

803.2.1 Multifamily Buildings

For multifamily buildings where each unit has its own duct system, each unit may be tested individually using the procedures in this RESNET standard. Each unit should be treated as if it is a single family dwelling. The leakage to outside test is performed using a blower door in the main entry to the unit to pressurize the individual unit with reference to outside. If the main entry door is in an interior hallway then the hallway needs to be well connected to outside through open windows or doors or an exterior window or door (such as to deck or patio) may be used. Similarly, only the ducts in the unit under test are pressurized. For compliance testing, use measured leakage to outside. For energy audits or savings estimates, it may be assumed that the leakage to outside is one-half of this measured leakage. For compliance testing, the total leakage test method may be used instead of leakage to outside.

803.3 Protocol for Preparing the Building and the Duct System for a Duct Leakage Test (Items 803.3.1-803.3.8 are used for both Total and Outside Leakage tests)

803.3.1 Adjust the HVAC system controls so that the air handler fan does not turn on during the test.

803.3.2 Turn off any fans that could change the pressure in either the conditioned space or any spaces containing ducts or air handlers (bathroom fans, clothes dryers, kitchen vent hood, attic fan, etc.).

803.3.2 Turn off all vented combustion appliances if there is a possibility that the space containing the appliance will be depressurized during the test procedure.

803.3.3 Remove all filters from the duct system and air handler cabinet. If the duct leakage testing system is installed at a central return grille, also remove the filter from that grille.

803.3.4 Any intentional openings into the duct system such as combustion air or ventilation ducts shall be left in their normal non-ventilation operating position. Motorized dampers should be closed.

803.3.5 If ducts run through unconditioned spaces such as attics, garages or crawlspaces, open vents, access panels, doors, or windows between those spaces and the outside to eliminate pressure changes due to duct leakage during the test procedure.

803.3.6 Supply registers and return grilles shall be temporarily sealed in some manner so as to allow for the pressurization of the duct system.

803.3.7 Zone and bypass (not balancing) dampers shall be set to the open position to allow uniform pressures throughout the duct system.

Total leakage test only: Fully open at least one door, window or comparable opening between the building and outside to prevent changes in building pressure when the duct leakage testing system is running.

Leakage to the outside test only: All exterior doors and windows between the building and outside shall be closed, and other openings to the outside that may hinder the ability of a blower door fan to pressurize the building to 25 Pa with reference to outside should be closed or covered in some manner. Interior doors shall be open.

803.4 Installation of the Duct Leakage Testing System (used for both total leakage and leakage to outside tests)

803.4.1 Attach the duct leakage tester system to the largest return grille closest to the air handler. Use the manufacturer's recommended installation procedure that is consistent with the mode (i.e. pressurization vs. depressurization) of the test being performed. Be sure the remaining opening in the return grille is temporarily sealed.

When testing a duct system with 3 or more returns, installation of the duct leakage tester at the air handler cabinet may be a better attachment location.

Document the attachment location of the duct leakage testing system.

803.4.2 Select a location to measure duct pressure. Choose one of the following three locations to measure duct pressure:

- The largest supply register closest to the air handler, or
- The main supply trunk line, or
- The supply plenum can be used if the duct leakage tester is installed at a central return.

Document the duct pressure measurement location.

803.4.3 Insert a pressure probe into the duct system at the chosen measurement location. If measuring at the supply trunk line or supply plenum, you must use a static pressure probe (be sure the probe is pointing into the air stream). If measuring at a supply register, you may use a static pressure probe, or you may simply insert a straight pressure probe or the end of a piece of flexible tubing.

803.4.4 Install the pressure gauge and tubing connections in accordance with the manufacturer's instructions and the test mode (pressurization vs. depressurization) being used. The duct system pressure should be measured with reference to the inside of the building. Turn on and configure the pressure gauge for the test procedure being performed.

803.5 Procedure for Conducting a Total Duct Leakage Test

803.5.1 Select the appropriate range (e.g. flow ring) of the duct leakage testing fan and configure the flow gauge to match the selected range.

803.5.2 Turn on the duct leakage testing fan and increase fan speed until the duct system has been pressurized to 25 Pa (+/- 0.5 Pa). Measure and record the duct pressure reading (0.1 Pa resolution) and the fan flow reading (1 CFM resolution) using a 5 second averaging period. Also record the fan configuration (range), fan and manometer models and serial numbers. Be sure the fan is being operated according to the manufacturer's instructions.

If 25 Pa of duct pressure cannot be achieved because the duct testing fan does not have sufficient flow capacity, then achieve the highest duct pressure possible with the equipment available and record the values above.

Note: If your pressure gauge has the capability to adjust the fan flow value to a duct pressure of 25 Pa (i.e. @25 Pa feature), then follow the manufacturer's procedures for conducting a one-point total leakage test, and record the following values: duct pressure, CFM25 (or fan flow in CFM and pressure in Pa if 25 Pa not achieved), fan configuration, fan and manometer models and serial numbers. If your gauge does not have an @25 feature and the measured duct pressure was not exactly 25 Pa, calculate and record CFM25 as: CFM25 = (25 Pa/ duct pressure)$^{0.6}$ x fan flow.

803.5.3 Turn off the duct testing fan.

803.6 Installation of the Blower Door System (used for leakage to outside test only)

803.6.1 Install the blower door system in an exterior doorway that has unrestricted access to the building and no obstructions to air flow within five feet of the fan inlet. The blower door fan should be installed in a configuration that is consistent with the mode of the duct leakage test (i.e. pressurization vs. depressurization).

803.6.2 Install the pressure gauge(s), fan and tubing connections as per manufacturer's instructions.

803.7 Procedure for Conducting a Duct Leakage to Outside Test

803.7.1 With both the blower door and duct leakage fans sealed, measure the baseline building pressure with reference to outside using a 5 second averaging period.

803.7.2 Unseal the blower door fan. Turn on the blower door fan and pressurize the building by 25 Pa (+/- 0.5 Pa) from the measured baseline building pressure (i.e. change the building pressure by 25 Pa). **Note:** If your pressure gauge has the capability to display the induced building pressure (i.e. baseline adjustment feature), then follow the manufacturer's procedures for pressurizing the building by 25 Pa.

803.7.3 With the blower door fan continuing to run, unseal the duct leakage testing fan and select the appropriate range on the duct leakage testing fan. Configure the duct leakage testing system gauge to match the selected range.

803.7.4 Turn on the duct leakage testing fan and increase fan speed until the duct system pressure reads 0.0 (+/- 0.1 Pa). **Note:** The duct system pressure should be measured with reference to the inside of the building.

803.7.5 Re-check the blower door pressure gauge and if necessary, re-adjust the blower door fan to maintain a 25 Pa pressurization. **Note:** If the blower door fan is being operated with a "cruise control" feature, it is not necessary to recheck the blower door pressure gauge.

803.7.6 Return to the duct leakage pressure gauge and if necessary, re-adjust the duct leakage testing fan until the duct system pressure reads 0.0.

803.7.7 Record the following values: building pressure, duct pressure, CFM of flow through the duct testing fan, duct testing fan configuration, duct testing fan and manometer models and serial numbers. Calculate and record CFM25: CFM25 = (25 Pa/ building pressure)$^{.6}$ x duct leakage fan flow.

803.7.8 Turn off both the blower door and duct leakage testing fans.

Note: If the blower door system is unable to pressurize the building to 25 Pa because the blower door fan does not have sufficient flow capacity, then you will need to conduct the test at the highest achievable building pressure and adjust the measured duct leakage as described in step 803.7.7.

Note: If the duct testing fan was unable to create a pressure difference of zero between the duct system and the building (while the blower door is pressurizing the building to 25 Pa) because the duct testing fan does not have sufficient flow capacity, then the test will need to be performed at a lower building pressure and adjust the measured duct leakage as described in step 803.7.7.

803.8 Application of Results

803.8.1 The results of the total duct leakage test represent the total amount of duct leakage both to the inside and to the outside of the conditioned space and represent the overall leakage of the entire system. The total leakage may be of use in some programs where the total system duct leakage is required.

803.8.2 The duct leakage to the outside test is designed to measure only the duct leakage occurring to the outside of the conditioned space. Many programs use this measurement as the determining factor as to whether a duct system fails or passes.

803.8.3 If rating software requires separate input of supply and return leakage that have not individually been measured you shall assume that ½ of the total measured leakage is in the supply and ½ is in the return.

803.9 Equipment Accuracy and Requirements

Duct testing fans used for determining either total leakage or leakage to outside shall measure airflow with an accuracy of +/-5%. Pressure gauges shall measure pressure differences with a resolution of 0.1 Pa and have an accuracy of +/-1% of the reading or 0.5 Pa, whichever is greater.

Blower doors, duct testers, and associated pressure testing instruments shall be field-tested annually for calibration. The calibration procedure shall follow the equipment manufacturer's recommendations.

The HERS Rating Provider or Certified Rater shall maintain a written log of the annual calibration check to verify all equipment accuracy for a period of three (3) years. These records shall be made available within 3 business days to the RESNET Quality Assurance Administrator upon request.

804 On-site Inspection Procedures for ventilation air flow Testing

The purpose of these test procedures are to measure the air flows through whole house ventilation systems and local exhausts. The test procedures treat the air flows into and out of the grille being measured separately. The Air Flow Resistance method may only be used on systems that do not have multiple branches in the ventilation air duct system. Use of a manometer with manufacturer-installed calibrated ports (common on ERV/HRV equipment) is an acceptable method if the manufacturer's instructions are followed

804.1 Air Flows into Grilles

804.1.1 Powered Flow Hood

A powered flow hood consists of:

- A flow capture device that is to be placed over the grille to be measured. The flow capture element needs to be large enough to cover the whole grille and be airtight.
- A pressure measuring system inside the flow capture element that is designed and installed to measure the static pressure inside the flow capture element.
- A manometer to measure the pressure difference between the inside of the flow capture element and the room.

- An air flow meter to measure the air flow through the air flow capture element. The air flow meter shall measure airflow with an accuracy of +/-5%.
- A variable-speed fan to move air through the flow capture element and the flow meter.

804.1.1.1 Place the flow capture element over the grille to be measured.

804.1.1.2 Turn on the air flow assisting fan and adjust the airflow until zero pressure difference is measured between the flow capture element and the room.

804.1.1.3 Record the air flow through the air flow meter.

804.1.2 Air Flow Resistance

The Air Flow Resistance method measures the pressure difference across a flow capture element with a known air flow resistance. A rectangular user fabricated box can be used if the size of the hole is not greater than half the size of the box in each direction and the distance from the hole to the grill is at least as large as the larger dimension of the hole. User fabricated devices shall be approved by a provider prior to use.

804.1.2.1 Place the flow capture element over the grille to be measured. Ensure there is air tight seal around the grille and the flow device so that all of the air entering the grill goes through the device.

804.1.2.2 Measure the pressure difference (ΔP) between the flow capture element and the room at a corner of the inlet side of the box. The hole in the flow capture device should be sized so that the pressure difference is between 1 and 5 Pa.

804.1.2.3 Calculate the air flow using the manufacturer's calibration of the air flow resistance device.

For user fabricated devices that do not have a manufacturer's calibration, the following equations may be used to calculate the air flow.

Air Flow (cfm) = Open Area$\times 1.07 \times (\Delta P)^{0.5}$; for Area in in^2, ΔP in Pa
Air Flow (L/s) = Open Area$\times 0.078 \times (\Delta P)^{0.5}$; for Area in cm^2, ΔP in Pa

804.2 Air Flows Out of Grilles

804.2.1 Powered Flow Hood

The measurement procedure is the same as for air flow into grilles (Section 804.1.1) but with the fan and flowmeter arranged to have flow out of the grille.

804.2.2 Bag Inflation

The Bag Inflation method requires the use of a bag of a known volume, a method to hold the bag open (typically a lightweight frame of wood, plastic or metal wire), a shutter to start the air flow and a stopwatch.

804.2.2.1 Completely empty the bag of air and place a shutter over its opening.

804.2.2.2 Rapidly withdraw the shutter and start the stopwatch.

804.2.2.3 When the bag is completely full stop the stopwatch.

804.2.2.4 Calculate the airflow by dividing the bag volume by the elapsed time. Calculate the air flow in cfm as 8 X bag volume in gallons/number of seconds

804.2.2.5 Repeat measurement one or more times and average the results.

804.2.2.6 How to Choose a Bag

Plastic thickness. Bags made from thinner material often do not fill uniformly because the air flow from the register blows them about too much. If the bag sides flap a lot and measuring the same register twice gives results that differ by more than 20%, then try a bag with thicker material.

Use the right sized bags. Bags that fill in under two seconds will have increased errors because of resolution issues in timing how fast the bag is filled. Conversely, bags that are too large for a given register flow will have increased leakage around the edges of the bag before it fills completely and may not generate enough pressure to push a bag into its final shape. Aim for a fill time of 2 to 20 seconds.

804.3 Equipment Accuracy Requirements and Specification

The manometer shall measure pressure differences with a resolution of 0.1 Pa and have an accuracy of +/-1% of the reading or 0.5 Pa, whichever is greater.

805 Work Scope and Combustion Safety Procedures

805.1 These protocols shall be followed by RESNET-accredited Raters and Auditors (hereinafter referred to collectively as "Auditors") performing combustion appliance testing or writing work scopes for repairs.

805.2 If the Auditor has been trained and certified in accordance with a RESNET approved "equivalent home performance certification program" or the Building Performance Institute (BPI) Standards, the Auditor may follow protocols in accordance with those equivalent standards.

805.3 RESNET-accredited Training Providers shall train HERS Auditors on these protocols through either field exercise or through simulated conditions. A written exam administered by a RESNET-accredited Trainer is also required, provided by RESNET. The test shall cover the content of these guidelines with a minimum of 25 questions. A minimum score of 80% is required to pass.

805.4 Prior to conducting any test that affects the operating pressures in the home, the Auditor shall inquire whether a person that has environmental sensitivities (asthma, allergies, chemical sensitivity, etc.) is present in the home. If such a person is present, the Auditor shall not perform such tests without written disclosure from the affected party (or responsible adult). The written disclosure shall state (at a minimum) that "during the period of testing, some amount of dust, particles, or soil gases already present in the home may become airborne." Without a signed disclosure, the Auditor shall either reschedule the test for a time when they will not be present, or ask them to leave the home during the testing process. The Auditor shall also inquire as to the presence of pets that may potentially be affected by testing procedures.

806 Gas Leakage Test

806.1 If there is a noticeable odor indicating gas buildup within the home, the occupants and Auditor shall leave the house and the appropriate authorities and utility providers shall be notified from outside the home.

806.2 The Auditor should use a gas detector upon entry into the home to detect the presence of natural gas. If gas is suspected or confirmed, ensure that switches are not operated while exiting and no ignition concerns are present. The audit shall not proceed until the proper authorities have deemed it safe to re-enter the home. If there is no noticeable odor indicating gas buildup within the home, the Auditor shall determine if there are gas leaks in the fittings and connections of natural gas appliances within the home and natural gas/liquid propane supply lines following these protocols.

806.3 Inspect all fittings and joints in supply lines and appliance connectors and confirm suspected leaks with leak-detection fluid. Identify for repair or replacement any kinked, corroded or visibly worn flexible gas lines and any flexible connectors manufactured prior to 1974.

806.4 Equipment needed

- Combustible gas detector capable of measuring 20 ppm
- Leak detection fluid (non-corrosive)

807 Worst Case Depressurization Test

This test procedure measures the pressure in the Combustion Appliance Zone (CAZ) and provides visual evidence of spillage potential.

If there are any vented combustion appliances that use indoor air to vent combustion gases and which are not classified as a category 3 or 4 according to NFPA standard 54, then a worst case depressurization test shall be performed using the following protocol.

807.1 Check the combustion appliance zone for the presence of flammable or explosive material near a combustion source.

807.2 Visually inspect venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion or other deficiencies that could cause an unsafe condition.

807.2.1 Inspect burners and crossovers for blockage and corrosion.

807.2.2 Inspect furnace heat exchangers for cracks, openings or excessive corrosion.

807.3 Close all the exterior doors and windows of the home.

807.4 Close fireplace damper(s) if fireplace is present.

807.5 Close any interior doors between the CAZ and the remainder of the house, ensuring that all vented appliances and exhaust fans have been turned off.

807.6 Measure the baseline pressure difference between the CAZ with respect to (WRT) outside (ambient) and baseline CO levels. Set the gauge to read pressure and record the baseline pressure.

807.7 Turn on all exhaust fans in the home (kitchen range hood, bath exhaust, clothes dryer, etc.) that exhaust air outside the building envelope.

807.8 Record pressure in CAZ with respect to Outside.

807.9 Turn on the air handler. Record pressure in CAZ with respect to outside. If air handler makes the CAZ more positive (or less negative), turn it off. If the air handler is kept on, close interior doors to any rooms that have no return registers.

807.10 If fireplace is present install blower door and set to exhaust 300 CFM to simulate fireplace in operation.

807.11 Record net change in pressure difference within the CAZ WRT outside between baseline and worst case depressurization conditions. Record the position of doors and conditions of fans and air handler. When the net change in CAZ pressure is lower (more negative) than the limits specified below, the work scope shall specify remediation through pressure balancing, duct sealing, and/or other pressure-relief measures, as applicable.

807.12 Turn on vented combustion appliance with the smallest Btu capacity. Operate appliance for 5 minutes then measure CO levels according to the carbon monoxide test procedure below, and check appliance draft using a smoke pencil at the draft diverter. If the smoke is not fully drawn up the flue, the appliance has spillage under worst case depressurization. Record if there is any spillage and record CO level. When spillage occurs or CO exceeds the limits specified below in section 9, the work scope shall specify remediation, including equipment repair or replacement, and/or building pressure remediation, as applicable. If both spillage and high CO are found during the test, the homeowner should be notified of the conditions and that it needs immediate remediation.

807.13 Turn on all the other combustion appliances, one at a time, within the CAZ and repeat step 1.12 on each of them.

807.14 If spillage or high CO occurs in any appliance(s) under worst case depressurization, retest that appliance(s) under natural conditions.

807.14.1 Turn off the combustion appliances.

807.14.2 Turn off the exhaust fans.

807.14.3 Open the interior doors.

807.14.4 Let the vent cool.

807.14.5 Test CO and spillage under natural conditions. If the test failed under worst-case, but passes under natural conditions, the work scope shall specify building pressure remediation, as applicable.

807.14.6 If an appliance fails under natural conditions, the Auditor shall inform the homeowner of the problem, and the work scope shall specify remediation, including equipment or vent system repair or replacement, as applicable.

CAZ Pressure Limits
-15 Pa for pellet stoves with exhaust fans and sealed vents

-5 Pa for Atmospheric vented oil or gas system (classified as a category 1 or 2 according to NFPA standard 54, such as oil power burner; fan-assisted or induced-draft gas; solid-fuel–burning appliance other than pellet stoves with exhaust fans and sealed vents)

If ambient CO levels exceed 35 ppm at any time, stop any testing and turn the combustion appliances off. Open all the exterior doors and windows. No one should enter the home until the CO levels drop below 35 ppm. The combustion appliance causing the increase in CO levels must be repaired by a qualified technician prior to completing the combustion appliance tests, unless the work scope calls for replacement of the appliance(s).

808 Carbon Monoxide Testing
Test all spaces (including attached garages, crawlspaces, basements) containing combustion appliances for carbon monoxide using the following protocols.

808.1 CO testing of ambient air shall be performed continuously while performing a Worst Case Depressurization Test and/or under natural conditions, as required by paragraph 807.14.

808.2 Equipment used shall:

- Be capable of measuring carbon monoxide (CO) levels from 0 to 2,000 ppm (parts per million)

- Have a resolution of 1 ppm
- Have an accuracy rate of + 5 ppm
- Be calibrated annually by the manufacturer (or using manufacturer's instructions) and evidence of the calibration shall be submitted to the Rating Provider Quality Assurance Designee

808.3 Zero the carbon monoxide meter outside the building away from any combustion outlets or automobile traffic areas.

808.4 Take a measurement of CO levels within the home upon entering to establish a baseline. Do not measure near combustion appliances while they are operating. If ambient CO levels are higher than 35 ppm during normal appliance operation, turn off the appliance, ventilate the space, and evacuate the building. The building may be reentered once ambient CO levels have gone below 35 ppm.

808.5 For atmospherically-vented appliances:

808.5.1 Take a measurement of vent gases upstream of (before they reach) the draft diverter.

808.5.2 Appliance must operate for at least 5 minutes before taking sample.

808.5.3 Take sample during worst-case depressurization test and/or under natural conditions, as required by paragraph 1.14. Record the CO level.

808.6 For direct- or power-vented appliances:

808.6.1 Sample must be taken at vent termination.

808.6.2 Appliance must operate for at least 5 minutes before taking sample.

808.6.3 Take sample during worst-case depressurization test and/or under natural conditions, as required by paragraph 1.14. Record the CO level.

808.7 For LP- or natural gas ovens:

808.7.1 Open a window or door to the outside.

808.7.2 Remove any foil or cooking utensils within the oven.

808.7.3 Verify that the oven is not in self-cleaning mode.

808.7.4 Turn oven on to highest temperature setting.

808.7.5 Close the oven door and begin monitoring the CO levels in the kitchen, 5 feet from the oven at countertop height. Record CO levels.

808.7.6 Measure the CO levels within the oven vent.

808.7.6.1 Samples must be taken while burner is firing.

808.7.6.2 Operate burner for at least 5 minutes while sampling flue gases.

808.7.6.3 If CO levels are higher than 100 ppm, repeat the flue gas sampling until the CO levels stop falling.

808.7.6.4 Record the steady state CO reading in ppm and turn off oven.

808.8 If measured CO levels are higher than 100 ppm (200 for oven), or an appliance fails to meet manufacturer's specifications for CO production (whichever is higher), the work scope shall specify replacement or repair of the appliance, and the homeowner shall be notified of the need for service by a qualified technician.

808.9 If ambient CO levels exceed 35 ppm at any time, stop any testing and turn the combustion appliances off. Open all the exterior doors and windows. No one should enter the home until the CO levels drop below 35 ppm. The combustion appliance causing the increase in CO levels must be repaired by a qualified technician prior to completing the combustion appliance tests, unless the work scope calls for replacement of the appliance(s).

809 Work Scope for Contractors

809.1 Requirements

809.1.1 All work must meet applicable codes and regulations for the jurisdiction.

809.1.2 When air sealing is being performed the work scope shall specify CAZ depressurization testing to be performed at the end of each workday.

809.1.3 The work scope for recommended improvements will be determined by the Auditor and shall be based upon the findings of the assessment, the client's needs and budget, and priorities identified during combustion appliance testing, subject to health and safety requirements.

809.1.4 The work scope shall clearly identify for the client any remedial actions which require prompt attention, affect safety, or require a licensed trade.

809.1.5 The work scope shall provide sufficient specification that the client may obtain reasonably comparable bids from alternative sources for making recommended improvements.

809.1.6 All scopes of work shall include this statement: "**The estimated energy use and savings information contained in the audit report does not constitute a guarantee or warranty of actual energy cost or usage.**"

809.1.7 The work scope shall be developed based on the Auditor's diagnosis and analysis. Emphasis shall be on:

- bringing air distribution system components inside the building enclosure when it is feasible, or sealing and insulating ducts when it is not
- improving airflow and total HVAC system efficiency as applicable
- upgrades to the building enclosure as applicable
- improvements to lighting and appliances as applicable

809.1.8 The scopes shall reflect the "house as a system" approach, recognizing measure interaction. The following statement shall be included whenever a fireplace or combustion appliance is located within the building enclosure:

> "This work scope is not a list of recommendations that may be implemented independently; any exclusions or variations to this scope may increase the risk of flue gas spillage, back-drafting, carbon monoxide production and/or moisture problems within the home."

809.1.9 When specifying equipment replacement, new equipment sizing shall be based on the proposed, upgraded condition of the building enclosure and duct system.

809.1.10 The work scope shall call for post-work combustion appliance testing in accordance with these guidelines when any work affecting enclosure or duct tightness, or building pressures, is specified.

809.2 Work Scope: Carbon Monoxide

809.2.1 The source of the CO must be repaired or replaced and the problem corrected prior to commencing work on other tasks on the work scope, unless remediation of the CO production is specifically related to one or more of those tasks (such as duct repairs that will correct a large negative pressure in the CAZ).

809.2.2 If there are combustion appliances within the building envelope, a carbon monoxide detector should be specified in the main area of each floor according to manufacturer's recommendations, typically in the hallway outside each bedroom area.

809.2.3 If measured CO levels are higher than 100 ppm (200 for oven), or an appliance fails to meet manufacturer's specifications for CO production (whichever is higher), the work scope shall specify replacement or repair of the appliance, and the homeowner shall be notified of the need for service by a qualified technician.

809.3 Work Scope: Worst Case Depressurization

809.3.1 If the results of the Worst Case Depressurization Test indicate the potential for backdrafting by failing the CAZ pressure limits or spillage test, remediation of the failure must be addressed in the work scope, through one or more of the following (as applicable): targeted air- and duct-sealing, room pressure balancing, exhaust fan makeup air, or appliance replacement (with power- or direct-vented equipment). As an alternative, the combustion appliance zone may be isolated by creating a sealed combustion closet

containing the combustion appliances that has the proper amount of combustion air supplied to it according to the applicable version of the IRC. Adequate sealing for isolation purposes shall include air sealing and duct sealing (especially of adjacent platform or cavity return ducts) and confirmed by another CAZ depressurization test.

809.3.2 The work scope should specify replacement of atmospheric-vented combustion appliances with high-efficiency sealed combustion, direct vent, or power vented appliances when feasible. If the home has unvented combustion appliances, the /Auditor shall recommend they be disconnected and replaced with vented combustion appliances.

809.3.3 If unvented combustion appliances are not removed or replaced with vented combustion appliances or electric appliances, the work scope shall not specify measures that affect the air tightness of the envelope, including air sealing, duct sealing, sidewall insulation, or window replacements. Duct sealing outside the thermal envelope may be specified in IECC climate zones 1-3.

Auditor Referenced Standards

These referenced standards provide guidance for the Auditor in the performance of their role as an auditor or home energy rater (diagnostic testing, analysis, writing scopes of work).

1. 2006 Mortgage Industry National Home Energy Rating Systems Standards, published by the Residential Energy Services Network, latest version, www.resnet.us

2. ASHRAE/ANSI Standard 119-1998 RA-2004 Air Leakage Performance for Detached Single-Family Residential Buildings, published by the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., www.ashrae.org

3. ASHRAE/ANSI Standard 152-2004 Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems, published by the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., www.ashrae.org

4. ASTM E1998-02(2007) "Standard Guide for Assessing Depressurization-Induced Backdrafting and Spillage from Vented Combustion Appliances", published by ASTM International, www.astm.org

5. ASTM E1827-96(2007) "Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door", published by ASTM International, www.astm.org

6. ASTM E1554-07 "Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization", published by ASTM International, www.astm.org

7. Reflective Insulation, Radiant Barriers and Radiation Control Coatings, published by the Reflective Insulation Manufacturers Association- International, www.rimainternational.org

8. Protocols for Verifying HVAC Systems to the ACCA Quality Installation Standard, published by the Air Conditioning Contractors of America, www.acca.org (currently in draft)

9. Verifying ACCA Manual J® Procedures, published by the Air Conditioning Contractors of America, www.acca.org

10. Verifying ACCA Manual S® Procedures, published by the Air Conditioning Contractors of America, www.acca.org

11. Verifying ACCA Manual D® Procedures, published by the Air Conditioning Contractors of America, www.acca.org

12. NAIMA Fibrous Glass Duct Installation Check List, published by the North American Insulation Manufacturers Association, www.naima.org

13. AHRI Certification Directory, published by the Air-conditioning, Heating and Refrigeration Institute, www.ahridirectory.org

Contractor Work Scope Referenced Standards
These referenced standards should be referenced in the work scope, as applicable to provide guidance for the contractor to perform the work scope.

1. International Residential Code for One- and Two-Family Dwellings- 2006, published by the International Code Council, Inc., www.iccsafe.org

2. International Energy Conservation Code- 2006, published by the International Code Council, Inc., www.iccsafe.org

3. International Mechanical Code- 2006, published by the International Code Council, Inc, www.iccsafe.org

4. International Fuel Gas Code- 2006, published by the International Code Council, Inc., www.iccsafe.org

5. ANSI/ACCA Standard 5 QI-2007 HVAC Quality Installation Specification, published by the Air Conditioning Contractors of America, www.acca.org

6. Manual J, Residential Load Calculation, 8th edition, published by the Air Conditioning Contractors of America, www.acca.org

7. Manual D, Residential Duct Systems,3rd edition, published by the Air Conditioning Contractors of America, www.acca.org

8. Manual S, Residential Equipment Selection, published by the Air Conditioning Contractors of America, www.acca.org

9. Manual RS, Comfort, Air Quality, & Efficiency by Design, published by the Air Conditioning Contractors of America, www.acca.org

10. Manual T, Air Distribution Basics, published by the Air Conditioning Contractors of America, www.acca.org

11. Manual H, Heat Pump Systems, published by the Air Conditioning Contractors of America, www.acca.org

12. Manual G, Selection of Distribution Systems, published by the Air Conditioning Contractors of America, www.acca.org

13. ASHRAE Standard 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, published by the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., www.ashrae.org

14. ASHRAE Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size , published by the American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc., www.ashrae.org

15. ASTM Standard C1015-06 "Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation", published by ASTM International, www.astm.org

16. ASTM Standard C1320-05 "Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction", published by ASTM International, www.astm.org

17. ASTM Standard C727-01 (2007)e1 "Standard Practice for Installation and Use of Reflective Insulation in Building Constructions", published by ASTM International, www.astm.org

18. ASTM Standard C1158-05 "Standard Practice for Installation and Use of Radiant Barrier Systems in Building Constructions", published by ASTM International, www.astm.org

19. ASTM Standard E2112-07 "Standard Practice for Installation of Exterior Windows, Doors and Skylights", published by ASTM International, www.astm.org

20. Flexible Duct Performance and Installation Standards 4th edition, published by the Air Diffusion Council, www.flexibleduct.org

21. Fibrous Glass Duct Construction Standards, 5th edition, published by the North American Insulation Manufacturers Association, www.naima.org

22. FTC Trade Regulation Rule 16 CRF 460, Labeling and Advertising of Home Insulation, published by the Federal Trade Commission, www.ftc.gov

Sample Work Scope Form
(This is informative and does not contain requirements necessary for conformance to these guidelines.)

Work Scope for _____
All work will be performed according the following checked standards

This work scope is not a list of recommendations that may be implemented independently; any exclusion to this scope may increase the risk of flue gas spillage, back-drafting, carbon monoxide production or moisture problems within the home.

What qualifications are required from contractors/technicians conducting the work:

What work needs to be performed:

Where the work needs to be performed:

How the work is to be performed (referenced Standard(s)):

Chapter Nine
RESNET Standards

900 RESNET NATIONAL STANDARD FOR QUALITY ASSURANCE

901 GENERAL PROVISIONS

901.1 Purpose

RESNET has the responsibility of accrediting Providers. This chapter outlines the quality assurance responsibilities of RESNET and Providers , the role and responsibility of the Quality Assurance and Ethics Committee, the role and responsibility of the Accreditation Committee, the RESNET Accreditation Process for all Providers, the RESNET policies and procedures for Probation, Suspension and Revocation of Provider Accreditation, and the Appeals process for each of these disciplinary actions.

902 DEFINITIONS AND ACRONYMS

See Appendix B.

903 RESNET QUALITY ASSURANCE REVIEW OF ACCREDITED PROVIDERS

903.1 RESNET shall randomly select a limited number of accredited Providers and conduct an annual review of their Quality Assurance records. This QA review may be a review of electronic files submitted to RESNET upon request, an onsite field review, or both. The RESNET Board of Directors shall determine the number of Providers that shall be reviewed on an annual basis and who will provide the quality assurance review.

903.2 Records that may be reviewed may include, but are not limited to:

903.2.1 Rating electronic files

903.2.2 Rating quality assurance records

903.2.3 Complaint files

903.2.4 Rater agreements

903.2.5 Rater registry

903.2.6 Disclosure files

903.2.7 Rating databases;

903.2.8 Interviews with a Provider's QA Designee, Delegates, Raters or Rating Field Inspectors;

903.2.9 "Shadowing" a Provider's Raters or Rating Field Inspectors in the field as they complete data collection, testing and inspections.

903.3 An accredited Rating Provider has the right to challenge the findings of a RESNT Quality Assurance reviewer for cause by submitting, in writing to the RESNET Executive Director, the details of their challenge.

903.4 Significant inconsistencies or errors in electronic records reviewed may result in an onsite review by RESNET.

904 QUALITY ASSURANCE REQUIREMENTS FOR PROVIDERS

904.1 No step in the QA process may be performed by the same individual that performed any part of the testing, inspection or rating of the home being subject to the QA review. In other words, if an individual performed any part of the inspection or rating process on a home, that individual cannot be the QA Designee or Delegate performing any part of the QA process specific to that home. Any ratings performed by a QA Designee that are submitted as part of a Provider's QA Submission to RESNET shall be reviewed for quality assurance by a separate individual who meets the QA Designee requirements established by RESNET.

904.2 Providers are responsible for completing an annual submission of QA results to RESNET. RESNET shall designate the date submissions are due, the content of each submission, and the time frame for which data shall be provided, e.g. January 1st through December 31st. Providers will have at least thirty (30) days from notification until the submission is due.

904.3 Quality Assurance of Providers

904.3.1 RESNET shall develop a Quality Assurance Checklist that is to be used by QA Designees for the purpose of verifying a Provider's compliance with the individual requirements for Providers set forth in the RESNET Standards. The checklist shall consist of items that are to be reviewed during an initial, first-time QA review by a QA Designee new to a Provider as well as items that RESNET has identified as requiring annual verification.

904.3.2 For the first-time QA review completed by a QA Designee new to a Provider, including in the event that a Provider changes QA Designees, every item on the checklist should be checked for compliance, accuracy and completeness. In subsequent years, the list of items to be checked may be shortened to include only those items that RESNET has identified as requiring annual verification.

904.4 Quality Assurance of Raters and Ratings

904.4.1 Review of rating data files

904.4.1.1 The Provider's QA Designee shall be responsible for an annual rating data file review of the greater of one (1) home or ten percent (10%) of each Rater's annual total of homes for which confirmed or sampled ratings were provided. When determining the number of rating data files to review for a Rater, round up to the next whole number when the percentage calculation yields a decimal point, e.g. 101 homes x 10% = 10.1 means that 11 rating data files shall be reviewed.

904.4.1.2 A review of rating data files shall be conducted on an ongoing basis as appropriate for the volume of ratings being completed, and at a minimum quarterly.

904.4.1.3 The rating data file review completed by a QA Designee shall consist of, at a minimum, the following:

904.4.1.3.1 Rating data files shall be selected using a nonbiased selection process from the entire pool of files available at the time of the review for each Rater. It may be necessary to first select homes that represent a particular area of interest in the construction process for new and existing homes, geographic location, builder, etc. Once it is ensured that homes from these areas of interest will be included in the QA process, a nonbiased selection process can then be applied such as random selection. Special effort should be taken to make certain that the selected files are as representative as possible of the homes being rated which, in some instances, may require more than the minimum (1) home or ten percent (10%).

904.4.1.3.2 QA of rating data files does not require that Raters submit data to their Provider and/or QA Designee for every home that is rated. Only data for the homes selected for QA shall be required to be submitted to the QA Designee.

904.4.1.3.3 For projected ratings created from architectural drawings for Sampled Ratings, confirm that data were accurately entered into the rating software from data collection forms and/or plans, including worst-case analysis;

904.4.1.3.4 For projected ratings created from architectural drawings, confirm that the Minimum Rated Features and threshold specifications, including worst-case analysis, for each plan are made available for verification in the field (i.e. geometric characteristics, duct leakage and envelope leakage thresholds). In the case of confirmed ratings for homes built from architectural drawings, verify that Minimum Rated Features data from testing and specification findings from the field are accurately entered into the rating software after construction is completed;

904.4.1.3.5 For confirmed ratings on existing homes, review any field data collection forms or notes to confirm that data were accurately entered into the rating software.

904.4.1.3.6 Confirm that files, paper and/or electronic, are being maintained by Raters and archived for each rating and/or unique floor plan, including a set of

architectural drawings for projected ratings from plans. These files shall be maintained a minimum of three (3) years;

904.4.2 On-site verification of ratings.

904.4.2.1 For each Rater, the Provider's QA Designee shall be responsible for an annual onsite field evaluation of the greater of one (1) home or one percent (1%) of the Rater's annual total of homes for which confirmed or sampled ratings and diagnostic testing services were provided. When determining the number of onsite evaluations to complete for a Rater, round up to the next whole number when the percentage calculation yields a decimal point, e.g. 101 homes x 1% = 1.01 means that 2 onsite evaluations shall be completed.

904.4.2.2 For Raters utilizing Rating Field Inspectors (RFI's), the QA Designee shall ensure that an annual onsite field evaluation of the greater of one (1) home or one percent (1%) of the RFI's annual total of homes for which data was collected are subject to evaluation. The RFI evaluations may fulfill all or a portion of the Provider's annual onsite QA requirement. When determining the number of onsite evaluations to complete for an RFI, round up to the next whole number when the percentage calculation yields a decimal point, e.g. 101 homes x 1% = 1.01 means that 2 onsite evaluations shall be completed.

904.4.2.3 Onsite inspections shall be conducted on an ongoing basis as appropriate for the volume of ratings being completed, and at a minimum of annually.

904.4.2.4 Where feasible, each home selected for onsite inspections for each Rater shall be randomly selected and/or selected from as many different builders, communities and floor plans as possible.

904.4.2.5 As part of the onsite inspection of ratings, the QA Designee shall ensure that the minimum rated features of a rating are independently confirmed (i.e. confirmation of geometric characteristics, inspection of minimum rated features, and completion of any necessary performance testing) to determine whether the rating and/or diagnostic testing were accurately completed by the Rater, and determine whether information was completely collected and reported as required in 303.1 of Chapter 3 of these Standards.

904.4.2.6 Confirm that HERS Index scores for each home reviewed be no more than three percent (3%) (+/-) variation in the HERS Index from the HERS Index result as determined by the QA Designee. When calculating the HERS Index point variance allowed for a given Index, round down to the nearest whole Index point, with the allowable variance never less than two (2) HERS Index points.

904.4.2.7 Non-compliance of a reviewed rating shall trigger corrective action.

904.4.2.7.1 The rating shall be corrected in order to come into compliance with RESNET technical Standards under the supervision of the QA Designee.

904.4.2.7.2 The QA Designee shall develop and implement a corrective action plan for the Rater of the rating that addresses any underlying problems that led to the non-compliant rating.

904.4.2.7.3 The Provider shall initiate appropriate disciplinary action on the Rater in accordance with the Provider's written Rater disciplinary procedures.

904.4.2.7.4 Multiple instances of non-compliance with 904.4.2.5 shall, at a minimum, trigger an increased rate of file reviews or onsite inspections of homes and additional appropriate disciplinary action in accordance with the Provider's written Rater disciplinary procedures.

904.4.2.8 If a QA Designee is required to complete an onsite QA inspection on at least two (2) homes for a given Rater, the QA Designee may use one centralized – proctored rating QA event, and only one, for review of the Rater in lieu of an independent confirmation of the rating for the home as required for the balance of homes evaluated for the onsite inspection process.

904.4.2.8.1 A centralized proctored rating QA event is defined as a rating that occurs at a house assigned by the QA Designee at which the QA Designee, or their Delegate, must be onsite to ensure that the Rater being reviewed is working completely independently to gather all aspects of the minimum rated features of a home. The Rater being reviewed will not be allowed to communicate by any means with others while gathering information in the home or creating their rating software file and report. The review shall include, but is not limited to, the following:

1. Diagnostic equipment set-up and testing measurements
2. Insulation evaluation and R-value determination
3. Calculations of gross areas, volumes, and square footage of the home
4. Input and creation of the software rating file and reports

904.4.2.8.2 QA under this Section shall adhere to the same variance allowances provided for in Section 904.4.2.5.

904.5 Significant Non-compliance by Providers.

It is the expectation of RESNET that Providers fully comply with all the requirements set forth in these Standards. Discovery of one or more areas of non-compliance via the RESNET QA process, reporting by a QA Designee as part of the Provider's QA process, or in the course of RESNET's research of an ethics or consumer complaint will result in the QA Designee working with a Provider to come back into compliance. However, on occasion, there may be instances where actions by a Provider are truly egregious and, as such, would be deemed to be "significant non-compliance". This Section seeks to define the thresholds when actions by a Provider are deemed to be significant non-compliance, thereby requiring

that the QA Designee report the significant non-compliance to RESNET and additional action by RESNET may be taken.

904.5.1 Significant non-compliance by Providers shall include, but not be limited to, the following:

904.5.2.1 Failure to comply with multiple individual requirements, or requirements impacting multiple Raters and/or ratings, for Providers set forth in the RESNET Standards and enumerated in a RESNET Quality Assurance Checklist;

904.5.2.2 Failure of a Provider to comply with the RESNET Standards of Practice, Code of Ethics, or Conflict of Interest Disclosure;

904.5.2.3 Failure to follow a Provider's written Rater disciplinary procedures for known or obvious non-compliance with the RESNET Standards, Standards of Practice, Code of Ethics, or Conflict of Interest Disclosure.

904.5.2 Reporting of significant non-compliance to RESNET.

904.5.2.2 QA Designees must report all significant non-compliance by a Provider to RESNET when it becomes known to the QA Designee so that RESNET may assist the QA Designee in working with a Provider to come back into compliance.

904.5.2.3 Failure of a QA Designee to report significant non-compliance issues may result in actions taken by RESNET as stipulated in Section 905.10.

905 QUALITY ASSURANCE DESIGNEE (QA Designee)

905.1 A Home Energy Rating Provider and BOP Provider shall designate one and only one officer, employee, or contractor to be the Primary Quality Assurance Designee for the organization, responsible for quality assurance within the organization. This does not preclude a Provider from having more than one QA Designee on staff or as a contractor, as may be necessary for business models where QA Designees do Ratings. The Primary QA Designee shall have ultimate responsibility, on behalf of the Provider, for fulfilling the requirements listed in Section 905.8 and who shall be the single point of contact to RESNET regarding all Quality Assurance matters. All QA Designees shall meet each of the minimum requirements to be a QA Designee as stipulated in this Section.

905.2 The designated officer, employee, or contractor responsible for quality assurance shall meet the following minimum requirements:

905.2.1 Previous certification as a Home Energy Rater;

905.2.2 As a certified Home Energy Rater, complete confirmed ratings on a minimum of twenty-five (25) homes prior to becoming a QA Designee;

905.2.3 To be eligible to QA a particular rating type (e.g. sampled, BOP, survey/audit, EEP), a QA Designee must have completed a minimum of five (5) of that rating type;

905.2.4 Passing the RESNET Quality Assurance Designee Test.

905.3 Verification of QA Designee and Delegate Requirements

905.3.1 A QA Designee must confirm that the minimum requirements to be a QA Designee and Delegate, as set forth in this Section 905, have been met.

905.3.2 Five (5) of the twenty-five (25) required confirmed ratings for a QA Designee must be individually reviewed by a QA Designee in accordance with section 904.4.2, three (3) of which may have been included in the annual QA process for a Provider in the previous twenty-four (24) months.

905.4 Professional Development for QA Designees

905.4.1 All QA Designees annually shall complete a two hour RESNET QA Roundtable on current information AND complete one (1) of the following activities:

905.4.1.1 Document 12 hours of attendance at the RESNET Conference; or

905.4.1.2 Complete 12 hours of RESNET approved CEU's; or

905.4.1.3 Documented field QA reviews on a minimum of 25 homes.

905.4.2 A person that is both a Rater Trainer and Quality Assurance Designee shall have to complete both the two hour RESNET roundtable for a Rater Trainer (see Section 209) and the two hour roundtable for Quality Assurance Designees. Rater Trainers and QA Designees selecting the conference or CEU option need only comply with the 12 hour requirement one time, i.e. 12 hours is not required for each position.

905.5 Proof of QA Designee qualifications shall be submitted by Providers with an application for accreditation or with a notification to RESNET of a change to a Provider's QA Designee(s).

905.6 All QA Designees shall have a signed agreement with the Provider to be the Provider's QA Designee.

905.7 Changes to a Provider's QA Designee(s)

905.7.1 If a Provider changes Primary QA Designees or a Provider's Primary QA Designee leaves the organization, is terminated as an outside QA Designee contractor, or is no longer eligible to be the QA Designee, the following steps shall be taken:

905.7.1.1 Within five (5) business days of the Primary QA Designee change, departure, termination, or knowledge of ineligibility, the Provider shall inform RESNET of the change, departure, termination, or ineligibility;

905.7.1.2 In the case of a change in Primary QA Designee as a result of departure, termination, or ineligibility, the Provider shall have forty (40) business days from the date of departure, termination, or knowledge of ineligibility to appoint a replacement Primary QA Designee and notify RESNET of the newly designated officer, employee, or contractor, including proof of qualifications in accordance with 905.2.

905.7.2 If a Provider with multiple QA Designees adds or removes a QA Designee, the Provider shall inform RESENT within five (5) business days of the change.

905.8 Quality Assurance Designee Delegate (QA Delegate)

QA Designee's may have the file review and on-site inspection responsibilities performed by a Quality Assurance Designee Delegate. The QA Designee, however, remains responsible for the accuracy and compliance of the Provider's quality assurance program, including reviews and inspections completed by a QA Delegate.

905.8.1 A QA Delegate must be a certified Home Energy Rater and have completed, on a minimum of twenty-five (25) homes, the portion of the inspection or rating process for which the individual is performing quality assurance tasks. In other words, if the QA Delegate is repeating on-site testing and inspections as part of the QA process, that individual must have at least performed these tasks on a minimum of twenty five (25) homes.

905.8.2 The QA Designee is responsible for ensuring that the QA Delegate maintains their qualifications to be a QA Delegate, i.e. certification as a Rater.

905.9 Responsibilities of a QA Designee. Responsibilities of the QA Designee shall include:

905.9.1 Maintenance of quality assurance files;

905.9.2 Review of ratings conducted during a new Rater's probationary period. Prior to certifying a Rater Candidate, a Provider's QA Designee shall confirm that the Candidate has satisfactorily completed Rater training from a RESNET Certified Training Provider and satisfactorily completed their probationary ratings in accordance with Section 102.1.2.2.

905.9.3 Monitor the accuracy of the QA Delegate's performance of QA tasks by reviewing the results of the QA process for each QA Delegate (i.e. 1% field verification/10% file verification).

905.9.4 Complete annual submission of QA results to RESNET in accordance with Section 904.2;

905.9.5 With the annual QA submissions to RESNET, provide a listing of the QA Designees performing QA tasks on behalf of the Provider and a listing of the QA Delegates who have undertake QA reviews on behalf of a QA Designee;

905.9.6 In accordance with Section 904.3, annually complete the RESNET QA Checklist for Providers;

905.9.7 In accordance with Section 904.4, monitor ratings of all types conducted by certified Raters;

905.9.8 Maintenance of records for all ratings and tax credit verifications.

905.9.8.1 The QA record for each home shall contain at a minimum the information required by Section 904.4.1.3.

905.9.8.2 The record for each rating/tax credit verification shall be maintained for a minimum of three (3) years.

905.9.8.3 Upon RESNET's request, a Provider shall submit to RESNET the number of homes for which ratings/tax credit verifications were provided since the last data submittal. The ratings/tax credit verification shall be identified by type (to include projected and confirmed ratings for new and existing homes and the number of homes verified for tax credits). To the extent RESNET makes this information public; it will do so only in an aggregated form.

905.10 Failure of a QA Designee to Fulfill Their Responsibilities. Failure of a QA Designee to properly fulfill their responsibilities as specified in these Standards may include one or more of the following actions by RESNET:

905.10.1 The QA Designee being placed on probation;

905.10.2 Removal of the QA Designee from the RESNET Directory of qualified QA Designees;

905.10.3 Removal of the QA Designee's credential as a QA Designee;

905.10.4 RESNET no longer recognizing the QA Designee as a Home Energy Rater;

905.10.5 At the Provider's expense, further oversight by RESNET of the QA Designee and the Provider's processes and procedures;

905.10.6 To the extent that the Provider is at fault for the QA Designee's failure to fulfill their responsibilities, the Provider may be subject to probation, suspension or revocation in accordance with Section 911;

905.10.7 The QA Designee may appeal an Action taken by RESNET under this Section using the Appeals procedures stipulated in Section 912 of these Standards.

906 QUALITY ASSURANCE REQUIREMENTS FOR THIRD-PARTY ENERGY EFFICIENCY PROGRAMS

906.1 See Appendix B for definition of Third Party Energy Efficiency Program (EEP).

906.2 The rating data file for each home shall contain at a minimum an electronic copy of the rating software file as it pertains to the EEP and other pertinent required documentation (e.g. checklists, certificates, etc.). The rating data file will clearly identify which EEP the home qualifies under.

906.3 Rating data files and the results of onsite verification of ratings files will be made available by Providers for quality assurance initiatives implemented by EEP's.

906.4 EEP files will be inspected for quality assurance pursuant to section 904.4 and shall include those items related to energy efficiency specific to the EEP that may be in addition to the Home Energy Rating. Significant non-compliance by Providers shall be reported to EEP's when they become known to RESNET.

907 QUALITY ASSURANCE AND ETHICS COMMITTEE

907.1 Committee Membership. The Quality Assurance and Ethics Committee (QA Committee) shall be chaired by a member of the RESNET Board of Directors. The Chair shall be approved by the RESNET Board. Nominations of Committee members shall be made by the Chair to the RESNET Board for approval.

907.2 Committee Responsibilities. The QA Committee shall have the following responsibilities:

907.2.1 Oversight of RESNET's rating quality assurance program as defined in this chapter;

907.2.2 Review and rule on the merits of appeals from the Ethics and Appeals Committee;

907.2.3 Through the Ethics and Appeals Committee, review and rule on the merits of formal Ethics Complaints received by RESNET;

907.2.4 Through the Ethics and Appeals Committee, review and rule on the merits of Consumer Complaints received by RESNET;

907.2.5 Through the Ethics and Appeals Committee, review and rule on the merits of all appeals of non-approval or renewal of an application, probation, suspension, or revocation.

907.3 Ethics and Appeals Committee. The Ethics and Appeals Committee shall have the responsibility of investigating ethics and consumer complaints and hearing appeals of an Application or Renewal Application that has been denied, or if a Provider has been placed on probation, or if a Provider's accreditation has been suspended or revoked. The Committee shall report to the QA Committee.

907.3.1 Committee membership. The Ethics and Appeals Committee shall be composed of five (5) members, none of whom shall also be a member of the Quality Assurance and Ethics Committee.. Nomination of the Committee Chair shall be made by the Quality Assurance and Ethics Committee to the RESNET Board for approval. The Chair of the Ethics and Appeals Committee shall nominate the other members of the Committee to the RESNET Board for approval, two (2) being Home Energy Raters and two (2) being representatives of Provider organizations.

908 ETHICS AND CONSUMER COMPLAINTS

908.1 Filing of Ethics Complaints

908.1.1 Ethics complaints may be filed against an accredited Provider for violating the RESNET Code of Ethics, failing to enforce the Code of Ethics with their certified Raters, or failure to comply with the specific requirements set forth in the RESNET Standards.

908.1.2 An ethics complaint shall document the alleged violation(s). The complaint shall also be specific about which section(s) of the Code of Ethics or the RESNET Standards have been violated. To be considered, the full and complete complaint shall be sent by registered mail, or other method which provides evidence of delivery, to the Executive Director of RESNET and contain the following information:

908.1.2.1 The name of the complainant and contact information;

908.1.2.2 The accredited Provider that is the subject of the complaint;

908.1.2.3 A complete description of the alleged violation(s);

908.1.2.4 A recitation of all the facts documenting the complaint including contact information;

908.1.2.5 Copies of any relevant documents.

908.2 Investigation of Ethics Complaints

908.2.1 The RESNET Executive Director shall assign a case number and forward the ethics complaint to the Ethics and Appeals Committee. The Committee shall consider the documentation contained in 908.1.2 in making a decision whether to proceed or dismiss the complaint.

908.2.2 In cases where the Ethics and Appeals Committee finds the documentation submitted does not meet the minimum standards for an ethics complaint, the complaint may be dismissed. Both parties shall be notified by registered mail, or other method which provides evidence of delivery, of the Ethics and Appeals Committee's finding.

908.2.3 Upon a decision by the Ethics and Appeals Committee that the ethics complaint should proceed to the next step, the RESNET Executive Director shall send a copy of the complaint by registered mail, or other method which provides evidence of delivery, to the subject of the complaint immediately. The respondent has 20 business days to submit a full and complete response to the complaint. All relevant information and documentation shall be included in the response. The response shall be in writing and sent to RESNET by registered mail, or other method which provides evidence of delivery.

908.2.4 Upon receipt of the response, the RESNET Executive Director shall immediately forward the response to the RESNET Ethics and Appeals Committee for consideration and action. Within thirty (30) business days of receiving the ethics complaint, the Ethics and Appeals Committee shall take action on the complaint. The action may include, but is not limited to:

908.2.4.1 Dismissal of complaint;

908.2.4.2 Requirement that the rating Provider take steps to correct the problem;

908.2.4.3 Recommendation to the QA Committee of sanctions under Section 912 (Suspension and Revocation of Accreditation) of this chapter.

908.2.5 All parties to the complaint shall be informed by registered mail, or other method which provides evidence of delivery, of the Ethics and Appeals Committee's action.

908.3 Filing of Consumer Complaints

908.3.1 Consumer Complaints may be filed by consumers who have grievances against RESNET, a Provider accredited by RESNET, or a Rater certified by an accredited Provider.

908.3.2 RESNET shall implement a Consumer Complaint Response Process to address and investigate consumer complaints.

908.4 Complainants shall have the right to appeal the decision of the Ethics and Appeals Committee to the QA Committee and RESNET Board of Directors. The Appeals process shall follow the same process and procedures stated in Section 912.2.2 and 912.2.3 respectively.

908.5 All complaints, responses, and supporting documentation received by RESNET shall be handled in strict confidence by the RESNET staff, the Ethics and Appeals Committee, the QA Committee and the Board of Directors.

909 ACCREDITATON COMMITTEE

909.1 Committee Membership. The Accreditation Committee shall be chaired by a member of the RESNET Board of Directors. The Chair shall be approved by the RESNET Board. Nominations of Committee members shall be made by the Chair to the RESNET Board for approval.

909.2 Committee Responsibilities. The Accreditation Committee shall be responsible for the review and approval of all Applications for Provider accreditation.

910 PROVIDER ACCREDITATION AND RENEWAL PROCESS

910.1 National Registry of Accredited Providers

RESNET shall maintain a national registry of accredited Providers and will post the registry on its web site. The following Provider categories shall have individual registries.

910.1.1 Home Energy Rating Provider

910.1.2 Home Energy Rating Software Provider

910.1.3 Training Provider

910.1.4 Builder Option Package (BOP) Provider

910.1.5 Sampling Provider

910.1.6 Home Energy Survey Provider

910.2 Provider Accreditation Process

910.2.1 An entity seeking accreditation must file with RESNET an application for the specific Provider category for which they seek accreditation. RESNET shall create the applications for each accreditation category.

910.2.2 Confidentiality of Information. Any applicant for a Providerhip who wishes to have certain information in their application treated as confidential in order to limit disclosure shall, at the time of submission, attach a statement specifying the proprietary information and requesting confidentiality.

910.2.3 Review and Notification.

910.2.3.1 RESNET staff action. Within twenty (20) business days of receipt of an application, RESNET staff will review the application to determine whether the applicant and its Raters are eligible for accreditation in accordance with the specific requirements for each Provider category. Upon completion of the review, RESNET staff shall do one of the following:

910.2.3.1.1 Request for additional information. If additional information is required in order to complete the review of the application, the application shall be returned to the applicant along with a written request for additional information. Upon receipt of additional information, RESNET staff shall have twenty (20) business days to take action in accordance with 910.2.3.1.2 or 910.2.3.1.3

910.2.3.1.2 Recommendation for approval. If RESNET staff is satisfied that an application is complete and meets all the requirements for accreditation, they shall make a recommendation to the Accreditation Committee that the application be approved.

910.2.3.1.3 Recommendation for denial. If RESNET staff is not satisfied that an application is worthy of approval for accreditation, they shall make a recommendation to the Accreditation Committee that the application be denied and provide an explanation of the reasons for the recommendation (i.e. incompleteness, failure to meet/comply with a specific accreditation requirement, etc.).

910.2.3.2 Accreditation Committee action. Within fifteen (15) business days of receipt of a recommendation for approval or denial from RESNET staff, the Committee shall do one of the following:

910.2.3.2.1 Request for additional information. If the Committee requires additional information, the application shall be returned to the applicant along with a written request for additional information. Upon receipt of additional information, the Committee shall have twenty (20) business days to render a decision in accordance with 910.2.3.2.2 or 910.2.3.2.3.

910.2.3.2.2 Approve the application.

910.2.3.2.3 Deny the application. If an application is denied, RESNET staff shall inform the applicant in writing of the reasons for denial. Additionally, the applicant shall be informed of their right of appeal under Section 912 of this Chapter.

910.2.3.3 Within ten (10) business days of a decision by the Committee, RESNET staff shall inform the applicant in writing of the status of their application.

910.2.4 For each approved application, RESNET shall issue a unique Accreditation Identification Number (AIN) to the Provider for the Provider category approved and, in accordance with 910.1, the accreditation will be incorporated into the respective national registry of accredited Providers.

910.2.5 Term of accreditation.

910.2.5.1 All Provider accreditations shall be valid for a term of one calendar year and shall be renewed annually on January 1st upon successful completion and approval by RESNET of an application for renewal in accordance with Section 910.3.

910.2.5.2 For fist time applicants approved after September 1st, for any Provider category, initial accreditation is valid through the end of the calendar year, i.e. renewal of the accreditation shall not be required for the calendar year in which the application was approved.

910.3 Accreditation Renewal Process

910.3.1 Accredited Providers must submit an "application for renewal" (renewal application) with RESNET no later than October 1st of each calendar year. By September 1st, RESNET shall send to each Provider a renewal application and reminder of the deadline for submission.

910.3.2 Program element changes. At the time of submitting a renewal application, it is the accredited Provider's responsibility to inform RESNET of any substantive changes in the Provider's operating policies and procedures or other information that affects meeting the minimum accreditation criteria for each Provider category for which it is seeking renewal. Changes will be evaluated by RESNET in the same manner as the original application for accreditation.

910.3.3 Successful renewals. Successful renewals will be posted on the national registry and communicated to the applicant by RESNET.

910.3.4 Late applications.

910.3.4.1 Renewal applications received after the deadline for submission are not guaranteed to be approved prior to the end of the calendar year. Should an accreditation with a late renewal application expire prior to approval, the RESNET Accreditation Committee, at its sole discretion, may grant an extension with a grace period not to exceed twenty (20) business days.

910.3.4.2 Renewal applications not given an extension or not approved prior to the end of the grace period shall be noted as "pending" on the national registry and the applicant will be advised to cease representing themselves as accredited until the application receives approval.

910.3.5 Accreditation not renewed. Accredited Providers that elect not to renew or fail to meet renewal requirements will be removed from the national registry and be so advised in writing. Providers have the right to appeal a non-renewal decision in accordance with Section 912 of this Chapter.

910.3.6 Accreditations in appeal. Provider accreditations that have not been renewed and are under appeal will be noted as "pending" on the national registry until the appeal is resolved. Providers will be advised to cease representing themselves as accredited.

911 PROBATION, SUSPENSION, AND REVOCATION OF ACCREDIATION

911.1 Notification. RESNET shall provide written notification to Providers of any decisions under this section. All notices shall be sent by certified mail, or other method

which provides evidence of delivery. All notices shall clarify the procedures being followed, as stipulated in this Standard, and include, where applicable, a statement of the Provider's rights to appeal under Section 912 of this Chapter.

911.2 Probation. If RESNET determines at any time that a Provider has failed to adhere to the accreditation requirements set forth in these Standards, RESNET shall notify the Provider of the specified deficiencies and shall require that specific corrective action, set forth in the notification, be taken within a specified time after the date set forth in such notification. A notice of probation may be appealed under Section 912 of this Chapter.

911.3 Suspension- /Revocation. Any Provider accredited by RESNET may have their accreditation suspended or revoked in any of the following circumstances:

911.3.1 Failure to correct deficiencies. If RESNET determines at any time that an accredited Provider has failed to adhere to the accreditation requirements as established by these Standards and approved as part of the Provider's accreditation, RESNET shall notify the Provider of the specified deficiencies and shall require that specific corrective action, set forth in the notification, be taken not later than twenty (20) business days after the date set forth in such notification.

911.3.1.1 In the event that the deficiencies have not been remedied as stipulated in 911.3.1, RESNET shall have the authority to immediately begin the process of suspension by issuance of a Notice of Suspension Proceedings. Such Suspension Proceedings shall follow the due process procedures contained in 911.3.

911.3.1.2 In the event that the deficiencies have not been remedied within the period set forth in a Notice of Suspension, RESNET shall have the authority to immediately begin the process of revocation by issuance of a Notice of Revocation Proceedings. Such Revocation Proceedings shall follow the due process procedures contained in 911.4.

911.3.2 Acting in such a manner as to impair the objectivity or integrity of the Provider or harm the reputation of RESNET;

911.3.3 Submission of false information to RESNET, or failure to submit to RESNET any material information required to be submitted by the Provider, in accordance with obtaining or maintaining accreditation;

911.3.4 Knowingly or negligently issuing ratings or reports required to be or purported to be completed in accordance with the RESNET Standards which are not;

911.3.5 Misrepresentation by the Provider in advertising or promotional materials of its accreditation status in general or with respect to any service provided by the Provider;

911.3.6 Pursuant to any of the express provisions of sections 910.3.5, non renewal;

911.3.7 Provider goes out of business;

911.3.8 Provider does not re-apply at the end of accreditation period;

911.3.9 Investigated and validated ethics or consumer complaints;

911.3.10 Upon expiration of a Provider's right to appeal a suspension of accreditation pursuant to Section 912 of this Chapter.

911.3.11 Willful misconduct;

911.3.12 Failure to disclose a self-serving interest to clients via the RESNET Home Energy Rating Standard Disclosure form.

911.4 Suspension/Revocation Due Process.

RESNET shall comply with the following due process procedures in considering any suspension or revocation actions against an accredited Provider.

911.4.1 RESNET may, at its discretion, initiate a suspension or revocation action against an accredited Provider by providing the Provider written notice of the action. Such notice shall inform the subject Provider of the entire basis and justification for the action.

911.4.2 Providers have the right to appeal a suspension or revocation action in accordance with Section 912 of this Chapter.

911.4.3 Notifications. Upon the expiration of the notice to appeal period or failure to submit appeal documentation, as stipulated in 912.2.1.1, or the conclusion of the appeals process in which a Provider's appeals are unsuccessful, Providers and their Raters are not allowed to perform ratings, must inform their clients and Raters of their suspended status in writing with a copy of this correspondence sent to RESNET. RESNET will remove the Provider's name from the RESNET website, post their suspended or revoked status on the RESNET website with other Providers and Raters who are under suspension/ revocation, and will, at a minimum, inform the EEP of their suspended/revoked status.

912 APPEALS PROCEDURES FOR NON-APPROVAL OR RENEWAL OF APPLICATIONS, PROBATION, SUSPENSION, OR REVOCATION

912.1 Notification.

RESNET shall provide written notification to the Appellant of any decisions under this section. All notices shall be sent by certified mail, or other method which provides evidence of delivery. All notices shall clarify the procedures being followed, as stipulated in this standard, and include, where applicable, a statement of the Provider's rights to remedy.

912.2 Appeal

912.2.1 Appeals to the RESNET QA Committee's Ethics and Appeals Committee.

912.2.1.1 In the event that an Application or Renewal Application has been denied, or if a Provider has been placed on probation, the Provider shall have the right, for a period of

twenty (20) business days after the date of notice, to appeal to the RESNET Ethics and Appeals Committee. If a Provider's accreditation has been suspended or revoked, the Provider shall notify RESNET with five (5) business days after the date of notice of their intent to appeal. The Provider shall then have twenty (20) business days after the date of notice, to submit their appeal documentation, in accordance with 912.2.1.2 and 912.2.1.3, to the RESNET Ethics and Appeals Committee.

912.2.1.2 Appeals shall be in writing and sent by certified mail, or other method which provides evidence of delivery, to RESNET, attention Chairman of the RESNET QA Committee.

912.2.1.3 Appeals shall contain all pertinent and substantive information and arguments that are in contradiction to the proposed non-approval or renewal of an application, probation, suspension, or revocation, including identification of all disputed materials and facts.

912.2.1.4 The appellant Provider may, at the time of noticing its appeal, request a telephonic hearing by the RESNET QA Committee's Ethics and Appeals Committee which gives the appellant the opportunity to provide oral arguments in favor of their appeal. In such an event, the Committee shall, not later than ten (10) business days after the filing of the notice of appeal, notify the appellant Provider of the date of the hearing, which shall be held as expeditiously as possible, but not later than thirty (30) business days after the receipt of the notice of appeal.

912.2.2 Appeals to the RESNET Quality Assurance and Ethics Committee.

912.2.2.1 In the event that a Provider's appeal of its non-approval or renewal of an application, probation, suspension, or revocation is rejected by the Ethics and Appeals Committee, the Provider shall have the right, for a period of twenty (20) business days after the date of the notification of the denial of the appeal, to appeal to the RESNET QA Committee.

912.2.2.2 Appeals shall be in writing and sent by certified mail, or other method which provides evidence of delivery, to RESNET, attention Chairman of the RESNET QA Committee.

912.2.2.3 The appellant Provider may, at the time of noticing its appeal, request a telephonic hearing by the QA Committee which gives the appellant the opportunity to provide oral arguments in favor of their appeal. In such an event, the Committee shall, not later than ten (10) business days after the filing of the notice of appeal, notify the appellant Provider of the date of the hearing, which shall be held as expeditiously as possible, but not later than thirty (30) business days after the receipt of the notice of appeal.

912.2.3 Appeals to the RESNET Board of Directors

912.2.3.1 In the event that a Provider's appeal of its non-approval or renewal of an application, probation, suspension, or revocation is rejected by the QA Committee, the

Provider shall have the right, for a period of twenty (20) business days after the date of the notification of the denial of the appeal, to appeal to the RESNET Board of Directors.

912.2.3.2 Appeals shall be in writing and sent by certified mail, or other method which provides evidence of delivery, to RESNET, attention President of the RESNET Board of Directors.

912.2.3.3 The appellant Provider may, at the time of noticing its appeal, request a telephonic hearing by the RESNET Board which gives the appellant the opportunity to provide oral arguments in favor of their appeal. Within thirty (30) business days, the Board shall render a decision as to whether it chooses to hear the appeal and whether or not there shall be a telephonic hearing for oral arguments. If the Board chooses to hear the appeal, the Board shall, not later than ten (10) business days after the decision to hear the appeal, notify the appellant Provider of the date of the hearing and whether or not the hearing will include oral arguments. The hearing shall be held as expeditiously as possible, but not later than forty (40) business days after notification that the appeal will be heard.

913 EFFECTIVE DATES

913.1 The effective date of these changes to the RESNET Standards shall be January 1, 2011.

913.2 The QA of Low-Volume Raters in accordance with the original provisions of Section 904.6, effective January 1, 2010, shall be allowed until December 31, 2010.

913.3 As of the effective date of these changes to the RESNET Standards, as stipulated in Section 913.1, all individuals who have been qualified as QA Designees or Delegates under the current version of the RESNET Standards shall not be required to meet any new requirements to become a QA Designee as stipulated in Section 905.2.

913.4 As of the effective date of these changes to the RESNET Standards, as stipulated in Section 913.1, any consumer complaints, ethics complaints, and appeals pending before RESNET shall follow the provisions of the RESNET Standards that were in effect as of the date of the filing of the complaint or appeal.

RESNET
Residential Energy Services Network

Setting the STANDARD for QUALITY

NATIONAL HOME ENERGY RATING TECHNICAL GUIDELINES

December 28, 2005

Appendix A

ON-SITE INSPECTION PROCEDURES FOR MINIMUM RATED FEATURES

Excerpted from: *Guidelines for Uniformity: Voluntary Procedures for Home Energy Ratings, Version 2.0*, Home Energy Rating Systems Council (HERSC), August 1996.
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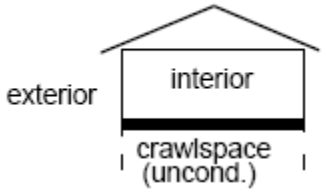
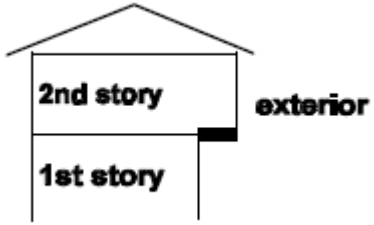
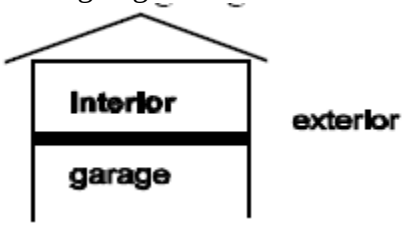
ON-SITE INSPECTION PROCEDURES FOR MINIMUM RATED FEATURES

Building Element: Foundation		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Conditioning of space	Determine whether a crawl space or basement is unconditioned, indirectly conditioned or directly conditioned	To determine whether a crawl space or basement is conditioned, assess the insulation placement in the walls or floor/ceiling assembly. A vented crawl space is considered unconditioned regardless of the location or existence of insulation. This is because the ambient temperature of the crawl space is close to the outdoor ambient temperature.  An unvented crawl space or basement may be considered either unconditioned, indirectly conditioned, or fully conditioned, based on the following criteria: *Unconditioned* -Foundation walls are not insulated, floor/ceiling assembly is insulated, and any heating or plumbing distribution systems in the space is insulated. The intention in an unconditioned crawl space or basement is to minimize the heating system losses into the space by means of the distribution and plumbing insulation, and to minimize heat flow through the insulated floor/ceiling assembly. *Conditioned, indirectly* -Foundation walls are not insulated with floor/ceiling assembly insulated and distribution system in the space uninsulated, or foundation walls insulated with floor ceiling assembly insulated or non-insulated and distribution system uninsulated. In an indirectly conditioned crawl space or basement, heating or cooling is unintentionally delivered to the space either through the floor/ceiling assembly or by unintentional losses

		from the heating/cooling system. Indirectly conditioned spaces are typically between the temperature of the outdoor ambient temperature and the indoor conditioned space temperature.

Building Element: Foundation (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Conditioning of space (continued)	Determine whether a crawl space or basement is unconditioned, indirectly conditioned or directly conditioned (continued)	*Conditioned, directly* -Foundation walls insulated or uninsulated and basement or crawl space is intentionally or unintentionally conditioned, by means of a forced air heating or cooling system, hydronic heat, electric resistance, etc. Fully conditioned spaces are typically maintained at the same temperature as the above grade spaces. The distinction between indirectly and directly conditioned basement spaces may be difficult, but is important from a heat transfer perspective. Rater judgment will have to be utilized in many cases. Interview the owner about the temperature in the basement during the heating season, and assess the potential for standby loss from the heating equipment and distribution system, e.g., jacket insulation, leakiness of ducts, insulation on distribution systems, etc.
Construction type	Identify floor over crawl space	A crawl space is typically defined as a foundation condition with a clear vertical dimension 4 feet high or less. Crawl spaces may be vented or unvented. Vented crawl spaces have some form of vent or louver in the crawl space walls, or are constructed in such a manner so that air moves freely from outside the walls to inside the crawl space. Unvented crawl spaces are constructed without any form of vents or louvers in the wall, and are constructed to exclude, to the greatest extent possible, air leakage from outside the walls to inside the crawl space. Crawl spaces may be accessed by a hatchway in the floor of the house or in the wall of the crawl space. To identify a crawl space, look for foundation vents and/or stairs leading up to floor levels from the outside of the building.
	Identify floor over full basement	A full basement has characteristics similar to an unvented crawl space, except that the clear vertical dimension is typically greater than 4 feet. Stairs that lead from the main floor to a below grade space are an indication of a basement in a house, although a house may have a basement with access similar to a crawl space access.

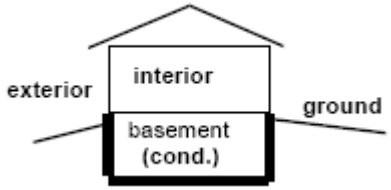
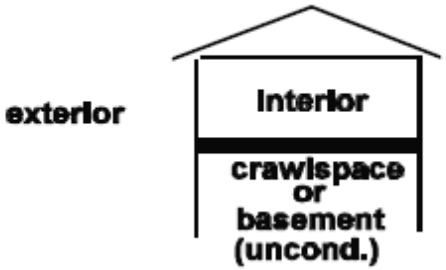
	Identify floor over exterior space	Floor area that borders exterior unenclosed space above grade is considered floor to exterior. For example, in a two story house, the second story may extend horizontally further than the first story, creating some floor area that is exposed to the exterior. 

Building Element: Foundation (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
	Identify floor over unconditioned garage	Identify floors over an unconditioned garage. 
	Identify slab on grade foundation	A slab on grade can be recognized by the absence of either a crawl space or basement. A slab on grade is constructed by pouring a concrete slab directly on the ground as the floor for the house. 
	Identify walkout basement	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).
Interior surface condition	Determine the inside surface condition of floor (exposed or covered)	*Covered* -If floor is covered with wall-to-wall carpet, consider it covered. Floors with only area rugs are not considered covered. *Exposed* -If the floor has tile, linoleum or wood, consider it exposed.

Building Element: Foundation (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Surface area	Measure floor dimensions	Measure floor dimensions in accordance with ANSI Z765-1996 with the exception of Section 3 Paragraph 6 (floor areas with ceiling heights of less than 5' will be included in finished square footage). For conditioned basements and crawl spaces, find dimensions of basement walls and floor. Divide walls into above and below grade sections. Measure the house or assembly element (window, wall, ceiling, etc.) to the nearest inch, and record the square footage to the nearest square foot. Use exterior measurements; those measurements should start at the exterior finished surface of the outside wall. Openings to the floor below should not be included in the square footage calculation, with the exception of stairways; stairways and associated landings are counted as square footage on both the starting and ending levels. Do not include the "footprint" of protruding chimneys or bay windows. Do include the "footprint" of other protrusions like a cantilever when it includes finished floor area. Do include the square footage of separate finished areas that are connected to the main body of the house by conditioned hallways or stairways. Note to divide basement and crawl space walls into above and below grade.
Thermal mass	Determine presence of thermal mass	Concrete slabs and basement walls when uninsulated or insulated on the exterior can be considered as thermal storage mass when combined with solar gain from south fenestration. Note type of thermal mass: concrete, brick, tile, water.

		South fenestration is defined as fenestration oriented between 45E SE to 45E SW. Slab-on-grade construction in climates with more than 3600 HDD (65) may not be considered solar storage mass unless properly insulated (edge, perimeter, or under slab).

Building Element: Floor of conditioned basement or crawl space		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Insulation	Determine insulation in walls and floor of conditioned basement or crawl space	If basement or crawl space is determined to be fully conditioned, its walls and floor are considered part of the building envelope. (The floor between the house's ground floor and the basement or crawl space is considered an interior boundary with no associated heat transfer calculated.)  Determine insulation type, thickness and R-value in walls. Wall insulation may be located inside foundation wall (studs and batts, foam under drywall, etc.), integral with foundation wall (insulated cores of block wall, insulating concrete block such as insulating formwork) or outside the foundation wall (rigid foam insulation).
Insulation	Determine amount of floor insulation	

		Use the inspection guidelines under "Walls—Insulation value" to assess "Grade I", "Grade II", or "Grade III" installation. Note: in addition to the inspection guidelines under "Walls", "Grade I" installation for floor insulation also requires that the insulation be installed in complete contact with the subfloor surfaces it is intended to insulate. For loose fill applications, multiply the thickness of the insulation (in inches) by the appropriate R-value per inch based on the insulation type in order to calculate the total existing floor insulation R-value. Floor insulation over unconditioned basements or enclosed (vented or unvented) crawlspaces need not be enclosed to attain a "Grade II" or "Grade I" assessment; floor insulation over ambient conditions does.

Building Element: Slab-on-grade		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Perimeter	Determine perimeter of slab foundation	Determine the perimeter of the slab foundation by measuring each dimension to the nearest ½ foot and adding them together.
Insulation	Determine if slab perimeter insulation exists	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 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 between the foundation wall and the slab itself, although this is harder to assess and verify. If the floor has carpeting, a sharp needle may be poked through the carpet near the baseboard on an outside wall. If the needle penetrates beyond the depth of the carpet, there is probably foam insulation between the slab and foundation wall.

		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.

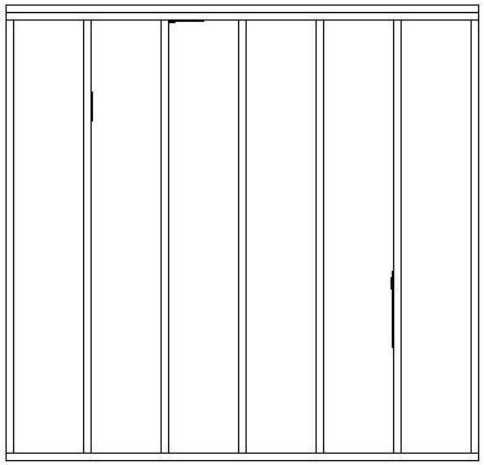
Building Element: Walls		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Color	Determine the color of the wall	Identify the color of the wall as light, medium, or dark.
Construction type	Determine the structural system of walls	*Wood framing* -is very common in residential construction. Wood 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 or brick. A wood framed wall with brick veneer would not be considered a masonry wall. Also note the siding or finish material on the wall. *Foam core walls* - are a sandwich panel consisting of a foam center with 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 homes 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 manufactured with insulated cores. Unless manufacturer's documentation is available or visual inspection of insulation type and thickness can be made, assume no added insulation exists in a log wall.

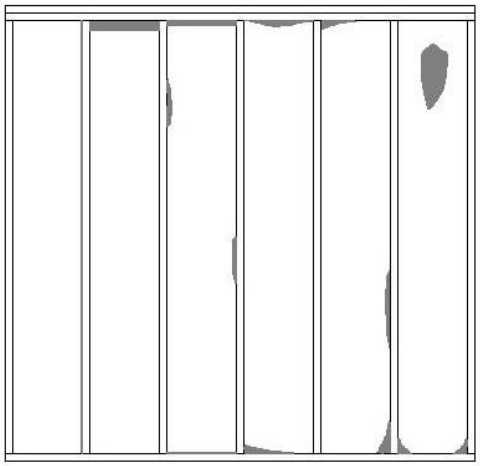
Building Element: Walls (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Framing members	Determine framing member size for all framed walls exposed to unconditioned space	To determine whether 2x4 or 2x6 framing exists: Measure the width of the window jambs; Subtract the widths of 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 2x4 wall or 5.5" for a 2x6 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 2x4 or 2x6, inspect for foam sheathing on the inside or outside of the walls. In superinsulated construction, "double stud" or "strapped" walls may account for thickness greater than 5.5". For brick veneer walls, assume 4.5" - 5" for brick, airspace and sheathing material. Check the framing member size on all sides of the house. If an addition has been added, be sure to check the walls of the addition separately. If the house has more than one story, check the framing member size for each floor.

Building Element: Walls (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Insulation value	Determine type and thickness of existing	<u>Framed Walls</u> Check at plumbing outlet under sink or, in order of preference, remove cable outlet plate,

	insulation and resultant R-value	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 (fiberglass, cellulose insulation, foam, etc.). Inspect outlets/switch plates on each side of the house to verify that all walls are insulated. Multiply the wall framing member size (in inches) by the R-value per inch. 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 house that were added later must be checked separately from the original walls. <u>Sheathing</u> 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.

Building Element: Walls (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Insulation Installation	Determine cavity insulation installation characteristics	When it is possible to inspect insulation as installed (i.e., new construction), inspectors shall rate the installation as "Grade I, II, or III" according to the following guidelines, regardless of insulation material or installation process. Note that all insulation installation techniques require proper care to ensure they are completed correctly; if they are not, thermal performance can suffer dramatically. These guidelines apply to cavity fill insulation, continuous rigid insulation, and any other field-installed insulation products. 1. "Grade I" shall be used to describe insulation that is generally installed according to manufacturers instructions and/or industry standards. A "Grade I" installation requires that the insulation material uniformly fills each cavity side-to-side and top-to-bottom, without substantial gaps or voids around obstructions (such as blocking or bridging), and is split, installed, and/or fitted tightly around wiring and other services in the cavity. To inspect, probe in, around, or through the insulation and/or vapor retarder in several places to see whether these requirements are met. Replace or repair the vapor retarder and insulation as necessary. During inspection (typically before drywall is installed), if the exterior sheathing is visible from the building interior through gaps in the cavity insulation material, it is not considered a "Grade I" installation. To attain a rating of "Grade I", wall insulation shall be enclosed on all six sides, and shall be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity. Exception: the interior sheathing/enclosure material is optional in climate zones 1-3, provided insulation is adequately supported and meets all other requirements. For rim or band joist insulation, use the inspection guidelines under "Walls—Insulation value" to assess "Grade I", "Grade II", or "Grade III" installation. Exception: the interior sheathing/enclosure material is optional in all climate zones, provided insulation is adequately supported and meets all other requirements.

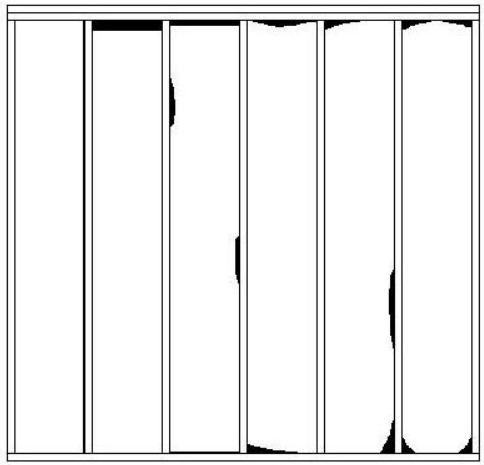
		For exterior applications of rigid insulation, insulation shall be in firm contact with the structural sheathing materials, and tightly fitted at joints to be considered a "Grade I" installation. For faced batt insulation, Grade I can be designated for side-stapled tabs, provided the tabs are stapled neatly (no buckling), and provided the batt is only compressed at the edges of each cavity, to the depth of the tab itself, and provided it meets the other requirements of Grade I. For sprayed or blown-in products, density shall be sufficient that the fill material springs back when compressed slightly with a hand or finger, and provided it meets the other requirements of Grade Interpretation: The following illustrations represent the boundary conditions between Grade I and Grade II, that is, the installation shall be at least this good to be labeled as "Grade I":  Occasional very small gaps are acceptable for "Grade I".

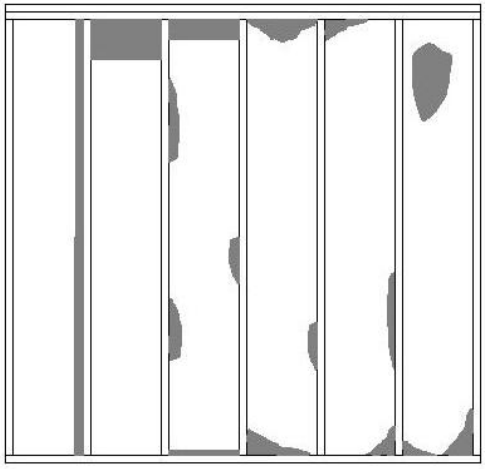


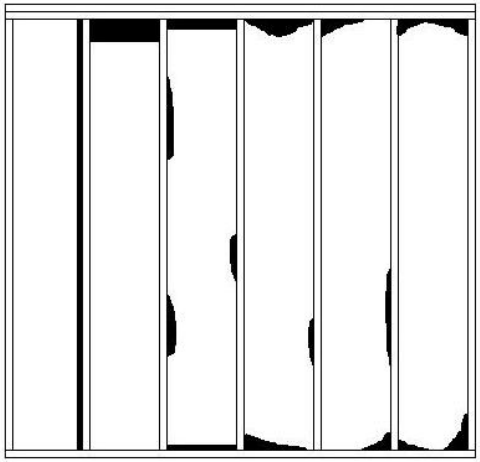
Compression or incomplete fill amounting to 2% or less, if the empty spaces are less than 30% of the intended fill thickness, are acceptable for “Grade I”.

The following standards may be applied as a reference: NAIMA, Recommendations for Installation in Residential and Other Light-Frame Construction—Fiber Glass Home Insulation (PUB # BI402), Recommendations for Installation in Residential and Other Light-Frame Construction—Fiber Glass Loose Fill Insulation (PUB # BI403), CIMA, Technical Bulletin #2 -- Standard Practice for Installing Cellulose Building Insulation, Technical Bulletin #3-- Standard Practice for Installation of Sprayed Cellulosic Wall Cavity Insulation. For other products and materials, manufacturer's installation instructions will apply.

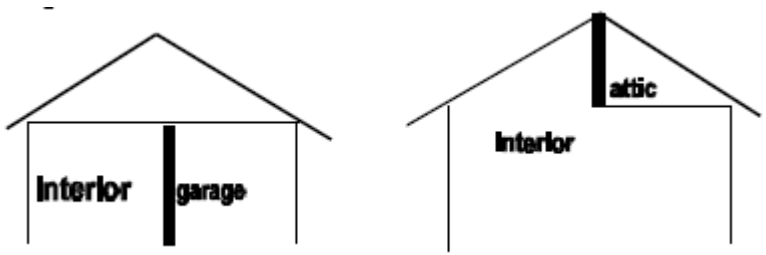
2. "Grade II" shall be used to describe an installation with moderate to frequent installation defects: gaps around wiring, electrical outlets, plumbing and other intrusions; rounded edges or “shoulders”; or incomplete fill amounting to less than 10% of the area with 70% or more of the intended thickness (i.e., 30% compressed); or gaps and spaces running clear through the insulation amounting to no more than 2% of the total surface area covered by the insulation. To attain a rating of "Grade II", wall

		insulation shall be enclosed on all six sides, and shall be in substantial contact with the sheathing material on at least one side (interior or exterior) of the cavity. Interpretation: The following illustrations represent the boundary conditions between Grade II and Grade III, that is, the installation shall be at least this good to be labeled as “Grade II”:  No more than 2% of surface area of insulation missing is acceptable for “Grade II”

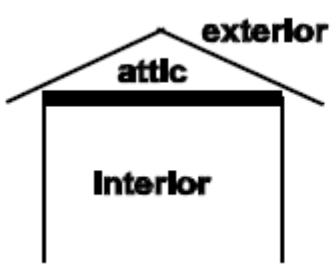
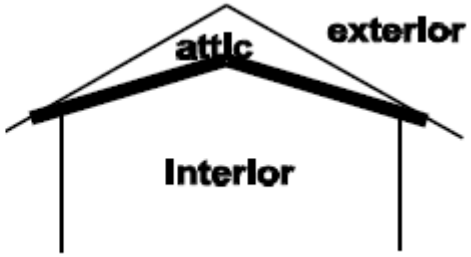
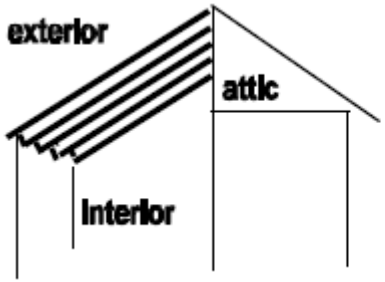
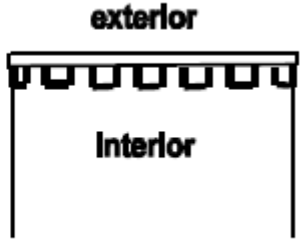
		 No more than 10% of surface area of insulation compressed or incomplete fill, by up to 30% (70% or more of intended thickness) is acceptable for “Grade II”. 3. "Grade III" shall be used to describe an installation with substantial gaps and voids, with missing insulation amounting to greater than 2% of the area, but less than 5% of the surface area is intended to occupy. More than 5% missing insulation shall be measured and modeled as separate, uninsulated surfaces according to 3.B.5.p. This designation shall include wall insulation that is not in substantial contact with the sheathing on at least one side of the cavity, or wall insulation in a wall that is open (unsheathed) on one side and exposed to the exterior, ambient conditions or a vented attic or crawlspace. The presence of an air-impermeable barrier such as housewrap will be considered to enclose the building cavities. Interpretation: The following illustration represents the boundary conditions between Grade III and the situation whereby one must measure the uninsulated areas; that is, the installation shall be at least this good to be labeled as “Grade III”:

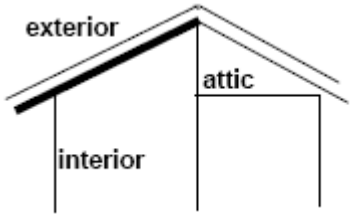
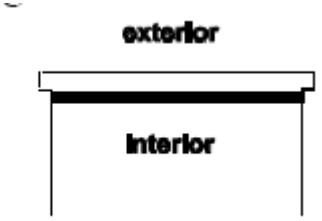
		

Building Element: Walls (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Location	Determine whether walls border exterior space, attic, garage or crawl space	*Wall to exterior* -Walls border exterior space.  *Wall to enclosed unconditioned space* -Walls that border unconditioned attics, garages and crawl spaces.

		
Surface area	Determine surface area of all walls exposed to unconditioned space	Measure linear perimeter of the walls to the nearest ½ foot. Measure the interior wall height of the walls to the nearest 1/4 foot. Use these measurements to calculate surface area.
Thermal mass	Determine type and thickness of all mass walls	If the dwelling's walls are constructed of concrete, masonry or brick, determine their type and thickness. <u>Solid concrete walls (poured)</u> Measure the thickness of the poured concrete wall in inches. <u>Concrete Masonry Unit</u> Cinder block or uninsulated concrete wall - hollow in the middle. May contain vermiculite or perlite insulation. Check for additional insulation (interior furring, foam board, foam fill). Measure the thickness of the wall in inches.

Building Element: Roof/Ceiling		
Rated Feature	**Task**	**On-Site Inspection Protocol**
All ceiling areas between conditioned and unconditioned space	Obtain measurements of all ceiling areas	Measure the linear perimeter of the ceiling area to the nearest ½ 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.

		Identify the ceiling as one of the following types. <u>Ceiling to attic</u> If the ceiling has attic space above (even if the ceiling is vaulted, as in a scissor truss) it is considered ceiling to attic. If there is a vaulted ceiling check it's 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 house.   Framed ceilings fall into two categories: *Roof on exposed beams or rafters* - when you look up from inside the room, you will see exposed beams or rafters.  

Building Element: Roof/Ceiling (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
All ceiling areas between conditioned and unconditioned space (continued)	Determine ceiling construction type (continued)	*Finished framed ceiling* -if the ceiling is framed (has no attic space above it, but you cannot see the rafters because the ceiling is finished with drywall, plaster, paneling, etc.) consider it a finished framed ceiling.  
	Determine the size of the framing members for framed ceilings	Determine the framing member size for framed ceilings exposed to unconditioned spaces. Check the framing by looking for an access through an attic over another part of the house or by looking at the rafters from the outside.
Color	Determine the color of the roof	Identify the color of the roof as light, medium or dark. Also check for a special reflective roof coating.
Construction type	Determine the roof's construction type	Identify the type of roofing surface. Some common types include: Asphalt shingle; Pebble/gravel built-up roof; Tile roof; Wood shingle roof; Rubber roof/roof coating; Metal.
Insulation value	Determine R-value of insulation in attic	Measure the average depth in four places.

Building Element: Ceiling (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Insulation value	Determine R-value of insulation in attic	Use the inspection guidelines under "Walls—Insulation value" to assess "Grade I", "Grade II", or "Grade III" installation. Note: in addition to the inspection guidelines under "Walls", "Grade I" installation for ceiling insulation also requires that the insulation be installed in complete contact with the drywall or sheathing surfaces it is intended to insulate. For loose fill applications, be sure to get four readings which accurately reflect the insulation level (the depth should be representative of the entire attic area being examined). Multiply the minimum depth of insulation by its R-value per inch to obtain the total R-value. Insulation in ceilings with attic above need not be enclosed to attain a "Grade II" or "Grade I" assessment. For sealed, unvented attic/roof assemblies, the interior sheathing/enclosure material is optional in climate zones 1-3, provided insulation is adequately supported and meets all other requirements, including full contact with the exterior (roof) sheathing. For ceiling insulation, eave baffles or equivalent construction is required to prevent wind washing to be considered "Grade I". Note whether the cavity insulation leaves the framing elements exposed, or covers them; if covered, note the thickness that covers the framing.
	Determine the R-value of insulation in framed ceiling	Determine the insulation R-value which exists in the ceiling area (cavity). Use the following method for calculating the overall ceiling R-value: • Determine the type of ceiling insulation present (may be a combination of more than one type); • Multiply the R-value of the material by the depth of the insulation; • If there is no access to the framed ceiling, ask the customer for documentation of insulation or use a default value based on age.

Building Element: Roof Ceiling (Continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Insulation value	Determine insulation value	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 house. <u>Crawl space or Basement</u> From the basement or crawl space, visually identify and measure the depth of insulation at the rim joist. The insulation used is generally fiberglass batts, often folded in an L-shape and attached to the rim joist. Rigid board insulation may also be found.
Insulation value (continued)	Determine insulation value (continued)	<u>Between Stories</u> 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 house; or • Insulation is found in the walls of the same house. Otherwise, assume no rim joist insulation exists.

Building Element: Doors		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Construction type	Determine construction type of doors	Determine if the exterior door(s) is fiberglass, metal, or wood by making a close inspection of its texture, distinguishing the sound produced when knocking on it, and checking its side view.
Insulation	Determine whether doors are insulated	Judge whether the exterior door(s) is insulated (or not) by its sound, temperature transfer, labeling, or thermal break. *Sound* - Insulated/solid door will sound dull when knocked on. An uninsulated/hollow door

		will sound hollow. *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.
Insulation (continued)	Determine whether doors are insulated (continued)	*Labeling* - Check the side view of the door at the hinges for a descriptive label. *Thermal break* - Check the side view of metal doors for thermal breaks.
Surface area	Determine surface area of doors	Measure the surface area of the door(s) to the nearest ½ square foot.

Building Element: Windows		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Area	Determine area of windows	Measure the area of the window openings using width times height to the nearest inch. Window openings are measured from the outside edge of the framing and include the frame width.

Building Element: Windows (continued)		
Construction type	Determine window framing and glazing characteristics	<u>Framing Type</u> 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 is dual-pane or multiple-pane and is metal framed, determine if a thermal break is present by looking for two separated metal extrusions connected by a rubber spacer. Ask the customer for documentation if you can't tell.

		Some wood windows may have vinyl or aluminum cladding. Check both the inside and outside, since some windows will have vinyl cladding on one side only. <u>Glazing Type</u> Check all windows in the house for number of panes and existence of tint and/or low-e coating. To determine whether the windows are single-paned or multiple-paned: • Look at frame width and spacers; • Look at reflections; • Look at edge thickness. To determine if glazing has a tint or low-e coating: • Check the customer's product literature if available; • Perform a "match test" - there should be one reflection per pane or coating, including low-e and tinting (e.g., a double-paned window with low-e and tint should show 4 reflections); • Compare to glazing samples with and without tinting; • Compare the windows within the space, since tinting is often applied only to certain windows in a house; • Look for a low-e label or etching on the glass.
Orientation	Determine orientation of all windows	Use a compass (adjusting for magnetic deviation) to determine orientation of all windows.
Building Element: Windows (continued)		
Shading	Determine shading of windows	Identify shading by external shade screens, house overhangs/awnings, and shade from trees and other buildings. <u>External Shade Screens</u>

		The most common screen is an insect screen that covers some or all of the window. If it is a full-coverage type screen, assume it is a shade screen. Compare samples of the screen's mesh pattern to those of a window screen sample to determine the type and shading coefficient of the screen. Ask customer for documentation for the shading coefficient (SC) of the screen. If you cannot determine the shading coefficient of the screen, use 36% SC as a default. <u>Projection (Overhang)</u> The shading impact of an overhang can be found by measuring the distance of the projection from the exterior wall surface and the distance (height) between the top of the window and the bottom edge of the overhang. Measure the length of the overhangs over each exterior wall. Measure the height above the window to the bottom edge of the overhang. <u>Exterior Shading</u> *Full (40% SC)* -Consider a 40% SC for an entire side of a house as being roughly equivalent to having a shade screen over a window. For trees and/or bushes to equal this effect, there should be a very dense amount of trees and/or bushes along the entire side of the house that shade both its vertical and horizontal surfaces almost totally. *Partial (70% SC)* -Based on the above definition for full shading, partial shading is considered to be anything in between full and none (no shading). *None (100% SC)* - No shading indicates there may be small plants or shrubs only,

Building Element: Windows (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Solar heat gain factor	Determine solar heat gain factor of glazing	Check product information and consult NFRC guide.
U-value	Determine window U-value	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-value, or consult manufacturer's literature.

Building Element: Skylights		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Area	Determine area of skylights	See windows.
Construction type	Determine framing and glazing characteristics of skylights	See windows.
Orientation	Determine orientation of skylights.	Determine the orientation of the lower edge of the skylight. Use this direction as the orientation of the skylight.
Shading	Determine shading of skylights	See windows.
Solar heat gain coefficient	Determine solar heat gain coefficient of skylights	See windows.
Tilt	Determine tilt of skylights	Measure the tilt of the skylight relative to horizontal. This can be done with a level and angle finder instrument, or geometrically with a protractor (from the ceiling length and heights).
U-value	Determine skylight U-value	See windows.

Building Element: Air leakage		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Blower door test	Determine effective leakage area from a blower door test	Use the testing protocol described in ASHRAE Standard 119 Section 5.1, with the modifications described below: The following protocol shall be followed in preparing the building envelope for testing: 1. Leave all supply registers and return grills open and uncovered. 2. Leave all bathroom and kitchen fans open (i.e., in their normal operating condition). Only a permanently installed back draft damper in its normal condition may impede the flow of air. 3. Leave any combustion air ducts or louvers to the exterior open. (If a homeowner or builder has sealed them off, open them for the test.) 4. Leave any make-up air ducts with in-line dampers (e.g., for large kitchen exhaust fans or combustion air) as-is (unsealed). Only a permanently installed back draft damper or motorized damper, in its normal condition may impede the flow of air. 5. Leave the dryer vent as-is, whether or not the dryer is in place during the test. Only a permanently installed back draft damper in its normal condition may impede the flow of air. 6. Leave open any outside air duct supplying fresh air for intermittent ventilation systems (including a central-fan-integrated distribution system) 7. Operable crawl-space vents, where present, are to be left in the open position. 8. Open all interior doors within the conditioned space, including doors to conditioned basements. (Closet doors may be left closed unless the closet contains windows or access to the attic or crawl space). 9. Leave louvered openings of a whole-house fan as is. (If there is a seasonal cover in place during the test, leave it in place.) 10. Close all doors to the exterior or unconditioned spaces; if any door to the exterior or unconditioned space lacks weather-stripping at testing time, it can be temporarily

		taped off. 11. Close and latch all windows. 12. Close chimney dampers. 13. Either seal or fill with water plumbing drains with p-traps that may be empty. 14. Seal off exterior duct openings to *continuously operating* fresh-air or exhaust-air ventilation systems (preferably at the exterior envelope). 15. Close any adjustable window trickle ventilators and/or adjustable through-the-wall vents. 16. If an evaporative cooler has been supplied with a device used to seal openings to the exterior during the winter, that device should be installed for the test. Use the testing protocol described in ASHRAE Standard 119 Section 5.1. Blower door and associated pressure testing instruments, which include but are not limited to hoses, and Manometers, gauges and fans shall be field tested annually for calibration by the HERS provider or rater. The provider shall use a standard for field testing of calibration provided by the equipment manufacturer. Magnehelic Gauges cannot be field tested and shall be recalibrated by the Blower Door manufacturer annually. Field check the fan and flow measuring systems for defects and maintain them according to manufacturers recommendations The HERS provider shall maintain a written log of the annual calibration check to verify all equipment accuracy for a period of three (3) years. These records shall be made available within 24 hours to a RESNET Quality Assurance Committee member upon request. It is recommended all pressure equipment be field checked for calibration more frequently than is required in these standards, i.e., monthly, quarterly, etc.
Conditioned volume of space	Determine conditioned volume of space	Determine conditioned and indirectly conditioned volume of space by multiplying conditioned floor area by ceiling height. The house may need to be split into different spaces with different ceiling heights and added to each other for both conditioned and indirectly conditioned spaces. For areas with vaulted ceilings, volume must be calculated geometrically.

Estimate	If diagnostic equipment is not used, determine window type and distribution system to estimate leakage	To be determined.
Tracer gas test		To be determined.

Building Element: Heating & Cooling/Distribution System		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Air leakage (ducts)	Determine air leakage from ducts	The application of ASHRAE Standard 152 for testing of ducted distribution systems shall be implemented with the following additions and exceptions: 1. Air Handler Fan Flow Measurement using either of the methods specified in Annex A of the standard is preferred. If such measurement is not made, default values of 275 CFM per 12,000 btu/hour of nominal HVAC capacity shall be used. For fossil-fired furnace systems, a default value of 200 CFM for every 12,000 btu/hour of nominal furnace capacity shall be used for heating. 2. Supply and return leakage may be determined by measuring the leakage of each side as in Annex B, or as an alternate the leakage of the entire system may be measured, with the duct pressurization device in the return and the duct-pressure probe in the supply side. The ratio of supply side leakage to return side leakage Q25,s to Q25,r shall be selected separately for heating and cooling based on a worst case determination. The supply side of the system shall be assigned 67% of the leakage and the return shall be assigned 33%, and the overall distribution efficiency determined; then the efficiency with the reverse conditions (67% return and 33% supply) shall be determined, and the lower of the two efficiencies will be applied. 3. Total leakage (Annex C) . The limitation of applicability of Annex C (Section C1) to leakage measurement of 10% or less of air handler air flow shall be based on tested air flow or default air flow, as appropriate according to (1) above. The calculations of 2.5% of air flow in Section C1.1,2, and 3 shall use tested air flow,

		or nominal air flow of 400 CFM per ton. If the register grilles are not installed during the test (C1.2), the 2.5% of fan flow added to the measured leakage may be waived, on condition that a visual inspection, verifying effective sealing of register boot-to-drywall and/or boot-to-subfloor connections, is conducted prior to issuing the final rating.
Insulation	Determine the value of distribution system insulation	Air ducts may be insulated with insulation blankets or rigid insulation board. Inspect the duct or pipe insulation for R-value labeling (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.
Location of air ducts	Determine the location of ducts	Air ducts may be located in the attic, crawl space, basement or in a conditioned area. You must 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.).
Type	Identify type of distribution system used to provide space heating and cooling	*Forced air* - a central fan unit connected to ducts which supply heated or cooled air to each room in the home. 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 home. *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/air conditioner* - heating or cooling is supplied directly from a heating or cooling device located within the space it serves. Window air conditioners and through-the-wall heaters are common examples. Unitary equipment typically has no distribution system.

Building Element: Heating & Cooling/Distribution System (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Type (continued)	Identify type of distribution system used to provide space heating and cooling (continued)	*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.

Building Element: Heating and Cooling/Energy Source		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Fuel type	Determine fuels used for heating and cooling	Heating systems may use natural gas, propane, oil, electricity, or some other fuel. Typically the homeowner will know what type of heating fuel is used. Cooling is typically driven by electricity, however some cooling equipment may use natural gas or propane. Look for electric cables and dedicated fuses or circuit breakers for the cooling equipment or gas lines running to the equipment. Note that gas equipment will also have electric cables to power some of the components. Be sure to distinguish between refrigerant lines and possible gas supply lines. *Oil* - look for a large storage tank (typically oblong-shaped) or fill pipes which would indicate a buried tank. Oil is typically supplied to the heating equipment via a 1/4" - 3/8" copper line. A fuel filter may be evident in the line. *Natural gas* - look for a meter connected to piping on the exterior of the home. Piping to the heating equipment is typically done with ½" - 1" iron piping. *Propane* - look for storage tank(s) (typically cylindrical-shaped). Large tanks may be buried with a 12" - 18" cap exposed above grade. Fuel is typically supplied to equipment through 1/4" - 3/8" diameter copper piping. *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). *Other fuels* - include coal, wood, processed wood pellets, or other combustible products.

Building Element: Heating and Cooling/Equipment		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Control system	Identify the control system for the heating and cooling system(s)	Determine the type of control systems. There may be separate controls for the heating and cooling systems. Thermostat controls may be programmable. Note types of features available and/or utilized.
Efficiency	Determine the heating and cooling equipment efficiency	Check nameplate for efficiency rating. If the nameplate is missing, use appropriate directories to determine an appropriate default value. SEER is used to measure the efficiency of central air conditioning and air source heat pump systems. AFUE is used to measure the efficiency of furnaces and boilers. EER is used to determine the efficiency of room air conditioners and ground source heat pumps. Check nameplate for SEER or AFUE rating. EER can be calculated from nameplate information by dividing btu output by watt input.

Building Element: Heating and Cooling/Equipment (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Equipment type	Identify type(s) of equipment for heating and/or cooling	*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. *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.

Building Element: Heating and Cooling/Equipment (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Equipment type (continued)	Identify type(s) of equipment for heating and/or cooling (continued)	*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" 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. *Split system central air conditioner* - similar to a split system air source heat pump. Consists of an outdoor unit and a coil in the forced air distribution system, usually in a fossil fuel furnace. These systems are electrically powered and provide cooling. *Single packaged central air conditioner* - similar to single packaged air source heat pumps, providing cooling only. *Through-the-wall ductless air source heat pump* - a single packaged air source heat pump designed to be installed without a distribution system. Provides both heating and cooling and is usually installed through an exterior wall. *Window/through-the-wall air conditioner* - a single packaged ductless air conditioner designed to be installed without a distribution system. *Direct evaporative cooler* - is used primarily in very dry climates. Evaporative coolers work by blowing air over a damp pad or by spraying a fine mist of water into the air. Direct evaporative coolers add moisture to the home. *Indirect evaporative cooler* - evaporation takes place on only one side of a heat

Building Element: Heating and Cooling/Equipment (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Equipment type (continued)	Identify type(s) of equipment for heating and/or cooling (continued)	*Absorption cooler* - this is a gas air conditioner. Look for a cooling tower, an exhaust pipe, a gas burner to evaporate refrigerant and a heat exchanger similar to an electric air conditioner. *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.
Location	Determine the location of heating and cooling equipment	Note whether systems are located in conditioned or unconditioned space.

Building Element: Domestic Hot Water System		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Efficiency	Determine the Energy Factor or Seasonal Efficiency of the water heater	<u>Storage Water Heater</u> Look for the water heater's rating plate and product literature. Some water heaters will list their 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 a default efficiency. If accessible, record the Make and Model #. Look up the EF rating of that model in an appropriate efficiency rating directory. If the EF rating is not listed in the directory use a default based on the estimated age of the water heater. <u>Instantaneous Water Heaters</u> Check the unit's nameplate for the RE (Recovery Efficiency). If a gas model, note whether there is a standing pilot light.
Building Element: Domestic Hot Water System (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**

Extra tank insulation value	Determine the insulation value of any exterior wrap	Visually determine if the water heater is wrapped with exterior insulation. If so, measure thickness of the wrap and determine R-value.
Location	Determine location of storage tank	Determine whether water heater is located in conditioned or unconditioned space.
Pipe insulation value	Determine the insulation value of the pipes	Determine whether pipe insulation is installed on all 3/4" or larger, non-recirculating hot water mains. Measure depth of insulation and identify material to determine R-value.
System type	Determine type and heat source of water heater	<u>Storage</u> These water heaters are the most common type. Water is heated in an insulated tank that typically ranges in capacity from 30 to 75 gallons. Storage water heaters may use electric resistance, gas, propane, oil or electric heat pump. *Storage electric* -look for rigid or flexible 240 A/C conduit, UL seal, no vent, no burner or pilot tubing. Thermostats are usually hidden behind metal access doors. Often there is both an upper and a lower thermostat. *Storage gas* -look for a vent connection (top of tank), gas connector and line valve, thermostat, burner and pilot tubing, burner compartment doors, and "AGA" seal rating plate. Most gas water heaters have legs to lift the unit above the floor level to provide combustion air to the burner. *Storage propane* -look for the same features as those listed for gas water heaters. Also, look for a rating plate or tag that states "For Use with LP Gas Only." *Storage oil* -look for features that are similar to a gas water heating storage system. In addition, oil systems are usually furnished with draft regulators which are attached to the vent pipe between the tank and chimney (hinged metal flap with counterweight to allow for variations in flue gas pressure). Vent dampers may also be apparent on the vent pipe. *Storage heat pump* -water heaters remove heat from the air in the room where they are located and then release the heat to the water in the storage tank. Look for the same features as those

		found on electric water heating systems. In addition, there will be a fan, condenser and evaporator. Also, the system may be one single unit, or may be a split system.

Building Element: Domestic Hot Water System (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
System type (continued)	Determine type and heat source of water heater (continued)	*Combination DHW/furnace system* - natural gas combo systems use heat drawn from a hot water tank circulating through an air handling module to heat the space. *Geothermal heat pump de-superheaters* - devices which utilize heat pump cycle superheater to heat domestic hot water. Look for insulated lines between air handler unit and storage water heater tank. <u>Instantaneous</u> These water heaters heat water on demand, instead of storing pre-heated water in a large tank. They are usually small units, with storage of no more than 2 gallons, and are often attached to a wall close to the point of use. Instantaneous water heaters may be used in addition to a primary storage water heater to serve fixtures in a distant location of the house, so check for a main storage unit as well. Determine if the instantaneous heater uses gas or electricity. *Instantaneous gas* - look for a connector and line valve, vent connection, thermostat, burner and pilot tubing, and AGA seal. Check whether unit has a pilot light or intermittent ignition device. *Instantaneous electric* - look for the absence of a gas line, vent or pilot light. Look for a UL seal. *Super-heater* - check for this supplementary heat source.

Building element: Solar Domestic Hot Water System

Rated Feature	Task	On-Site Inspection Protocol
Collector	Determine area, orientation, and tilt of collector	Determine the area of the collector. Determine the orientation of the solar collector by taking a compass reading (adjusting for magnetic deviation) in the direction toward which the collector faces. Determine the tilt of the collector. A site selection and angle finder instrument can be used to determine the tilt of the collector. Geometric calculations based on horizontal length and vertical height measurements can also be used.
Efficiency	Determine efficiency of solar system	Look for SRCC label. Check for SRCC system and component name plates. Refer to the Directory of SRCC Certified Solar Collector and Water Heating System Ratings, or other SRCC literature for energy factor (EF) and other performance data.
Extra tank insulation value	Determine the insulation value of any exterior wrap	See Domestic Hot Water, above.
Pipe insulation value	Determine the insulation value of the pipes	Determine the R-value of insulation installed on pipes.
Solar collector type	Identify type of solar collector	Identify the type of solar collector by checking for the SRCC label or manufacturer's information.
Storage tank size and location	Determine the capacity of the storage tank and location	To determine the size of the storage tank refer to documentation or a label indicating the tank capacity. Note if storage is inside or outside of conditioned space.

Building element: Solar Domestic Hot Water System (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
System type	Determine type of solar systems	Identify whether a solar domestic hot water system exists. These systems collect and store solar thermal energy for domestic water heating applications. If a solar water heating system

		exists, determine system type. For systems manufactured after Jan. 1, 1995, system type, energy factor (EF), and other performance characteristics shall be determined from the SRCC label (usually affixed to the solar storage tank) and by referring to SRCC literature. For systems lacking an SRCC label, energy factor and other performance characteristics can be determined using a certified HERS modeling tool, or appropriate default values. Identify as passive or active. Base your evaluation on these criteria: *Passive* - No purchased electrical energy is required for recirculating water through a passive solar collector. Three types of passive systems are integrated collector storage (ICS), thermosiphon systems and self-pumped systems. *Integrated Collector Storage (ICS)* - consists of a single unit which incorporates both collector and water storage. An example is the common "bread box" design. Storage is usually outside the conditioned space. *Thermosiphon* - consists of a flat-plate solar collector and hot water storage tank. Instead of using a pump, circulation of the fluid is achieved by natural convection action. The storage tank must be located above the collector, and is usually outside the conditioned space. *Self-pumped* - circulates fluid from storage to collectors without purchased electrical energy. Photovoltaic and percolating systems are examples of self-pumped systems. The storage tank is usually inside the conditioned space. *Active* -Also known as pumped systems. *Pumped* -purchased electrical energy input is required for operation of pumps or other components. The storage tank is usually inside the conditioned space.

Building Element: Passive Solar Heating System

Rated Feature	Task	On-Site Inspection Protocol
Direct gain	Identify system type and determine solar aperture orientation, aperture area	A solar direct gain system can reduce heating, cooling, and lighting energy requirements through proper sizing, placement, orientation, and/or control of windows, skylights, shading devices, and solar storage mass within the building. To determine aperture area, measure width and height of south-facing glazing and indicate tilt angle. Note glass type(s) (e.g., double glazing) and presence of night insulation (if any). Determine orientation with a compass reading (adjusted for magnetic deviation). Determine the type of thermal mass, its thickness and dimensions. Determine if the mass will be lit by direct solar rays between the hours of 9:00 a.m. and 3:00 p.m. during the winter. Note any trees or other obstructions to solar gain.
Greenhouse or solarium	Identify system type and determine solar aperture orientation, aperture area and information about thermal mass	A greenhouse or solarium creates a South-glazed buffer zone between the house and the exterior and can help heat the living area. They may be used in conjunction with thermal mass (such as bricks or drums filled with water) to store heat and reradiate it at night. See Direct gain, above, for specific inspection items.

Building Element: Passive Solar Heating System (continued)		
Rated Feature	**Task**	**On-Site Inspection Protocol**
Thermal storage mass	Identify system type and determine solar aperture orientation, aperture area and information about thermal mass	Thermal mass systems consist of solar-exposed heavyweight materials with high heat capacitance and relatively high conductance (high thermal diffusivity) such as masonry, brick, concrete, tile, stone, or water placed in the same zones(s) as the solar collection area(s). These elements may be integral with the building or distinct elements within the building. Distinct components: *Trombe wall* -uses a heat storage mass placed between the glass and the space to be heated.

		Measure area of storage mass, determine material, thickness, and capacitance. *Water wall* -replaces the existing wall, or parts of it, with containers that hold water.
Thermosiphon Air Panel (TAP)	Identify system type	*Thermosiphon air panel (TAP)* -has one or more glazing layers of glass or plastic, an air space, an absorber, another air space, and (often) an insulated backing. These are similar in appearance to active flat-plate collectors, often mounted vertically on walls, or ground-mounted, so that the living space is higher than the collector to facilitate convection from the TAP to the house. See Greenhouse, above, for specific inspection items.

Appendix B
GLOSSARY OF TERMS

Abnormal **-** Some defect exists in the construction and operation of the building enclosure.

ACCA **-** Air Conditioning Contractors of America

Accreditation Identification Number (AIN) – A unique accreditation number assigned to each Provider for each Provider category accreditation.

Accreditation Committee – A Standing Committee of the RESNET organization that is responsible for the review and approval of all Applications for Provider accreditation submitted to RESNET.

Accredited Rating System Provider **-** A home energy rating Provider accredited through the Mortgage Industry National Home Energy Rating System Standards.

Accredited Rater Training Provider or Training Provider **-** A home energy Rater training organization accredited by RESNET.

Acrylic Adhesive Tape **-** Any tape composed of an acrylic nature used as a sealing material primarily for moisture intrusion for house wraps, around windows, and to seal sheets of polyethylene covering the dirt on the floor of a crawl space or a basement

Additional Failure – When additional instances of initial failure(s) are identified in one or more of the other homes in the sample set being tested or inspected.

Air Barrier **-** Any solid material installed to control air leakage either into or out of the building envelope. The material used shall have an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m^2 @ 75 Pa.) when tested in accordance with ASTM E 2178-01.

Air Exfiltration **-** Air from the conditioned space leaking outside of the thermal boundary of a structure.

Air-free Carbon Monoxide **-** A unit of measurement designed to compensate for the excess air to the burner and is only used to express CO levels in a flue gas sample as opposed to ambient air testing. The measurement represents the CO levels with no excess air in the sample or with "perfect" combustion (an unrealistic situation). The measurement incorporates an adjustment to the as-measured CO ppm (parts per million) value to simulate oxygen-free conditions in the sample. (See "as-measured carbon monoxide.")

Air Infiltration **-** Air from outside the thermal boundary of a structure, which enters the conditioned space.

Air Leakage Site **-** A specific location in a structure where the air barrier has irregularities in it allowing both air infiltration and exfiltration depending on the interior pressures of the building.

Air Pressure Boundary - Any part of the building shell that offers resistance to air leakage. The most effective Air Pressure Boundary consists of a series of air barriers of interior and/or exterior sheeting material that resists airflow through it. An effective air pressure boundary is nearly airtight.

Air Wash **-** The movement of air through insulation.

Annual Fuel Utilization Efficiency **or** ***AFUE*** – A standardized measure of heating system efficiency, based on the ratio of annual output energy to annual input energy that includes any non-heating season pilot input loss.

Anomaly (defect)- An area of a building where the temperature distribution seen with an infrared imaging system differs by more than 4°F from the temperature distribution expected for the type of construction being viewed, denoting a possible problem area; an inconsistency.

ANSI **-** American National Standards Institute

As-measured Carbon Monoxide **-** A direct measurement of carbon monoxide CO in a sample of air or flue gas, usually measured in ppm (parts per million) units. (See "air-free carbon monoxide.")

ASHRAE **-** American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASNT **-** American Society for Nondestructive Testing

ASTM **-** ASTM International, originally known as the American Society for Testing and Materials (ASTM)

Atmospherically-Vented **-** An appliance using a natural draft venting system.

Atmospheric Pressure **-** The weight of air and its contained water vapor on the surface of the earth; at sea level, this pressure is 14.7 pounds per square inch.

Auditor An individual who is certified by a RESNET accredited Home Energy Survey Provider to conduct comprehensive home energy audits. Auditors shall be certified as Home Energy Raters by a RESNET accredited Home Energy Rating Provider.

Auxiliary Electric Consumption – The annual auxiliary electrical energy consumption for a fossil fuel fired furnace or boiler in kilowatt-hours per year, derived from the Eae as follows:

> Auxiliary Electric Consumption (kWh/yr) = Eae * (HLH) / 2080) – where: HLH = annual heating load hours seen by the furnace/boiler. Note: If fan power is needed (kW), it is determined by Eae / 2080.

Back Draft - Sustained downdraft during burner operation.

Base Load - An estimate of fuel consumption that does not include cooling or heating fuel consumption.

Bedroom – A room or space 70 square feet or greater, with egress window and closet, used or intended to be used for sleeping. A "den." "library," "home office" with a closet, egress window, and 70 square feet or greater or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.

Biomass Fuel – Non-liquid and non-gaseous combustible substance burned to create energy, such as chunk wood, wood chips, corn husks, etc.

Biomass System – A biomass fuel combustion device and all associated mechanisms, controls, venting, and heat delivery components designed to provide space heating.

Blackbody - An object or surface which absorbs all radiant energy, within a specific spectral band, coming into contact with the surface and does not reflect or transmit any. Thus, the surface has an emissivity of 1.

Boiler - A space heating appliance that heats water with hot combustion gases that pass through a heat exchanger.

BPI - Building Performance Institute

Building Analyst (BA), Certified - An individual who successfully passes the BPI written and field examination requirements for certification in order to evaluate the performance of a home, taking into account systems, physical conditions and other energy and non-energy characteristics of the home.

Building Envelope **-** The components of a building (walls, ceilings, windows, doors, floors, and foundations) that separate the conditioned space from the unconditioned spaces or conditioned space from outside..

CAZ - See "Combustion appliance zone"

Carbon Monoxide (CO) - An odorless, colorless gas that can cause illness or death.

Carbon Monoxide Emissions **-** Carbon monoxide (CO) resulting from combustion as measured in ppm (parts per million. The measurement of CO emissions in flue gas requires a sample to be taken before dilution air enters the venting system. (See "air-free carbon monoxide" and "as-measured carbon monoxide.")

Climate Zone – A geographical area defined as having similar long-term climate

Code Approved HVAC Tape **-** Any tape that is approved by current International Codes (UL181 A or 181 B) used for the air sealing of a heat and air duct system.

Combustion Appliance Zone (CAZ) **-** A contiguous air volume within a building that contains a combustion appliance; the zone may include, but is not limited to, a mechanical closet, mechanical room, or the main body of a house, as applicable.

Comprehensive Home Energy Audit **-** A level of the RESNET Home Energy Audit process defined by this standard to include the evaluation, diagnosis and proposed treatment of an existing home. The Comprehensive Home Energy Audit may be based on a Home Performance Assessment ("Comprehensive Home Performance Energy Audit") or Home Energy Rating ("Comprehensive HERS Audit"), in accordance with the criteria established by this Standard. A homeowner may elect to go through this process with or without a prior Home Energy Survey or Diagnostic Home Energy Survey.

Compression (insulation) - This condition includes but is not limited to batt insulation compressed behind plumbing, heat and air, electrical, and other in cavity obstructions that results in the loss of R-value of the installed insulation. This condition can also occur within a wall cavity without obstructions. See also "Misalignment".

Conditioned Floor Area (CFA) – The finished floor area in square feet of a home that is conditioned by heating or cooling systems, measured in accordance with ANSI Standard Z765-2003 with exceptions as specified in Appendix A of this Standard.

Conditioned Space **-** Any directly conditioned space or indirectly conditioned space, as defined in this standard.

Conditioned Space Boundary – The continuous planes of the building envelope that comprise the primary thermal and air flow barrier between the directly or indirectly conditioned space and either the outdoors or an adjacent unconditioned space.

Contractor, Certified - A contractor accredited by the Building Performance Institute (BPI) or an equivalent certification organization recognized by the Home Performance with ENERGY STAR® Program to complete specific home performance improvement work.

COP – Coefficient of Performance, which is the ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system under designated operating conditions.

Crawl Space - A shallow unfinished space, beneath the first floor or under the roof of a building allowing access to wiring or plumbing.

Data Collection - The gathering of information on building energy features, energy use history and other relevant building and building operation information.

Defect - See Anomaly

Design Temperature - A high or low outdoor temperature equaled or exceeded 97.5% of the time, used for designing heating and cooling systems.

Detached One- and Two-Family Dwelling – A building with one or two independent dwelling units with an individual or central HVAC system.

Dewpoint - The temperature at which a given air/water vapor mixture is saturated with water vapor (i.e. 100% relative humidity). Consequently, if air is in contact with a surface below this temperature, condensation (dew) will form on the surface.

Diagnostic Testing - The use of building performance-testing equipment (e.g. blower door, duct blaster, flow hood, infrared camera, CO monitor, etc.) to measure, assess and document specific performance characteristics of the building system.

Dilution Air - Air that enters a draft diverter or draft regulator from the room in which the appliance is located.

Directly Conditioned Space – An enclosed space having heating equipment with a capacity exceeding 10 Btu/hr-ft^2, or cooling equipment with a capacity exceeding to 10 Btu/hr-ft^2. An exception is if the heating and cooling equipment is designed and thermostatically controlled to maintain a process environment temperature less than 65 degrees Fahrenheit or greater than 85 degrees Fahrenheit for the whole space the equipment serves.

Direct Vent Appliance - A combustion appliance for which all combustion gases are vented to the outdoors through an exhaust vent pipe and all combustion supply air is vented to the combustion chamber from the outdoors through a separate, dedicated supply-air vent.

Distribution System Efficiency – A system efficiency factor, not included in manufacturer's performance ratings for heating and cooling equipment, that adjusts for the energy losses associated with the delivery of energy from the equipment to the source of the load, such energy losses associated with heat transfer across duct or piping walls and air leakage to or from forced air distribution systems.

Downdraft - Air flow from a chimney or venting system into an enclosed building space.

Draft - A pressure difference that causes combustion gases or air to move through a vent connector, flue, chimney, or combustion chamber.

Draft Diverter - A nonadjustable device built into an appliance or a part of a vent connector that is intended to (1) permit the escape of flue gases in the event of a blockage or backdraft; (2) prevent a downdraft of outdoor air from entering the combustion chamber of an appliance; (3) reduce the effect of the chimney's stack action; and (4) lower the dew point temperature of the flue gas by the infusion of room air.

Draft Regulator - A self-regulating damper attached to a chimney or vent connector for the purpose of controlling draft: A draft regulator can reduce draft; it cannot increase draft.

Drainage Plane – A seamless or overlapping membrane designed to redirect water away from vulnerable building materials.

EAE – The average annual auxiliary electrical energy consumption for a gas furnace or boiler in kilowatt-hours per year as published in the AHRI Consumer's Directory of Certified Efficiency Ratings.

Emissivity - The ability of a surface to emit radiation, measured as the ratio of the energy radiated within a specific spectral band by a surface to that radiated within that same specific spectral band by a blackbody at the same temperature.

Energy Efficiency Rating - An unbiased indication of a home's relative energy efficiency based on consistent inspection procedures, operating assumptions, climate data and calculation methods.

Energy Analysis Tool – A computerized calculation procedure for determining a home's energy efficiency rating and estimating annual purchased energy consumption and cost.

Energy Efficiency Ratio, or EER – the ratio of net equipment cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions.

Energy Efficiency Rating, or Energy Rating – See Home Energy Rating.

Energy Factor, or EF –A standardized measure of water heater energy efficiency as determined under Department of Energy Regulations, 10 CFR 430.23(e)(2)(ii).

Energy Saving Measure, or Feature - Any material, component, device, system, construction method, process, or combination thereof that will result in a reduction of energy use.

EPAct - The U.S. Energy Policy Act of 1992.

Equivalent Electric Energy – The amount of electricity that would be produced from site fossil fuel uses when converted to electrical power using the Reference Electricity Production Efficiency.

Estimated Annual Energy Cost Savings – Positive dollar difference between estimated annual energy costs for an improved existing home as compared with the same home in its original condition or for a new home, as compared with the HERS Reference Home, local code or, for the purposes of Fannie Mae mortgages, the RESNET representation of the 1993 Model Energy Code, whichever is applicable.

Ethics & Appeals Committee – A Committee that is responsible for investigating ethics and consumer complaints and hearing a Provider's appeal of its non-approval or renewal of an application, probation, suspension, or revocation.

Evaluation - An analysis of the data collected from any survey or audit, on-site data collection and performance testing, available energy usage records to determine energy use and potential savings from improvements.

Examination - Test administered by an accredited Rater Training Provider from questions developed by Training and Education Committee.

Excess Air - Air supplied to a burner in excess of the amount needed for complete combustion.

Exposed Wall – Walls subjected to heat loss or gain.

Failed Item – A "failed item" constitutes a category of failure, such as insulation installation, duct leakage, prescriptive air sealing requirements, insulation enclosure, eave baffles, mechanical system efficiency, window specifications, etc. For the purpose of follow-up inspections, a "failed item" is not limited to the specific instance in a home but to that category of the minimum rated features as it applies to that home design.

Failure - When one or more of the threshold specifications is not met during the testing and inspection process.

Fenestration – A glazed opening and its associated sash and framing that is installed into a building.

Fan-assisted Combustion - A combustion appliance with an integral fan that draws combustion supply air through the combustion chamber.

Field-of-View (FOV) - The total area of height by width, normally expressed in either degrees or radians, in which an infrared imaging system is capable of displaying, imaging, and recording objects.

Flame Rollout - A condition in which burner flames discharge from the cabinet of a combustion appliance.

Flashing - sheet material used to cover building joints to prevent bulk water entry

Framing Spacing - The distance from center to center of wall studs, ceiling joists, floor joists and roof rafters.

Furnace - A space heating appliance that heats indoor air with hot combustion gases that pass through a heat exchanger.

Gaps (insulation) - An insulation defect where installed insulation does not completely fill areas of the building enclosure, which allows for conductive and convective heat loss and a reduced R-value of the overall building enclosure.

Heat Exchanger - A device built for heat transfer from one medium to another. The medium may be separated by a solid wall, so that they never mix, or they may be in direct contact. Furnaces contain heat exchangers, of referred to as combustion chambers, made from stamped steel. Air is directed around the exchanger while the combustion process is occurring inside the heat exchanger, allowing the exchange of heat into the air medium, which is then transferred into the home.

Heat Pump - A vapor-compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of heat flow may be reversed in order to transfer heat from one location to another using the physical properties of an evaporating and condensing fluid known as a refrigerant. Most commonly, heat pumps draw heat from the air or from the ground moving the heat from a low temperature heat source to a higher temperature heat sink.

Heating Seasonal Performance Factor, or HSPF - A standardized measure of heat pump efficiency, based on the total heating output of a heat pump, in Btu, divided by the total electric energy input, in watt-hours, under test conditions specified by the Air Conditioning and Refrigeration Institute Standard 210/240.

HERS-BESTEST – The Home Energy Ratings System Building Energy Simulation Test published as NREL Report No. NREL/TP-472-7332

HERS Index – A numerical integer value that represents the relative energy use of a Rated Home as compared with the energy use of the HERS Reference Home and where an Index value of 100 represents the energy use of the HERS Reference Home and an Index value of 0 (zero) represents a home that uses zero net purchased energy.

Home – A building with one or more dwelling units that has three or fewer stories above grade, or a single dwelling unit within a building of three or fewer stories above grade.

Home Energy Assessment - Defined by this standard as one of two levels of energy assessment of a home, including Home Energy Survey and Comprehensive Home Energy Audit.

Home Energy Rater, or HERS Rater or Rater – An individual meeting the minimum training requirements for Raters set forth in Chapter 2 of these Standards, documented by an Accredited RESNET Training Provider, and certified by an Accredited Home Energy Rating Provider to inspect a home to evaluate the minimum rated features and complete Home Energy Ratings (see also Rating Field Inspector and Senior Certified Rater).

Home Energy Rater Candidate, or Rater Candidate – An individual who has completed two (2) supervised ratings with a RESNET Accredited Training Provider, passed the National Core Rater Test and is in the process of completing three (3) additional probationary ratings necessary for certification by an Accredited Home Energy Rating Provider as a Home Energy Rater.

Home Energy Rating, or Rating - An unbiased indication of a home's relative energy performance based on consistent inspection procedures, operating assumptions, climate data and calculation methods in accordance with the "National Energy Rating Technical Standards" (Chapter 3 of this Standard). See also "Rating, Confirmed" and "Rating, Projected".

Home Energy Rating Provider, or HERS Provider, or Rating Provider- An organization accredited by RESNET in accordance with section 102 of these Standards that develops, manages, and operates a home energy rating program.

Home Energy Rating System, or HERS® - The procedures, rules and guidelines by which Home Energy Ratings are conducted by accredited Providers (Home Energy Rating, Software, Training, BOP, Sampling, Home Energy Survey), as specified in these Standards.

Home Energy Survey **-** A level of the RESNET Home Energy Audit process defined by this standard to include one of the following: Diagnostic Home Energy Survey, In-Home Home Energy Survey, , On-Line Home Energy Survey

Home Energy Survey, Diagnostic **-** A level of the RESNET Home Energy Survey in accordance with this standard, consisting of an In-Home Home Energy Survey and additional diagnostic testing.

Home Energy Survey, In-Home **-** A level of the RESNET Home Energy Assessment process defined by this standard intended to assess both the general energy performance of the home and the level of the commitment to action on the part of the homeowner. The survey may include data be collected and reported on-line by the homeowner or by a home energy survey professional for the purpose of further analysis and general identification of home performance problems. The intent of the energy survey is to refer homeowners to the next level if it is determined that the home needs further analysis, and the homeowner is motivated to invest in improvements. The On-Line or In-Home Home Energy Survey is not required if the homeowner wishes to directly pursue a Diagnostic Home Energy Survey or Comprehensive Home Energy Audit.

Home Energy Survey, On-Line **-** A basic energy review of a home using an internet-based tool or software.

Home Energy Survey Provider **-** An organization accredited by RESNET in accordance with Section 703 of the Mortgage Industry National Home Energy Rating Systems Standards to certify Home Energy Survey Professionals to perform Home Energy Surveys and Auditors to perform Comprehensive Home Energy Audits in accordance with this Standard, and to maintain QUALITY assurance of the Home Energy Survey.

Home Energy Survey Professional **-** An individual certified by an accredited Home Energy Survey Provider to conduct Home Energy Surveys.

Home Performance Assessment - A detailed evaluation of the condition of a home as a building system, including evaluation of all materials, components, features, systems and subsystems that affect the energy use of the home.

Home Performance with ENERGY STAR®, or HPwES **-** A national program developed by the Environmental Protection Agency (EPA) and the Department of Energy (DOE), that offers a comprehensive, whole-house approach to improving energy efficiency and comfort of homes, while maintaining or improving safety.

RESNET Recognized Home Performance Standard **-** Technical standard developed to offer a comprehensive, whole-house approach to improving energy efficiency and comfort of existing homes, while maintaining or improving and durability safety.

House Wrap - A weather-resistant material, intended to serve as an air/moisture barrier if sealed carefully at seams.

HVAC – Heating, Ventilating and Air Conditioning.

IECC - International Energy Conservation Code.

Inches of Water Column (IWC) - A unit of pressure difference; 1 IWC = 250 Pascals (see "Pascal.")

Indirectly Conditioned Space - A space within a building that is not directly conditioned, but meets one of the following criteria: (1) the area-weighted U-factor of the boundary between it and directly conditioned space exceeds that of the boundary between it and the outdoors or the ground, where U = sum (UA)/sum(A); (2) air to or from directly conditioned spaces is mechanically transferred at a rate exceeding 3 air changes per hour; or (3) any unvented basement or crawl space that contains heating equipment or distribution systems, and for which 50% or more of the floor separating it from conditioned space has no thermal insulation installed.

Induced combustion - See "fan-assisted combustion."

Infrared Imaging System - An instrument that converts radiation differences associated with surface temperature variations into a two dimensional image by assigning specific colors or tones to the differing temperatures.

Infrared Thermography - The process of using an infrared imaging system to generate thermal images of the surfaces of objects, which can be viewed electronically or printed.

In-Home Home Energy Survey - A level of the RESNET Home Energy Assessment process defined by this standard intended to assess both the general energy performance of the home and the level of the commitment to action on the part of the homeowner. The survey may include data be collected and reported on-line by the homeowner or by a home energy survey professional for the purpose of further analysis and general identification of home performance problems. The intent of the energy survey is to refer homeowners to the next level if it is determined that the home needs further analysis, and the homeowner is motivated to invest in improvements. The On-Line or In-Home Home Energy Survey is not required if the homeowner wishes to directly pursue a Diagnostic Home Energy Survey or Comprehensive Home Energy Audit.

Initial Failure - When one or more failure(s) are first identified in a home during the sampling process.

Instantaneous Field of View (IFOV) - The instantaneous spatial resolutions characteristics of infrared imagers (expressed in angular degrees or radians per side if rectangular and if round, in angular degrees or radians), or the smallest object able to be viewed by the imaging system at a given distance.

Internal Gains – The heat gains within a home attributable to lights, people, and miscellaneous equipment.

International Energy Conservation Code (IECC) – The model code for building energy conservation as promulgated by the International Code Council.

Isolated Combustion Appliance Zone - A combustion appliance zone that is not a part of, nor directly connected to, habitable space. It is either outdoors, or is a mechanical room or attached garage that is supplied with outdoor combustion air and separated from habitable space, and which complies with the criteria in Section B.3.2 of this standard.

Knob and Tube Wiring - An early method of electrical wiring in buildings, used from about 1880 to the 1930s. It consisted of single insulated copper conductors run within wall or ceiling cavities, passing through joist and stud drill-holes via protective porcelain insulating *tubes*, and supported on nailed-down porcelain *knob* insulators.

KBtu – 1,000 British Thermal Units (Btu)

Labeled Ceiling Fan – A ceiling fan that has been labeled for efficiency in accordance with EPA guidelines such that the label shows the cfm, cfm/watt and watts of the fan at low, medium and high speeds

Labeled Ceiling Fan Standardized Watts (LCFSW) – The power consumption in watts of a Labeled Ceiling Fan "standardized" to a medium speed air delivery of 3000 cfm.

Lead Based Paint - Paint containing the heavy metal lead, that was used as pigment, to speed drying, increase durability, retain a fresh appearance, and resist moisture that causes corrosion. Although the United States has regulation that prohibits the manufacture or use of lead based paints in residential or applications with direct human exposure, lead paint may still be found in older properties painted prior to the introduction of such regulation introduced in 1978. Paint with significant lead content is still used in industry and by the military.

Light Fixture – A complete lighting unit consisting of a lamp or lamps, and ballasting (when applicable) together with the parts designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply. For built-in valence lighting, strings of low-voltage halogens, and track lights, each individual bulb shall count as a fixture.

Low-Volume Raters – Raters which complete less than twenty five (25) ratings per year or less than fifty (50) ratings over a two year period.

MBtu – One million British thermal units (Btu)

Metropolitan Area - Metropolitan and micropolitan statistical areas as defined by the United States Office of Management and Budget (OMB) and published by the United States Census Bureau at www.census.gov (the most current edition). In areas not included in any defined Metropolitan Area, individual counties may be substituted for the purpose of applying the sampling process.

Misalignment (insulation) – A defect which occurs when installed insulation is not in contact with the air barrier and air intrusion between the insulation and the air barrier seriously compromises the effectiveness of the insulation in framed buildings.

Model Energy Code: 1993 (MEC '93) – The building energy code as promulgated by the Council of American Building Officials (CABO) in 1992 as amended in 1993. The RESNET representation of MEC '93 is the HERS Reference home as defined in the "Mortgage Industry National Home Energy Rating Standards" dated 1999.

Mechanical Ventilation - The active process of supplying or removing air to or from an indoor space by powered equipment such as motor-driven fans and blowers but not by
devices such as wind-driven turbine ventilators and mechanically operated windows.

Mechanical Ventilation System – A fan designed to exchange the air in the house with outside air, sized to provide whole-house service per ASHRAE 62.2, and controlled automatically (i.e. not requiring human intervention to turn on and off). The presence of a remote-mounted on-off switch or dedicated circuit breaker labeled "whole house ventilation" (or equivalent) shall not disqualify a system from meeting the requirement of automatic control. The following are three types of mechanical ventilation:

- ***Balanced*** - One or more fans that supply outdoor air and exhaust building air at substantially equal rates from the space. This makes heat recovery possible via an air to air heat exchanger.

- ***Exhaust-Only*** - One or more fans that remove air from the building, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope.

- ***Supply-Only*** - one or more fans that supply outdoor air to the building, causing indoor air to leave by normal leakage paths through the building envelope

Minimum Rated Features – The characteristics of the building elements which are the basis for the calculation of end use loads and energy consumption for the purpose of a home energy rating, and which are evaluated by Home Energy Raters in to order collect the data necessary to create a home energy rating using accredited simulation tools.

NFPA - National Fire Protection Association

NASEO - National Association of State Energy Officials

National Core Rater Test - Computer-based examination developed by the Residential Energy Services Network's (RESNET) Training and Education Committee and administered by RESNET.

National Home Energy Rating Technical Guidelines - Voluntary home energy rating system technical guidelines adopted by the National Association of State Energy Officials (NASEO).

National Accreditation Body - The Residential Energy Services Network (RESNET) is the National Accreditation Body for all Providers designated in this Standard.

Natural Draft Venting System - A venting system that relies on buoyancy to move combustion gases to the outdoors.

NIOSH - National Institute for Occupational Safety and Health.

Normal -The building shell is functioning as designed.

NREL – National Renewable Energy Laboratory.

On-Line Home Energy Survey - A level of the RESNET Home Energy Survey in accordance with this Standard that is a basic energy review of a home using an internet-based tool or software.

On-site Power Production (OPP) – Electric power produced at the site of a Rated Home. OPP shall be the net electrical power production, such that it equals the gross electrical power production minus any purchased fossil fuel energy, converted to its Equivalent Electric Power, used to produce the on-site power.

OSHA - Occupational Safety and Health Administration.

Pascal (Pa) - The metric unit of pressure equaling 1 Newton per square meter, or 0.004 inch W.G..

Performance Testing - Testing conducted to evaluate the performance of a system or component using specified performance metrics.

Polyethylene Sheeting - Any sheet material made of polyethylene, often called Visqueen™, used as a moisture barrier either on the walls of a structure built in an extreme northern climate or as a barrier covering the dirt on the floor of a basement or crawl space.

Power Burner - A burner for which air is supplied at a pressure greater than atmospheric pressure; includes most oil-fired burners and gas burners used as replacements for oil burners.

Power-Vented - An appliance that operates with positive static pressure in the vent, and is constructed and installed with a fan or blower to push all the products of combustion directly to the outdoors through independent sealed vents connected directly to the appliance.

Predicted Depressurization - Calculated house depressurization after improvements, accounting for estimated change in house tightness and exhaust fan flow.

Purchased Energy – The portion of the total energy requirement of a home purchased from a utility or other energy supplier.

Purchased Energy Fraction (PEfrac) – The fraction of the total energy consumption of the Rated Home that is purchased energy, wherein all site fossil energy uses are converted to their Equivalent Electric Power using the Reference Electricity Production Efficiency of 40%.

Qualitative (insulation) - In relation to insulation inspections, determining general areas of anomalies without assigning temperature values to the patterns.

Qualifying Light Fixture – A light fixture located in a Qualified Light Fixture location and comprised of any of the following components: a) fluorescent hard-wired (i.e. pin-based) lamps with ballast; b) screw-in compact fluorescent bulb(s); or c) light fixture controlled by a photocell and motion sensor.

Qualifying Light Fixture Locations – For the purposes of rating, those light fixtures located in kitchens, dining rooms, living rooms, family rooms/dens, bathrooms, hallways, stairways, entrances, bedrooms, garage, utility rooms, home offices, and all outdoor fixtures mounted on a building or pole. This excludes plug-in lamps, closets, unfinished basements, and landscape lighting.

Quality Assurance (QA) – The planned and systematic processes intended to ensure compliance with current applicable standards in a systematic, reliable fashion.
Quality Assurance Plan – A Provider's written quality assurance processes and procedures as specifically required in Section 904 of these Standards.

Quality Assurance Designee (QA Designee) – An officer, employee, or contractor responsible for quality assurance within a Provider organization, who has met the requirements of section 904.7 of this Chapter and has signed an agreement with the Provider to be the Provider's QA Designee.

Quality Assurance Designee Delegate (QA Delegate) – An individual certified as a Home Energy Rater , appointed by a Quality Assurance Designee to complete a portion of the Quality Assurance process, who has met the requirements of section 904.7.4 of this Chapter.

Quality Assurance Designee, Primary (Primary QA Designee) – The one QA Designee for a Provider who shall have ultimate responsibility, on behalf of the Provider, for fulfilling the Provider's QA requirements/responsibilities and who shall be the single point of contact to RESNET regarding all Quality Assurance matters.
Quality Assurance & Ethics Committee (QA Committee) – A Standing Committee of the RESNET organization that is responsible for the oversight of RESNET's rating quality assurance program, review and ruling on the merits of formal Ethics and Consumer Complaints received by RESNET, and review and rule on the merits of all appeals of non-approval or renewal of an application, probation, suspension, or revocation.

Quantitative - In relation to insulation inspections, determining the total square footage of anomalies of a structure as a percentage of the total surface area of the structure in square feet.

Radon Mitigation - The method(s) for reducing radon entry into attached and detached residential buildings. This practice is intended for use by trained, certified or licensed, or both, or otherwise qualified individuals, following ASTM E 2121-09, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings.

Radon Testing - Typically one of two approaches is used: 1) Approved radon test kit is purchased and used by the person responsible for the building, 2) Certified and/or licensed independent radon tester to perform the required radon test. A short-term test remains in the home for 2 to 90 days, whereas a long-term test remains in your home for more than 90 days.

There are two types of radon testing devices. **Passive** radon testing devices do not need power to function and include; charcoal canisters, alpha-track detectors, charcoal liquid scintillation devices, and electret ion chamber detectors. Both short- and long-term passive devices are generally inexpensive. **Active** radon testing devices require power to function and usually provide hourly readings and an average result for the test period. These include continuous radon monitors and continuous working level monitors, and these tests may cost more. All radon tests should be taken for a minimum of 48 hours. A short term test will yield faster results, but a long-term test will give a better understanding of the home's year round average radon level. Regardless of the approach used if the radon level is confirmed to be 4 picocuries per liter (pCi/L) or higher, the mitigation should occur.

Rated Home - The specific home being evaluated using the rating procedures contained in the National Home Energy Rating Technical Guidelines.

Rater – See Home Energy Rater.

Rater Candidate – See Home Energy Rater Candidate.

Rater Specialty Certification – Professional building performance certification recognized by RESNET as part of a Home Energy Rater's advanced certification.

Rater Trainer, Certified - An individual designated by an Accredited Rater Training Provider to provide instruction and assistance to trainees. A class instructor who has demonstrated, by means of passing the RESNET National Rater Trainer Competency Test, mastery of the building science and rating system and competency necessary to effectively teach Rater training courses.

Rating, Confirmed – An energy rating accomplished using data gathered from an on-site audit inspection and, if required, performance testing of the physical building and its installed systems and equipment.

Rating Data File – The collection of information that makes up a file for Home Energy Ratings projected from plans or confirmed, including take-off forms, field data collection forms, energy simulation software files, RESNET Standard Disclosure Forms, rating certificates, rating reports, QA records (including findings and the resolution of any issues) as well as any documentation required by Third-Party Energy Efficiency Programs (EEP's) such as checklists, copies of labels or third-party certificates,

Rating Field Inspector (RFI) – A Field Inspector is the entry level of Rater certification. A Field Inspector under the direct supervision of a certified home energy Rater may conduct the inspections and necessary basic performance tests (blower door& duct blaster) to produce a home energy rating. This category requires the ability to identify and quantify building components and systems.

Rating Index – See HERS Index.

Rating, ***Projected*** - A rating performed prior to the construction of a new building or prior to implementation of energy-efficiency improvements to an existing building.

Rating Software - A computerized procedure that is accredited by RESNET for the purpose of conducting home energy ratings and calculating the annual energy consumption, annual energy costs and a HERS Index for a home.

Rating Tool – A computerized procedure for calculating a home's energy efficiency rating, annual energy consumption, and annual energy costs.

Reference Electricity Production Efficiency – Electric power production efficiency, including all production and distribution losses, of 40%, approximating the efficiency of a modern, high-efficiency, central power plant. The Reference Electricity Production Efficiency is to be used only to convert site fossil fuel energy uses to an Equivalent Electric Power for the sole purposes of providing home energy rating system credit for On-site Power Production.

Reference Home - A hypothetical home configured in accordance with the specifications set forth in the National Home Energy Rating Technical Guidelines for the purpose of calculating rating scores.

Refrigerant - A compound that absorbs heat when it under goes a phase change, e.g**.** gas to a liquid. Traditionally, the chlorofluorocarbon (CFC) R-22 was used as a refrigerant for residential air conditioners and heat pumps. Since 1992 time frames have been established for replacing chlorofluorocarbon refrigerants, with non chlorofluorocarbon refrigerants often referred to as R-410A. The ideal refrigerant has a boiling point somewhat below the target temperature, a high heat of vaporization, a moderate density in liquid form, a relatively high density in gaseous form, and a high critical temperature. Since boiling point and gas density are affected by pressure, refrigerants may be made more suitable for a particular application by choice of operating pressure.

Refrigerant Charge - Quantity of refrigerant in a vapor compression refrigeration/heating system, determined by measuring the discharge and suction pressures/temperatures in the system.

Relative Humidity (RH) - The water vapor pressure in the air expressed as a proportion of the saturated water vapor pressure (ie the highest possible value) at the current air temperature.

RESNET - Residential Energy Services Network

RESNET National Rater Trainer Competency Test – Certification test developed and administered by RESNET to ensure that accredited Rater training Provider' trainers have the requisite knowledge and competence to serve as trainers for prospective certified Rater. The test is based on the national core competency exam developed and maintained by RESNET.

Return Duct - Duct carrying air back (return) to the heating and cooling equipment.

Room Pressure Differential - In many parts of the country, supply air is delivered to individual rooms, but return air is located only or primarily in the central body of the home. The absence of return air in closeable spaces causes positive pressure in the closed rooms and negative pressure in the central zone. These positive and negative pressure differentials create a number of unwanted impacts, which may include; contaminants in the soil (e.g., radon), sewer gases in poorly trapped drain lines, and air contaminants (e.g., pesticides, mold odors, chemicals, auto exhaust, dust) in unconditioned zones such as crawl spaces and garages being drawn into the conditioned living space. Negative pressure can also produce combustion venting problems such as; very high levels of Carbon Monoxide or push the flame out of the combustion chamber in a process referred to as flame rollout. These combustion system impacts can create serious dangers for both home and occupants. In order to alleviate the differentials, "jumper ducts", "transfer grills" or individual returns are installed to alleviate or balance the pressures differential between zones.

R-Value – Thermal resistance value measured in h-ft^2-F/Btu.

Sample Set - A specific group of homes from which one or more individual homes are randomly selected for sampling controls.

Sampling - An application of the Home Energy Rating process whereby fewer than 100% of a builder's new homes are randomly inspected and tested in order to evaluate compliance with a set of threshold specifications.

Sampling Controls - A collection or set of required tests and inspections performed for a sample set of homes in order to confirm that the threshold specifications have been met. "Sampling controls" may refer to the entire set of tests and inspections, or to a particular phase that constitutes a defined subset of those tests and inspections (e.g. pre-drywall, final, HVAC, windows and orientation, etc).

Sampling Provider - An entity, accredited through these standards, that oversees the sampling process and issues the sampling certifications that homes meet a particular set of threshold specifications such as the ENERGY STAR® specifications adopted by the U.S. Environmental Protection Agency.

Seasonal Energy Efficiency Ratio,* or *SEER - A standardized measure of air conditioner efficiency based on the total cooling output of an air conditioner in Btu/h, divided by the total electric energy input, in watt-hours, under test conditions specified by the Air Conditioning and Refrigeration Institute Standard 210/240.

Senior Certified Rater – A senior Rater is the first category of advanced Rater certification. Senior Certified Raters have demonstrated that they have the increased experience and knowledge base to interpret the findings of a rating and make recommendations on how the home can be improved.

Sensible Heat Ratio (SHR) - The sensible heat or cooling load divided by the total heat or cooling load.

Spectral Wavelength - The electromagnetic wavelength interval or equivalent over which observations are made when using an infrared imaging system.

Spillage, Spill - Combustion gases emerging from an appliance or venting system into the combustion appliance zone during burner operation.

Standard Ceiling Fan – The ceiling fan against which Labeled Ceiling Fans are measured for efficiency. At medium fan speed, the Standard Ceiling Fan produces 3000 cfm of air flow and uses 42.6 watts of power.

Standards (HERS Standards) – The "Mortgage Industry National Home Energy Rating System Standards", as maintained by the Residential Energy Services Network (RESNET).

Standards Committee - A Standing Committee of the RESNET organization that is responsible overseeing the Standards Amendment process.

Super Heat – Heat added to a vapor under pressure, raising the temperature of the vapor above the temperature pressure reference point

Technical Committee - A Standing Committee of the RESNET organization that is responsible for review and oversight of the RESNET Technical Standards (Chapter 3).

Thermal Boundary - The line or boundary where the air barrier and insulation are installed in a building assembly. The air barrier and insulation should be adjacent to one another in a building assembly to prevent airflow from circumventing insulation.

Thermal Boundary Wall - Any wall that separates directly or indirectly conditioned space from unconditioned space or ambient conditions.

Thermal Boundary Wall (Above-Grade) - Any thermal boundary wall, or portion of such wall, not in contact with soil.

Thermal Expansion Valve (TXV) - A component of a vapor compression refrigeration system that varies the amount of refrigerant flow into the evaporator coil based on temperature and pressure, thereby controlling the superheat at the outlet of the evaporator coil**.**

Thermal Storage Mass – Materials or equipment incorporated into a home that will store heat, produced by renewable or non-renewable energy, for release at a later time.

Thermal bridging - Heat conduction through building components, typically framing, that are more conductive than the insulated envelope.

Thermal Bypass - Air movement, air leakage or convection "cell", that circumvents the thermal barrier, is usually hidden and is the result of an incomplete or compromised air barrier.

Thermal Image - A recorded electronic or printed image provided by an infrared imaging system of the thermal surface variations of an object or a surface.

Thermal Resolution, or Noise Equivalent Temperature Difference (NETD) - The minimum temperature difference, typically specified in degrees Centigrade at 30 degrees Centigrade, an infrared imaging system is able to distinguish between two blackbody points on a thermal image.

Thermogram **-** An infrared picture obtained through the use of an infrared imaging system or other means of recording such images.

Thermographer, Level I **-** A person who is qualified by training, experience and testing to gather high-quality data and, where pass/fail guidance is provided, to interpret that data. The American Society for Nondestructive Testing (ASNT) defines a Level I as one who can, 1) Perform calibrations, tests, and evaluations for determining the acceptance or rejection of tested items in accordance with specific written instructions, 2) Record test results but have no authority to sign reports for the purpose of signifying satisfactory completion of NDT operations, and 3) Receive instructions or supervision from a Level III or designee.

Thermography **-** The process of generating and interpreting thermal images.

Third-Party Energy Efficiency Program, or EEP **-** A national or local program that has set a standard for energy efficiency in building performance and requires a HERS analysis for verification (e.g. ENERGY STAR Qualified Homes, Building America's Builders Challenge, building code, International Code Council, utility companies, etc.)

Threshold Specifications - A set of qualification criteria which are established for a sample set based on worst-case Projected Ratings with consideration of all options, and in worst-case orientation, or a set of prescriptive specifications such as the ENERGY STAR® prescriptive path adopted by the U.S. Environmental Protection Agency.

Training and Education Committee - A Standing Committee of the RESNET organization that is responsible for overseeing RESNET training, RESNET tests, and education and professional development for RESNET Providers and Raters.

Transfer Duct **-** Properly sized ducting and register grills installed in the wall or door between the central body of a home and an isolated area, in order to reduce room pressure differentials.

Transfer Grill **-** Properly sized grills installed in the wall or door between the central body of a home and an isolated area, in order to reduce room pressure differentials.

Typical Meteorological Year, or TMY Data – Hourly climate data published by the National Climatic Center, Asheville, NC, based on historical climate data in 216 locations.

U-factor **-** Coefficient of thermal transmittance (expressed as Btu/h-ft2-oF (W/m2-oC)) of a building envelope component or system, including indoor and outdoor air film transmission coefficients.

Unconditioned Space **-** Any enclosed space within a building that is neither directly nor indirectly conditioned.

Unvented Combustion Appliance - Any appliances not used with a duct, chimney, pipe, or other device that carry the combustion pollutants outside the home. These appliances can release large amounts of pollutants directly into a home.

U-Value – Thermal transmittance value measured in Btu/h-ft^2-F.

Vapor barrier/retarder - A material used in the construction process to either slow or stop the movement of moisture, whether in liquid or vapor form, into or out of the building envelope or the wall structure.

Vapor-Cycle Refrigerant-Based Equipment - The most widely used method for air-conditioning of private residences in the United States. System uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere, typically includes four components: a compressor, a condensing coil, an expansion valve (also called a thermal expansion valve), and an evaporator coil.

Vent Connector - The pipe that connects a combustion appliance to a vent or chimney.

Venting System - A passageway or passageways from a combustion appliance to the outdoors through which combustion gases pass.

Voids (insulation) - Areas where no insulation has been installed.

Wind Wash(ing) - Air intrusion between the insulation and the air barrier seriously compromises the effectiveness of the insulation in framed buildings. The long path exfiltration on the cold side of insulation allows moisture from the air to be deposited in the building assembly.

Weather Resistant Barrier (WRB) - Is designed to keep water from entering the building through the walls and is made up of several individual materials: house wrap or building paper (with weather resistive coating), flashings, sealants and tapes. When installed properly, these materials combine to protect the building from rain-induced moisture damage. If the WRB is sealed to block air flow it also contributes to the air barrier system of a home.

Work Scope - A set of written recommendations, including specifications detailing repairs and improvements to be made to a home; a work scope may include pre- and post-work
performance testing and acceptance criteria.

Appendix C

(Informative)

General Guidelines for Determining Energy Conservation Measure (ECM) Service Lifetimes and Maintenance Fractions

Improvement Category	ECM Life	Maint. Frac.
Air Sealing, Ducts	20	0
Air Sealing, Envelope	30	0
Attic, Ventilation	30	0
Attic, Radiant Barrier	30	0
Color, Roof Shingles	15	0
Color, Wall Paint	10	0
HVAC, Replacement	15	0
Furnace, Replacement	20	0
Hot Water, Heat Pump	15	0.009
Hot Water, Heat Recovery	15	0
Hot Water, Pipe Insulation	15	0
Hot Water, Tank Wrap	12	0
Hot Water, Solar, Direct	40	0.011
Hot Water, Solar, ICS	40	0.004
Hot Water, Solar, Indirect	40	0.011
Hot Water, Standard System	12	0
Hot Water, Tankless, Gas	12	0.024
Insulation, Block Wall	40	0
Insulation, Ceiling	40	0
Insulation, Frame Wall	40	0
Lighting, High Efficiency	5	0
Pool Pump, High Efficiency	15	0
Refrigerator, Replacement	15	0
Showers, Low Flow	15	0
Window, Replacement	40	0
Window, Film Tinting	15	0
Window, Solar Screen	15	0