CHEERS

Unmatched Service with Integrity

INTRODUCTION

To assist in navigating through the CHEERS manual, open the bookmark tool bar to jump to a specific location.

VISIT CHEERS.ORG FOR MORE INFORMATION ON THE CHEERS PROGRAM

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C|H|E|E|R|S

Unmatched Service with Integrity

2013 HERS I Training

Introduction

CHEERS

Main Website

- www.CHEERS.org

Training

- www.cheerstraining.com

Technical Support

- 1-888-982-7980
- TechSupport@CHEERS.org

Administrative Support

- 1-800-424-3377
- AdminSupport@CHEERS.org

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CHEERS (Cont.)

Mailing Address:

- 5757 Pacific Ave, Ste. 220
  Stockton, CA 95207

Feedback

- 1-888-982-7970
- Feedback@CHEERS.org

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California Energy Code

Regulated by the California Energy Commission;

- www.Energy.CA.GOV

First adopted in 1978;

Also known as Title 24, part 6; Building Energy Efficiency Standards;

As Title 24, it is on a 3 year cycle.

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HERS Certifications

Residential New Construction*

Residential Alterations/ Additions*

Photo-Voltaic (PV)*

Whole House Rater

Building Performance Contractor

Non- Residential

*Denotes the certifications CHEERS is currently approved to provide.

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Class Agenda

Introduction

Legal Aspects of The HERS Profession

Basics of Building Science

Title 24 Overview

Rater and Job Safety

HERS Verification Procedures

The CHEERS Registry

Written and Field Test

Completing the Certification Process

1. Complete the online module with a 90% average or above
2. Schedule and complete your field training
3. Schedule and complete your written and field test

All scheduling is done thru the On Demand Learning Center website

Field Training

The field training will cover hands on all HERS procedures covered in the online modules and in the Residential Appendices.

In addition, it will demonstrate hands on examples of concepts and situations explained during the online lecture.

Written Test

Designed to test your knowledge of applicable building science and HERS regulations:

- Comprehensive online test
- Open book
- 50 Multiple choice questions
- 2 hours to take
- 80% to pass

*** *If taking a combination HERS I/ Solar exam, the test will be 70 questions, with 2.5 hours to take***

Field Test

Designed to test your proficiency in HERS verification procedures and applicable paperwork:

- Hands-on test
- Open book
- You will be required to show proficiency in each HERS procedure outlined in the Residential Appendices and HERS forms
- You have to receive a 75% in each procedure, and 80% overall to pass the test

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QUESTIONS

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LEGAL ASPECTS OF THE HERS PROFESSION

2013 HERS I Training

Legal Aspects of the HERS Profession

References

- HERS Regulations-August 2009
- Found at: http://www.energy.ca.gov/HERS/documents/regulations.html

Introduction

Most of us think of ethics in very personal terms; the word actually assumes a much greater meaning the minute we become part of an organization or an established group of people;

At that point, individual values are not enough to define what behavior will or will not be acceptable or tolerated;

Definitions of right and wrong may vary, even if the group is composed of individuals who all consider themselves to be “ethical”.

Overall Training Goal

Understand the legal and ethical implications of the HERS profession, provider Quality Assurance Process , along with its expectations and requirements.

Training Sections

Section 1- Ethics

Section 2- HERS Regulations

Section 3- Quality Assurance

Ethics

Ethics

What is ethics, and why is it important to act according to a code of principles?

Why is business ethics becoming increasingly important?

What are corporations doing to improve business ethics?

Why are corporations interested in fostering good business ethics?

What approach can you take to ensure ethical decision making?

Legal Aspects of the HERS Profession 7

Ethics

Definition of Ethics:

1. A system of moral principles;
2. The rules of conduct recognized in respect to a particular class of human actions or a particular group, culture, etc.;
3. Moral principles, as of an individual;
4. That branch of philosophy dealing with values relating to human conduct, with respect to the rightness and wrongness of certain actions and to the goodness and badness of the motives and ends of such actions.

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Ethics

Importance of Ethics

- Companies, Government Agencies and Nonprofits are now including ethics as a critical part of their employee training and management;
- Within the organizational context, ethics is a system of rules or principles of behavior within a group against which actions can be judged;
- It must be agreed upon by all members of the group to ensure consistency of action.

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Ethics

The importance of Integrity

- Your moral principles are statements of what you believe to be rules of right conduct;
- A person who acts with integrity acts in accordance with a personal code of principles – integrity is one of the cornerstones of ethical behavior.

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Ethics

Why fostering good business ethics is important

- To gain the goodwill of the community;
- To create an organization that operates consistently;
- To produce good business;
- To protect the organization and its employees from legal action;
- To avoid unfavorable publicity.

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Ethics

How Management can affect Employees' Ethical Behavior #1

Manager:

- Set and hold people accountable for meeting "stretch" goals, quotas, and budgets

Possible Employee Reaction:

- "My boss wants results not excuses, so I have to cut corners to meet the goals has set."

Ethics

How Management can affect Employees' Ethical Behavior #2

Manager:

- Fail to provide a corporate code of ethics and operating principles to guide decision making

Possible Employee Reaction:

- "Because there are no guidelines, I don't think my conduct is really wrong or illegal."

Ethics

How Management can affect Employees' Ethical Behavior #3

Manager:

- Fail to hold people accountable for unethical actions

Possible Employee Reaction:

- "No one will ever know the difference, and if they do, so what?"

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Ethics

Seven Steps for Ethical Decision Making

1. Get the facts
2. Identify stakeholders and their positions
3. Consider the consequences of their decision
4. Weigh various guidelines and principles
5. Develop and evaluate your decision
6. Review your decision
7. Evaluate the results of your decision

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Ethics

Evaluating your Decisions

- 'CLICK' MODEL
  - **C**onsequence- What are the consequences if I do this?
    - Who will benefit? Who will suffer?
  - **L**egal - Is it legal?
    - Are there considerations based on law?
  - **I**mage - Would I like to see this on the front page of the newspaper?
    - Will this decision affect our public image?
  - **C**ulture - Does this decision support or damage our organization's culture and values?
  - **K**not - Does it cause a knot in my stomach?
    - Would my mentor or hero approve?

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Ethics

Are personal ethics enough?

Where is the distinction between individual values, ethics, and the standards and policies of an organization or profession?

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Ethics

Walk the Talk

- Walking the talk consistently demands that our decision-making skills include:

1. Competence: the ability to recognize an ethical issue when it appears;
2. Confidence: the assurance and self-esteem to seek out different points of view rather than making the decision alone;
3. Tough-mindedness: the strength to ultimately to make a decision and act even though there is no guarantee that it is the absolute “right” decision.

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Ethics

" Ethics must guide
not only what we do
but how we do it"

Anonymous

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HERS Regulations

HERS Regulations

Definitions

- **Financial Interest:**
  - An ownership interest, debt agreement, or employer/employee relationship.
  - Financial interest does not include ownership of less than five percent of the outstanding equity securities of a publicly traded corporation.

HERS Regulations

Definitions (Cont.)

- **Independent Entity**
  - Having no financial interest in, and not advocating or recommending the use of any product or service as a means of gaining increased business with, firms or persons specified in Section 1673(j) of the HERS Regulations.

HERS Regulations

Definitions (Cont.)

- **NOTE:** The definitions of ”independent entity” and ”financial interest,” together with Section 1673(j), prohibit conflicts of interest between Providers and Raters, or between Providers/Raters and builders/subcontractors.

HERS Regulations

Conflict of Interest

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HERS Regulations

Conflict of Interest (Cont.)

- Raters shall be independent entities from Providers;
- Raters shall be independent entities from the builder **and** from the subcontractor installer of energy efficiency improvements field verified or diagnostically tested;
- Raters shall be independent entities from any firm or person that performs work on the home for a California Home Energy Audit or a California Whole-House Home Energy Rating.

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Quality Assurance

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Quality Assurance

HERS Providers shall conduct Quality Assurance Reviews, independently from the Rater, to evaluate each Rater's California Whole-House Home Energy Ratings, California Home Energy Audits, and field verification and diagnostic testing required for verifying compliance with the Title 24, Part 6, *Building Energy Efficiency Standards.*

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Quality Assurance

General Guidelines:

- Homes chosen for CHEERS QA evaluations are randomly selected by CHEERS;
- At a minimum, QA percentage thresholds are met by rounding up to the nearest whole number for each measure tested by a Rater;
- Raters are not informed that a building/installation will be field checked until after they have completed the original rating and all paperwork (CF3Rs and/or Whole-House Rating report) has been submitted;

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Quality Assurance

General Guidelines (Cont.):

- All QA evaluations, and associated results, conducted by CHEERS QA personnel are documented in the CHEERS database;
- QA reports are placed in the Rater's file. Within 5 business days of receiving a request from a Rater, an electronic (PDF) copy of the completed QA report will be sent to the Rater.

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Quality Assurance

QA Stages

1. Initial Review
2. Tested Homes Annual QAI
3. Sampled Homes Annual QAI
4. Database Total QAI

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Quality Assurance

QA Stages (Cont.)

1. Initial Review
   - CHEERS QA Personnel will conduct an initial review of rating documentation on **at least** the first 5 homes that are rated by a CHEERS Rater.

Note: *A home rated under CHEERS direct supervision during a Rater's certification process will not be counted in the 5-home requirement.*

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Quality Assurance

QA Stages (Cont.)

2. Tested Homes Annual QAI
   - CHEERS QA Personnel will annually evaluate the greater of 1 rating **or** 1% of the raters' past 12 months total number of ratings, (rounded up) for each measure tested by the rater.

Note: *Raters, upon demand, also have to be able to provide equipment calibration logs for the Blower Door and associated equipment within the last 3 years, and show proof of current calibration of other equipment in accordance with the specifications found in the Residential Appendices.*

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Quality Assurance

QA Stages (Cont.)

3. Sampled Homes Annual QAI
   - For houses or installations passed as part of a sample group, but not field verified or rated by a Rater, CHEERS QA personnel will evaluate the greater of 1 house or 1% (rounded up) of a Rater's annual sampled houses or installations.

Note: *Failures found in Sampled Homes will be recorded and communicated but will not count against a rater's pass/failure record.*

CHEERS

Quality Assurance

QA Stages (Cont.)

4. Database Total QAI
   - CHEERS QA Personnel will perform QAI on 1% of <u>**all**</u> annual ratings (tested & sampled) conducted through CHEERS from the entire pool of ratings in the CHEERS database.

Note: *This may result in some Raters having more QAI done on their work than them minimum required.*

Quality Assurance

QA Failure Protocols

1. If a Rater's work does not pass the 1% QAI, 2 additional ratings of the failed measure(s) performed by the same rater within the last 12 months will be evaluated by CHEERS QA personnel. In addition, CHEERS will report the QA failure on its Rater Registry web site for a period of 6 months;
2. If a second deficiency is found in the 2 additional ratings evaluated, then the rater shall have 2%, rounded up, of his/her ratings of the failed measure(s) evaluated for the next 12 months by **all** providers;
3. If additional failures occur during the 2% QA review, the Rater will be subject to the CHEERS Corrective Action Process (CAP).

ELO 3- Quality Assurance

QA Failure Protocols (Cont.)

- Depending upon the nature of the QAI failures, and at the discretion of CHEERS QA personnel, the rater may also be subject to being placed on probationary status and required to obtain additional training and recertification at his/her expense;
- The Rater may also be subject to immediate additional QAI and/or placed on a suspension or permanent decertification status depending on the nature of the QAI failure(s).

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Quality Assurance

Definitions

- **Class 1 QA Failure**: failures due to *perceived* Rater misunderstanding, improper training and/or human error. For example, the rater unknowingly conducted the diagnostic testing improperly, or he/she made a mistake during the data entry process.
- **Class 2 QA Failure**: failures due to *perceived* Rater negligence, improprieties, or general lack of willingness to provide truthful and accurate ratings. For example, a rater certifies a rating that he/she never conducted, or certifies a rating knowing that it didn't meet prescribed standards.

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Quality Assurance

Potential Rater Violation of CHEERS Rater Agreement

- Per the standard CHEERS Rater Agreement, CHEERS has the right, upon written notice, to decertify a rater for specified violations referenced in the aforementioned agreement, in the event that a violation is either reported to CHEERS or discovered by CHEERS through its QA Process.

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Quality Assurance

Every form you sign has a legal liability attached to it

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

1. I certify that this Certificate of Verification documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

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Quality Assurance

QA Results Notification to Raters

- Notification of the QA results will be sent to the Rater via email, within 24 hours of the QA report being completed by CHEERS QA personnel.

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Training Sections

Section 1- Ethics

Section 2- HERS Regulations

Section 3- Quality Assurance

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Overall Training Goal

Understand the legal and ethical implications of the HERS profession, provider Quality Assurance Process , along with its expectations and requirements.

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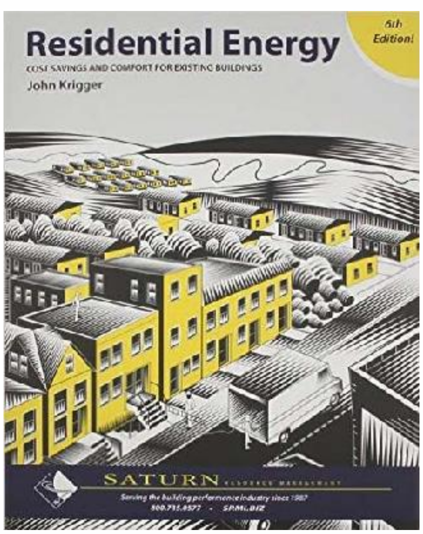
BASICS OF BUILDING SCIENCE

2013 HERS I Training

Basics of Building Science

References



- “Residential Energy: Cost Savings and Comfort for Existing Buildings”
- By John Krigger and Chris Dorsi

Introduction

Building science is the collection of scientific knowledge that focuses on the analysis and control of the physical phenomena affecting buildings. Traditionally includes the detailed analysis of building materials and building envelope systems.

Overall Training Goal

Understand the basics of building science, its principles, application, and how it relates to residential construction.

Training Sections

Section 1- Energy Basics

Section 2- Heat Transfer

Section 3- The House as a System

Section 4- Building Science & Energy Efficiency

Section 5- Building Science & Human Comfort

Energy Basics

Energy Basics

Energy
- A measurable quantity of heat, work or light

Two main types of Energy
- Potential: stored energy; like a cord of wood
- Kinetic: transitional energy; like a flame

Potential Energy turns into Kinetic Energy

Energy Basics

Laws of Thermodynamics:

1. Energy is neither created or destroyed, it merely moves from place to place and changes form.

2. Heat moves from high temperature regions to low temperature regions (hot to cold), never the reverse, without additional energy from an external source.

Energy Basics

Energy fuels units of measurement

- Electricity: Kilowatt-hours
- Natural Gas: Therms
- Propane and #2 Fuel Oil: Gallons

Each unit of each type of fuel, holds a different amount of BTUs

Energy Basics

Fuel Type	Fuel Units	Approximate Energy Content
F el Oil	G llo	3 B
N l G	T e	B
Ele i i	ilo	3 B
P o e	G llo	B

Energy Basics

British Thermal Unit (BTU)

- The amount of energy required to raise one pound of water 1°F
- One BTU is the approximate amount of heat produced by one lit match

Energy Basics

Calculating Energy

- Power X Time= Energy

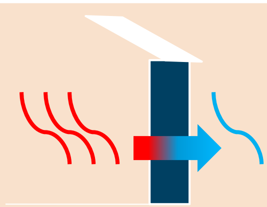
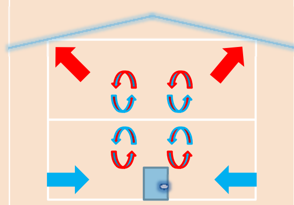
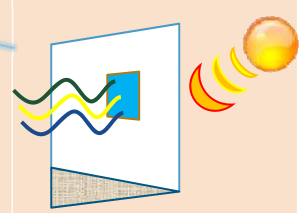
EXAMPLE:

- *Q: How much energy is used if a 100,000 BTU/Hr furnace runs for 10 hours?*
- *A: 100,000 X 10= 1,000,000 BTUs*

Heat Transfer

Heat Transfer

Types of Heat flow

CONDUCTION	CONVECTION	RADIATION
		
• Heat conducts through solid objects and between objects touching one another	• Heat transferred by a moving fluid like air or water	• Heat moves through space from one object to another

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Heat Transfer

Thermal Boundary Vs. Pressure Boundary

- **Thermal boundary**
  - ✓Prevents heat flow between inside and outside of home;
  - ✓The thermal boundary is the insulation;
- **Pressure Boundary**
  - ✓Prevents air flow between the inside and out side of home;
  - ✓The pressure boundary is usually the interior drywall and the exterior envelope.

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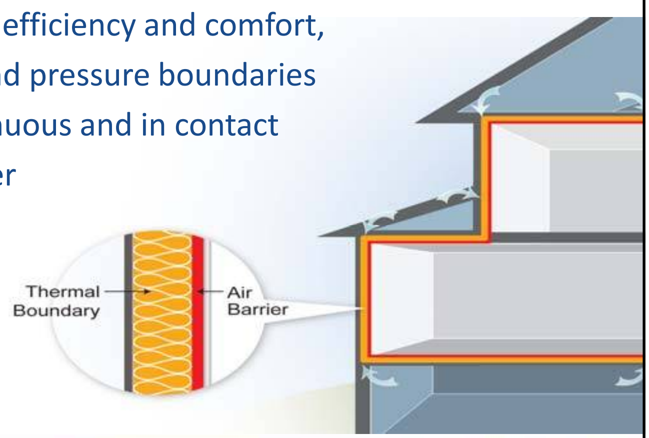
Heat Transfer

Thermal Boundary Vs. Pressure Boundary (Cont.)

- For maximum efficiency and comfort, the thermal and pressure boundaries must be continuous and in contact with each other



Heat Transfer

Thermal Boundary

- **R-Value** measures resistance
  - ✓R-Value of multiple building components can be added together to calculate the composite R-Value of Building components
  - ✓A higher R-Value, the more efficient the insulation is, assuming it's installed correctly

Heat Transfer

Thermal Boundary (Cont.)

- **U-Factor** measures transmittance or conductance
  - ✓U-Factors are not additive in nature and can be calculated from the R-Value
  - ✓The U-Factor is the inverse of the R-Value

    U=1/R R=1/U
  - ✓The lower the U-factor, the less heat the material will conduct

Heat Transfer

Thermal Boundary (Cont.)

- **Heat Loss over time formula**
  - ✓Q= U X A X ΔT X T

Q= Heat Loss over time (BTUs/Hr)
U= Surface U-Factor
A= Area of the surface
ΔT (Delta-T)= Difference between two sides of the surface
T= Time

Heat Transfer

Thermal Boundary (Cont.)

- **Heat Loss over time formula (Cont.)**
- *EXAMPLE:*
  - ✓*U-Factor= .32*
  - ✓*Wall =12' X 12'*
  - ✓*Inside Temperature= 72F*
  - ✓*Outside Temperature= 60F*

  Q=.32 X 144 X 12 X 24(hrs.)
  Q=13271 BTU
- *This particular surface will lose 13271 BTUs over the course of 1 day (24 hours)*

Heat Transfer

Pressure Boundary

- In addition to the three means of heat flow discussed earlier, a heat flow in a home is also affected by infiltration and exfiltration
  - ✓**Infiltration:** uncontrolled air movement to the inside of the home
  - ✓**Exfiltration:** uncontrolled air movement to the outside of the home

Heat Transfer

Pressure Boundary (Cont.)

- **Air Exchange**
  - ✓Estimated in cubic feet per minute (CFM)
  - ✓1 CFM of air enters a building for each CFM that escapes; the building has a constant volume
  - ✓In order for air movement to occur three things need to be present:
    1. A hole
    2. A pressure difference
    3. An amount of air

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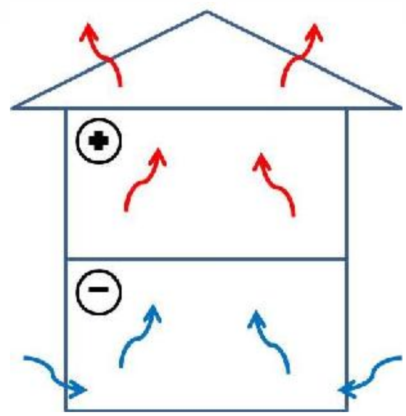
Heat Transfer

Pressure Boundary (Cont.)

- **Stack Effect**
  - ✓Warm air rises and leaves the home through the holes near the ceiling
  - ✓Cold air enters near the floor to replace it



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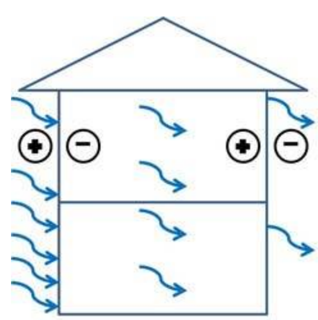
Heat Transfer

Pressure Boundary (Cont.)

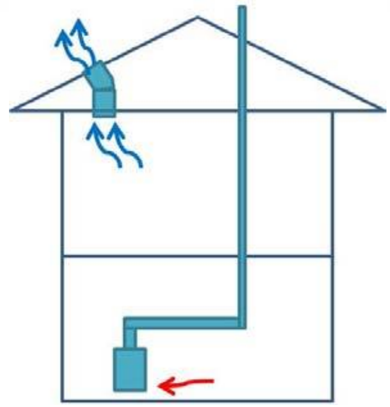
- **Wind Effect**
  - ✓Pressure builds up on the side of the house facing upwind
  - ✓Pressure is released through exfiltration on the side of house facing downwind



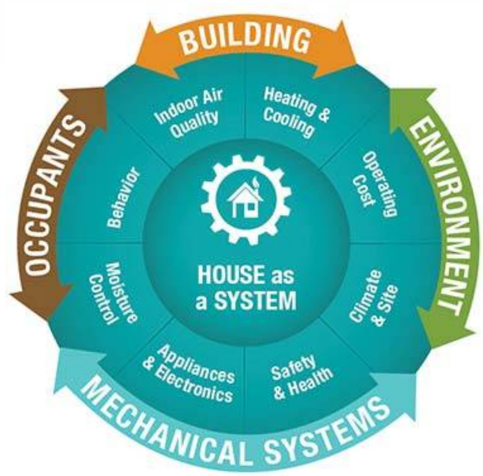
Heat Transfer

Pressure Boundary (Cont.)

- **Mechanical Effect**
  - ✓Not considered infiltration or exfiltration because it is controlled air movement



The House as a System



The House as a System

System

- A set of interacting or interdependent components forming an integrated whole

A system has

- A structure
- Behavior
- Interconnectivity

The House as a System

Components of a house:

- Building Envelope
- Space conditioning
- Lighting and Appliances
- Mechanical Ventilation
- Water Heating & Distribution
- The Occupants

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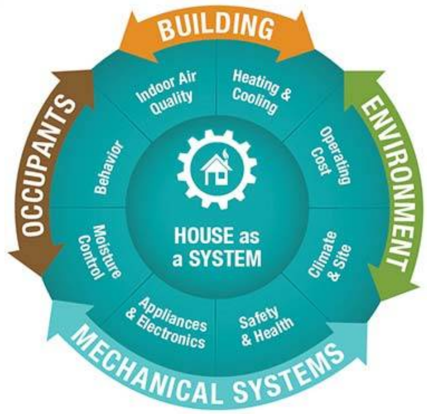
The House as a System

The house is a system made up of interdependent parts;

The operations of one part affects many others;

When all parts work together, the house is comfortable, safe, efficient, and durable;

A house will experience problems when its components do not work in unison.



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The House as a System

An attic without insulation…

…makes the heating and cooling system work harder than necessary

This will decrease the HVAC equipment's life and cause higher than necessary energy bills.

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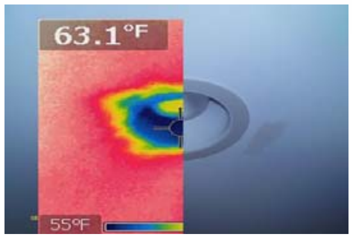
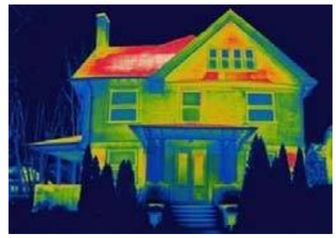
The House as a System





Leaky recessed lighting fixtures…

…increase heat loss and gain

Note the hot roof in the picture on the right. Hot air rising thru the leaks around the can light deposits in the attic.

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The House as a System

Mechanical ventilation not exhausting properly to the outdoors…

…causes moisture damage to the roof deck and trusses

Moisture will deposit and condense on the underside of the roof, casing it to rot over time.

The House as a System

Everything in the house interacts with one another:

- You can't insulate unless you air seal;
- You can't air seal unless you insulate;
- You can't air seal unless you have combustion air;
- You have to test for combustion air after you air seal.

The House as a System

When the house does not work as a system, problems will occur

- Insulating and venting the attic without air sealing could damage the roof;
- Air sealing without insulation could cause moisture problems;
- Air sealing and insulating without attention to the HVAC ducts will not reduce duct leakage;
- Air sealing without combustion safety testing will cause a hazardous, and potentially fatal situation for the residents. Not knowing the status of the airtightness of a house in relation to the combustion appliances present, it's a danger on it's own.

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The House as a System

Insulating and venting an attic without air sealing…

…could cause moisture damage on the roof

The hot air rising from the house will condense and potentially freeze on the underside of the roof, causing damage to the roof and allow moisture to fall back on the insulation and below.

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The House as a System

Air sealing without insulating…

…could cause moisture damage

Heat transfer will cause condensation to build within the walls once the outside air touches inside surfaces (or vice versa), thus causing moisture to form in the wall cavity and on the walls.

The House as a System

Air sealing and insulating without attention to the HVAC…

…will not reduce duct leakage

Improving the thermal and pressure boundaries of a home will not solve the energy loss associated with the leakage of the HVAC ducts and the moisture problems associated with it.

The House as a System

Air sealing without combustion safety testing…

…can potentially kill someone

Air sealing may cause a combustion appliance not to vent properly, thus causing back drafting and forcing CO inside the house rather than letting it flow outside.

The House as a System

Carbon Monoxide (CO)

- Colorless, odorless, tasteless gas
- Highly toxic
- Byproduct of improper combustion
- Can cause a range of symptoms depending on exposure levels, from headaches to death.

Building Science & Energy Efficiency

Building Science & Energy Efficiency

Energy inefficiency can be divided into the following general categories:

- Heating and Cooling
- Air Leakages
- Water Heating
- Appliances and Lighting
- Residential Behavior

Building Science & Energy Efficiency

Typical residential buildings use 1.5 to 2 times more energy than necessary;

This is largely caused by a lack of insulation, infiltration, and improperly installed or inefficient heating and cooling systems;

This excess energy usage costs the U.S. about $45 billion annually.

Building Science & Energy Efficiency

Achieving maximum energy efficiency can be reached through the use of two methods:

- **Energy Efficiency Strategies**: using devices that draw less energy, often resulting in energy savings
- **Energy conservation Strategies**: changing individual habits to reduce energy use

Building Science & Energy Efficiency

Examples of Energy Efficiency strategies:

- Making thermal improvements to the building shell;
- Replacing older heating and cooling systems with newer more efficient ones;
- Installing smart strips to appliances;
- Replacing incandescent light bulbs with CFLs or LEDs.

Building Science & Energy Efficiency

Examples of Energy Conservation strategies:

- Unplugging appliances when not in use;
- Do not cook during the heat of the day;
- Use clothes lines instead of dryers;
- Programming the thermostat.

Building Science & Human Comfort

Building Science & Human Comfort

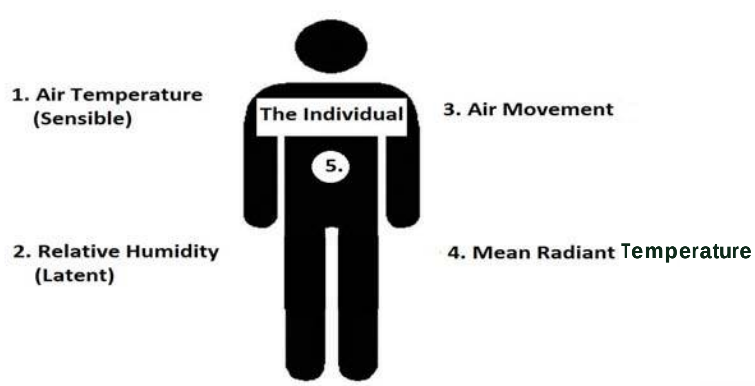
Sensible Heat Vs. Latent Heat

- **Sensible Heat**: Heat that causes a change in temperature in an object
- **Latent Heat**: Heat that causes a change of state (solid to liquid, liquid to vapor) with no change in temperature

Basics of Building Science 47

Building Science & Human Comfort

Factors that determine personal comfort:



Basics of Building Science 48

Building Science & Human Comfort

Air Temperature

- The measure of how hot or cold the air is;
- It described the kinetic energy of the gases that make up air;
- As the temperature increases, air molecules move more quickly.

Building Science & Human Comfort

Relative Humidity

- The ratio of amount of water in the air relative to the amount of water the air can hold at it’s current temperature;
- Warm air can carry more moisture than cold air, because it becomes less dense when heated;
- 100% relative humidity is completely saturated air;
- Healthy levels are between 40-60%.

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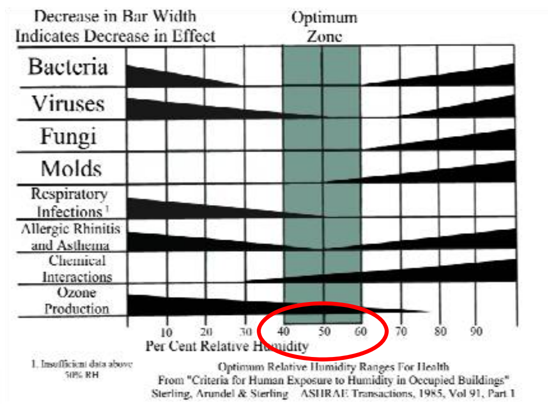
Building Science & Human Comfort

Relative Humidity (Cont.)

- Health implications of relative humidity



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Building Science & Human Comfort

Relative Humidity (Cont.)

- Perceived Temperature due to relative humidity

Relative Humidity	Air Temperature 70°F	75°F	80°F	85°F	90°F	95°F	100°F
0%	64°	69°	73°	78°	83	87°	91°
10%	65°	70°	75°	80°	85°	90°	95°
20%	66°	72°	77°	82°	87°	93°	99°
30%	67°	73°	78°	84°	90°	96°	104°
40%	68°	74°	79°	86°	93°	101°	110°
50%	69°	75°	81°	88°	96°	107°	120°
60%	70°	76°	82°	90°	100°	114°	132°
70%	70°	77°	85°	93°	106°	124°	144°
80%	71°	78°	86°	97°	113°	136°	
90%	71°	79°	88°	102°	122°		
100%	72°	80°	91°	108°			

Building Science & Human Comfort

Air Movement

- Can increase heat loss without any change in temperature
  - ✓Increases personal convective heat losses
  - ✓In moderately humid environments (30-80% RH), it will also accelerate the evaporation of sweat

Building Science & Human Comfort

Mean Radiant Temperature (MRT)

- The measure of the average temperature of all the objects in a space, including the walls, windows, furniture, and people;
- Critical to human comfort because our bodies radiate heat out toward cold surrounding surfaces and receive heat from hot surrounding surfaces;
- 1 degree change in MRT is approximately 1.5 degrees change in Air Temperature.

Building Science & Human Comfort

The Individual

- The individual will have an effect on his own comfort based on:
  - ✓Physical condition
  - ✓Level of activity and lifestyle
  - ✓Age
  - ✓Metabolism
  - ✓Acclimation
  - ✓Gender

Training Sections

Section 1- Energy Basics

Section 2- Heat Transfer

Section 3- The House as a System

Section 4- Building Science & Energy Efficiency

Section 5- Building Science & Human Comfort

Overall Training Goal

Understand the basics of building science, its principles, application, and how it relates to residential construction.

QUESTIONS

C|H|E|E|R|S

Unmatched Service with Integrity

TITLE 24 OVERVIEW

Introduction
Legal Aspects
Basics of Building Science
Title 24 Overview
Rater & Job Saftey
Duct Leakage
Building Air Leakage
Forced Air System, Fan Watt & Efficacy
Refrigerant Charge

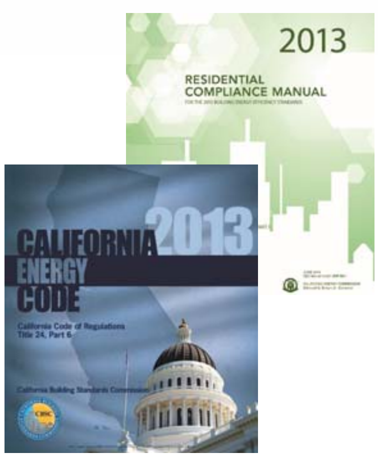
C|H|E|E|R|S
Unmatched Service with Integrity

2013 HERS I Training

Title 24 Overview

C|H|E|E|R|S

References



- California 2013 Residential Compliance Manual
  - Found at: http://www.energy.ca.gov/title24/2013standards/residential_manual.html
- California Building Standards Code Part 6
  - Found at: http://www.ecodes.biz/ecodes_support/Free_Resources/2013California/13Energy/13Energy_main.html

Title 24 Overview 2

Overall Training Goal

Gain a broad understanding of the California Title 24 code, and how it interacts with national standards, other State codes and local jurisdictions.

Training Sections

Section 1- Methods of Compliance
Section 2- Compliance Documentation
Section 3- HERS Diagnostic Inspections
Section 4- Fenestration
Section 5- Insulation and Roofing
Section 6- IAQ & Mechanical Ventilation
Section 7- Water Heating & Distribution
Section 8- Swimming Pools & Spa Heating
Section 9- Lighting
Section 10- Space Conditioning

CHEERS

Introduction

2013, T24 Energy Code:

- Effective on any permit applied for on 1 July 2014 or thereafter;
- Approximately 27% more stringent than previous code State wide;
- The cost impact over 2008/2010 T24 is an average of \$3,479 SF & \$2,569 MF using the performance approach;
- New NAECA standards for HVAC were made effective 1 January 2015.

CHEERS

Key Definitions

AER	Appliance Efficiency Standards
ASHRAE:	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CEC:	California Energy Commission
Energy Budget:	Estimated annual energy use (kTDV/sf/yr.)
Energy Credit:	Energy trade-off for more efficient features
HERS:	Home Energy Rating System
NAECA:	National Appliance Efficiency Conservation Act
TDV:	Time Dependent Valuation
T-24:	California Building Standards Code
T-24, Part 6:	California Building Energy Efficiency Standards

CHEERS

Methods of Compliance

CHEERS

Methods of Compliance

There are two approved methods of T24 compliance in California:

- **Prescriptive Method**: T24 is achieved by following pre-set T24 specifications and mandatory requirements, based on the climate zone that you're building in;
- **Performance Method**: T24 is achieved by having a T24 energy analyst demonstrate a project's T24 energy compliance by analyzing the building using CEC-approved T24 software.

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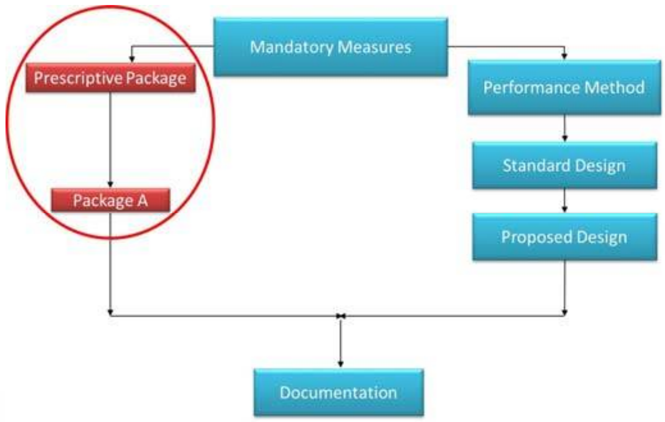
Methods of Compliance

Prescriptive Package A:



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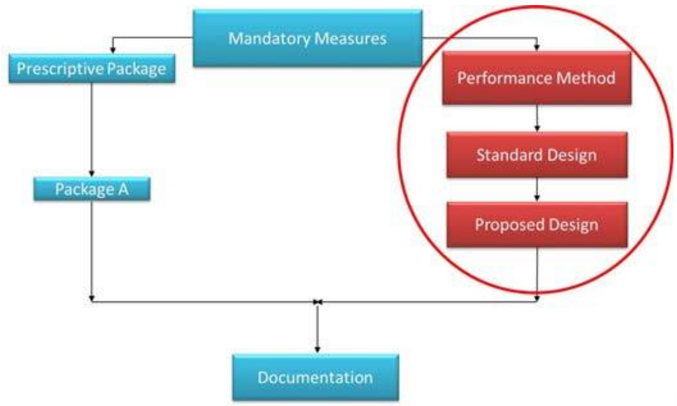
Methods of Compliance

Prescriptive Package A (Cont.):

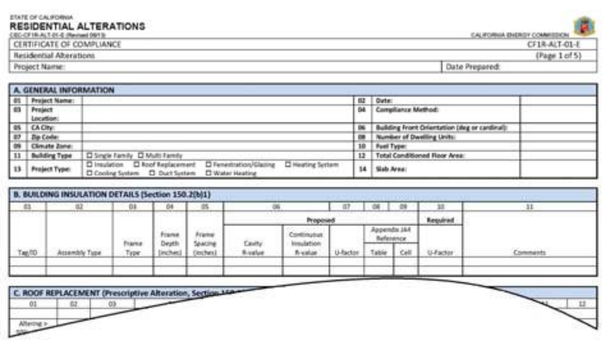
Building Envelope	Climate Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Insulation[1] Roofs /Ceilings U / R-Value	U 0.025 /R38	U 0.031/R 30									U 0.025 /R 38					
Walls Above Grade 2x4 Framed	U 0.065 /R 13+4/ or R 13+5															
Walls Above Grade Mass Wall Interior[2]	U 0.070 /R 13															U 0.059 /R 17
Walls Above Grade Mass Wall Exterior[2]	U 0.125 /R 8.0															U 0.070 /R 13
Walls Below Grade Below Grade Interior[3]	U 0.070 /R 13															U 0.066 /R 13
Walls Below Grade Below Grade Exterior[3]	U 0.200 /R 5.0													U 0.100 /R 10		U 0.053 /R 19
Floors Slab Perimeter	NR															U 0.58 /R 7
Floors Raised	U 0.037 /R 19															
Floors Concrete Raised	U 0.092 R 8.0		U 0.269 /R 0.0								U 0.092 /R 8.0	U 0.138 /R 4.0	U 0.092 /R 8.0	U 0.092 /R 8.0	U 0.138 /R 4.0	U 0.092 /R 8.0
Radiant Barrier	NR	REQ														NR

Methods of Compliance

Performance Method:



Compliance Documentation



STATE OF CALIFORNIA
RESIDENTIAL ALTERATIONS
CEC-CF1R-ALT-01-E (Revised 09/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Residential Alterations	(Page 1 of 5)
Project Name:	Date Prepared:

A. GENERAL INFORMATION

01	Project Name:		02	Date:	
03	Project Location:		04	Compliance Method:	
05	CA City:		06	Building Front Orientation (deg or cardinal):	
07	Zip Code:		08	Number of Dwelling Units:	
09	Climate Zone:		10	Fuel Type:	
11	Building Type	☐ Single Family ☐ Multi Family	12	Total Conditioned Floor Area:	
13	Project Type:	☐ Insulation ☐ Roof Replacement ☐ Fenestration/Glazing ☐ Heating System ☐ Cooling System ☐ Duct System ☐ Water Heating	14	Slab Area:	

B. BUILDING INSULATION DETAILS (Section 150.2(b)1)

01	02	03	04	05	06		07	08	09	10	11
					Proposed					Required	
								Appendix JA4 Reference			
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-factor	Table	Cell	U-Factor	Comments

C. ROOF REPLACEMENT (Prescriptive Alteration, Section 150...

01	02	03	...	12
Altering > ...				

Compliance Documentation

The compliance documentation and its process is a requirement to receive a building final;

A building inspector cannot issue a certificate of occupancy unless all necessary compliance documents (CF1R, CF2R, CF3R) have been completed;

Electronic registration of the forms is only required when HERS measures are required;

All permits requiring HERS inspections will require all forms to be processed electronically thru the registries.

Compliance Documentation

Forms:

- **CF1Rs- Certificates of Compliance**
- **CF2Rs- Certificates of Installation**
- **CF3Rs- Certificates of Verification**

CHEERS

Compliance Documentation

Forms (Cont.):

- **CF1Rs- Certificates of Compliance**:
  - ✓Documents what will need to be done in order to comply with the Building Energy Efficiency Standards, by summarizing what HERS verifications are required and the targets for those verifications;
  - ✓Generated at the beginning of the process and submitted as part of the permit application;
  - ✓Typically generated by an energy consultant, but certified electronically by the builder in the registry;

CHEERS

Compliance Documentation

Forms (Cont.): CF1R-PRF-NCB-01

Compliance Documentation

Forms (Cont.):

- **CF2Rs- Certificates of Installation**
  - ✓Documents what the installing contractor did to comply with the Building Energy Efficiency Standards and requirements of the CF1R;
  - ✓Completed by the installing contractor when the work has been completed;

  Note: there are CF2Rs required even when there are no HERS verifications

  - ✓In some cases it may be completed by the HERS Rater on behalf of the installer, but still needs to be signed by the Installer.

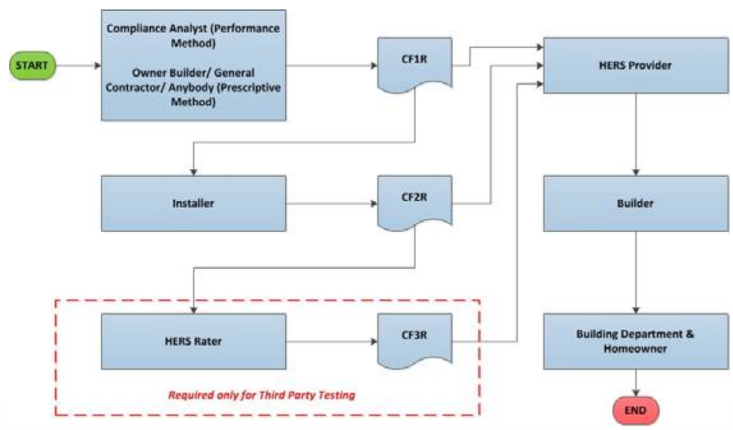
Compliance Documentation

Forms (Cont.):

- **CF3Rs- Certificates of Field Verification (FV) and Diagnostic Testing (DT)**
  - ✓HERS Rater certification that the tested energy features match or exceed the requirements of the CF1R;
  - ✓After a CF2R is completed, results of the field verifications are entered by the Rater in the registry and a CF3R is published;
  - ✓If sampling is used, a CF3R is still produced for all lots, tested or sampled.

Compliance Documentation

Documentation Process with HERS Measures:



Compliance Documentation

California approved HERS providers' registries:

- CHEERS
- CalCERTS
- USERA
  (Formerly CBPCA)

HERS Diagnostic Inspections

HERS Diagnostic Inspections

Features which require HERS Verification

- **Mandatory Measures**
  - ✓Duct Leakage;
  - ✓Fan Watt Draw & Cooling Coil Airflow;
  - ✓Air Filter Device Design;
  - ✓Return Duct Design;
  - ✓Verification of Bypass Duct Requirements;
  - ✓Whole Building Mechanical Ventilation.
- **Prescriptive Measures**
  - ✓Refrigerant Charge Measurement (RCM).

CHEERS

HERS Diagnostic Inspections

Features which require HERS Verification (Cont.)

- **Performance Compliance Options**
  - ✓Quality Insulation Installation (QII);
  - ✓Supply Duct Location, Surface Area and R-Value;
  - ✓Verified Duct System Design;
  - ✓Hot Water Pipe Insulation;
  - ✓Pipe Insulation Credit;
  - ✓Central Parallel Piping;
  - ✓Compact Hot Water Distribution System;

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CHEERS

HERS Diagnostic Inspections

Features which require HERS Verification (Cont.)

- **Performance Compliance Options (Cont.)**
  - ✓Point of use water heating;
  - ✓Water heating recirculation systems;
  - ✓Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER);
  - ✓Low Leakage Air Handler;
  - ✓Building air leakage;
  - ✓Photovoltaic systems;
  - ✓Existing conditions for performance alterations.

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HERS Diagnostic Inspections

HERS Sampling Process:

- Sampling is a process by which a HERS Rater randomly selects one dwelling unit from a group of up to seven dwelling units;
- If that unit passed , then the whole group is assumed to pass;
- The assumption is that if one home passes, the other ones should be built to the same standards and should also pass.
- If homes cannot meet sampling requirements, the HERS Raters will have to test 100% of the homes in the sampling group.

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Model/ Plan Testing
  - ✓100% of models/ plans have to be tested individually;
  - ✓Homes can be considered the same model/ plan if they have:
    - The same basic layout or floor plan;
    - The same energy design;
    - The same compliance features.
  - ✓Allows the builder to identify and correct any potential construction flaws or practices in the build out of each model/ plan.

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Allowed When
  - ✓All homes in the group are built within the same subdivision;
  - ✓All homes in the group have the same installing subcontractor;
  - ✓All homes in the group have the same associated HERS measures.

Note: *Homes with CFI systems (later discussed) shall be grouped separately from homes without CFI systems.*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Selecting groups:

Procedure	Open	Closed
Sampling Rate	1 tested home in a group of up to 5 homes	1 tested home in a group of up to 7 homes
Required Before Testing	CF-1R and CF-2R for home to be tested	ALL CF-1Rs and CF-2Rs for homes in sampling group
Group is Closed	180 days after first CF-2R is submitted	when HERS inspections begin

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Changing installing subcontractors mid-project:
  - ✓ If a subcontractor changes, the builder must notify the Rater and all sampling of the features the former subcontractor was responsible for must be closed.
  - ✓ Remaining homes completed by the former subcontractor are either tested or placed into a new group.
  - ✓ All model testing and sampling starts over with the new subcontractor.

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- General calculation process for sampling:
  1. Subtract number of individually tested models/plans from total number of homes
  2. Divide remaining number of homes by the sampling group size (5 or 7, open or closed)
  3. To the result of Step 2, add the number of individually tested models/ plans you originally subtracted in Step 1
  4. Round up

**The resulting number will be the total number of homes you will need to test in order to certify the whole project*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 1- Single Family:

- All homes have the same HERS Measures
- 40 Homes Total in the Project
- 4 different Models/ Plans
- Using the open sampling method

** Because all homes have the same HERS measures we will be able to group all homes together*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 1- Single Family (Cont.):

1. Subtract the individually 4 tested models/ plans from the total amount of 40= 36
2. Divide 36 by 5 because we are using the open sampling methods= 7.2
3. Add to our result from Step 2, 7.2, the number of models/ plans, 4, we originally subtracted in Step 1= 11.2
4. Round up= 12

** In order to certify the whole project we will need to test 12 homes in total*

HERS Diagnostic Inspections

CHEERS

HERS Sampling Process (Cont.):

Example 2- Single Family:

- Different models/ plans have different combinations of HERS Measures
- Plan 1; 20 units in the project
- Plan 2; 10 units in the project
- Plan 3; 17 units in the project
- Using the closed sampling method

** Because all homes **do not** have the same HERS measures we will have to group each plan type separately*

HERS Diagnostic Inspections

CHEERS

HERS Sampling Process (Cont.):

Example 2- Single Family (Cont.):

1. Subtract 1 lot as the individually tested model/ plan from each plan type=
   - Plan 1; 19
   - Plan 2; 9
   - Plan 3; 16
2. Divide each lot count by 7 because we are using the closed sampling method=
   - Plan 1; 2.7
   - Plan 2; 1.2
   - Plan 3; 2.2

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 2- Single Family(Cont.):

3. Add to each result from Step 2, the one model/ plan we originally subtracted in Step 1=
   - Plan 1; 3.7
   - Plan 2; 2.2
   - Plan 3; 3.2
4. Round up=
   - Plan 1; 4
   - Plan 2; 3
   - Plan 3; 4

Add these numbers together

** In order to certify the whole project we will need to test 11 homes in total*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Rules for multifamily sampling are the same as single family;
- Multifamily testing works in the same manner as single family except for:
  - ✓ You will test 100% of each tested building (all units in the building) and sample whole buildings rather than individual units;

OR

  - ✓ You will break down each tested building into an individual dwelling count and test similarly to single family.

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 1- Multifamily:

- All buildings/ individual units have the same HERS Measures
- 7 Buildings Total in the Project
- 2 building Models/ Plans
- Using the open sampling method
- Testing the project as **whole buildings**

** Because all buildings have the same HERS measures we will be able to group all homes together*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 1- Multifamily (Cont.):

1. Subtract the individually tested 2 buildings models/ plans from the total amount of 7= 5
2. Divide 5 by 5 because we are using the open sampling methods= 1
3. Add to our result from Step 2, 1, the number of buildings models/ plans, 2, we originally subtracted in Step 1= 3
4. Round up= (N/A) 3 **whole buildings**

** In order to certify the whole project we will need to test 3 whole buildings in total*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 2- Multifamily:

- All buildings have the same HERS measures
- 5 unique dwelling model/ plan types
- 300 units in the whole multifamily project
- Using the closed sampling method
- Testing the project as **individual units**

** Because all individual dwellings have the same HERS measures we will be able to group all dwellings together*

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

Example 2- Multifamily (Cont.):

1. Subtract the individually tested 5 dwellings models/ plans from the total amount of 300= 295
2. Divide 295 by 7 because we are using the closed sampling methods= 42.1
3. Add to our result from Step 2, 42.1, the number of dwellings models/ plans, 5, we originally subtracted in Step 1= 47.1
4. Round up= 48 **individual units**

** In order to certify the whole project we will need to test 48 individual dwellings in total*

HERS Diagnostic Inspections

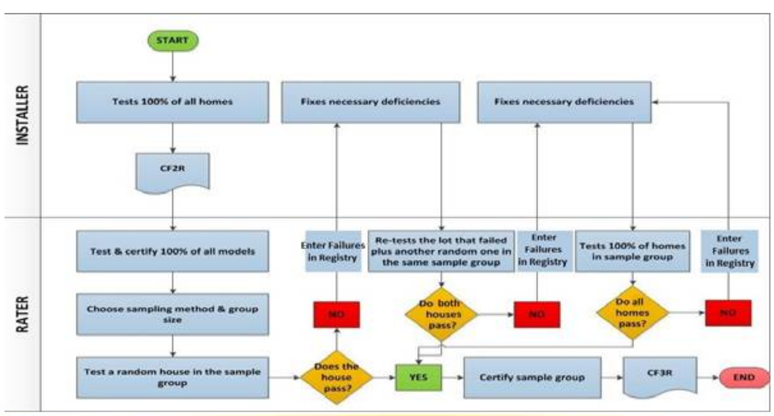
HERS Sampling Process (Cont.):

- Complete the additional learning activity to gain additional practice and experience with sampling calculations.

HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Pass/ Fail Protocols



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HERS Diagnostic Inspections

HERS Sampling Process (Cont.):

- Pass/ Fail Protocols(Cont.)
  - ✓ A HERS verification fails when it does not meet compliance with targets found on the CF1R;
  - ✓ All failures have to be reported in the registry;
  - ✓ If one house fails, a second one in the same group is tested;
  - ✓ If the second house tested in group fails, the Rater has to conduct 100% testing of the group;
  - ✓ Builder may elect to modify the CF1R and go thru the permit application process again to remove non-mandatory HERS verifications.

Title 24 Overview 43

CHEERS

Fenestration

Title 24 Overview 44

Fenestration

Windows, glazed doors, dynamic glazing, skylights and window film have a significant impact on energy use in a home;

They may account for up to 50 percent of residential space heating loads, and for homes that are air conditioned, up to 50 percent of the cooling load;

The size, orientation, and types of fenestration products can dramatically affect the overall energy performance of a house.

Fenestration

Different types of fenestration products:

1. Manufactured products
2. Site-built products
3. Field fabricated products

Fenestration

Different types of fenestration products (Cont.):

1. Manufactured products
   - ✓ Delivered pre-assembled from the factory;
   - ✓ This is the most common type of fenestration in residential construction.

Fenestration

Different types of fenestration products (Cont.):

2. Site-built products:
   - ✓ Glazed or assembled on site using factory prepared systems;
   - ✓ More common in nonresidential construction and include storefront and curtain wall systems;
   - ✓ The glazing contractor may also pre-assemble site-built fenestration at his or her shop before final installation.

CHEERS

Fenestration

Different types of fenestration products (Cont.):

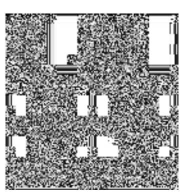
3. Field fabricated products:
   - ✓ Built on site using standard dimensional lumber or other materials not intentionally prepared for use as a fenestration product.

CHEERS

Fenestration

Labeling Requirements:

- Standards require windows to have both a temporary and permanent label that shows the NFRC performance values



Temporary Label

Permanent Label

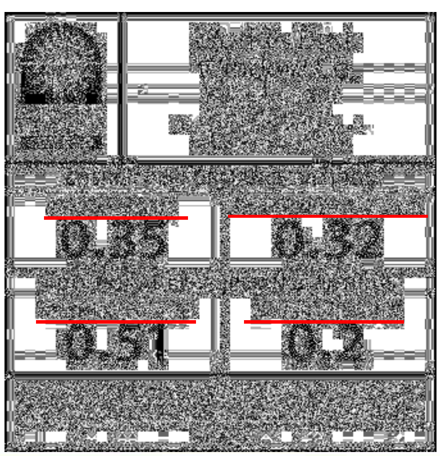
Fenestration

Labeling Requirements (Cont.):

- Both labels are required for manufactured products;
- Both labels are required for site-built products, but a label certificate can replace the temporary label;
- Temporary labels should not be removed until after inspection by the enforcement agency;
- Labels are not required for field fabricated products.

Fenestration

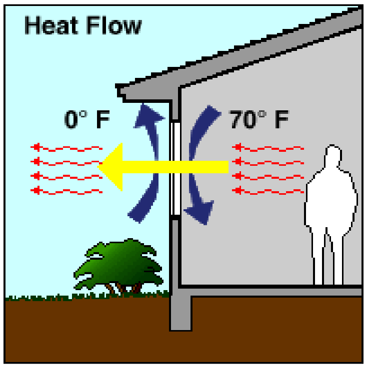
Performance Values:



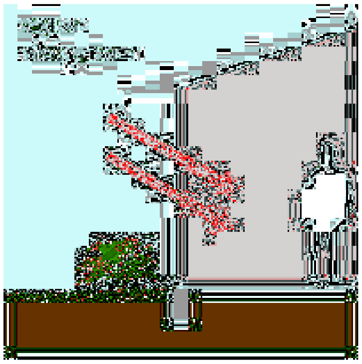
Fenestration

Performance Values (Cont.):

- **U-Factor**: measures the rate of heat loss through a product
  - ✓The lower the U-factor, the lower the amount of heat loss



Fenestration



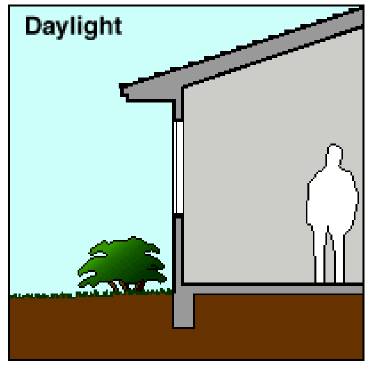
Performance Values (Cont.):

- **Solar Heat Gain Coefficient (SHGC)**: measures the rate of heat gain from solar energy passing through a product
  - ✓The lower the SHGC, the less amount of solar heat gain

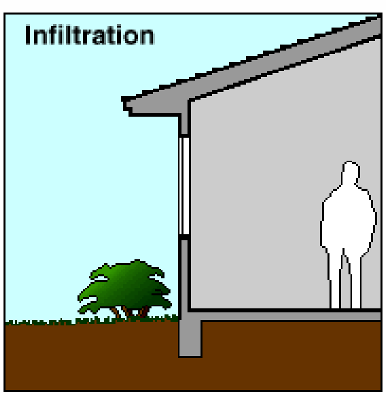
Fenestration

Performance Values (Cont.):

- **Visible Transmittance (VT)**: measures the amount of light that comes through a product
  - ✓ The higher the VT rating, the more light is allowed through a window or door



Fenestration



Performance Values (Cont.):

- **Air Leakage**: amount of uncontrolled air movement thru the casing of a window
  - ✓ The higher the rating, the more air leakage exists;
  - ✓ The prescribed standard is < 0.3 cfm/ft^2 of window surface area.

Fenestration

Mandatory Requirements:

Climate Zone	All
Maximum U-factor	

Fenestration

Prescriptive Requirements:

Climate Zone	3	
Maximum U-factor	3	3
Maximum SHGC	NR	
Maximum Fenestration Area		
Maximum West-Facing Fenestration	NR	

Fenestration

Prescriptive Requirements (Cont.):

- Exterior Doors:
  - ✓Any door that is more than one-half glass is considered a glazed door and must comply with the mandatory and prescriptive measures and other standards requirements that apply;
  - ✓Doors with less than 50% glass area, up to 3 ft^2, are exempt from U-Factor and SHGC requirements;
  - ✓Must meet same air leakage rates as windows (0.3 cfm/ft^2 of door area.)

Fenestration

Improved window performance:

1. Advanced window design
2. Dynamic Glazing
3. Chromatic Glazing
4. Window Film
5. Shading Devices

Fenestration

Dynamic Glazing:

- Dynamic Glazing products are either internal shading system or electro chromatic devices and are considered a fenestration product;
- Internal shading systems include blinds positioned between glass panes that can open and close;
- The labels for internal shading systems will reflect the endpoints of the product's performance for U-factor and SHGC ratings only.

Title 24 Overview 61

Fenestration

Dynamic Glazing (Cont.):

Title 24 Overview 62

Fenestration

Chromatic Glazing:

- Chromatic type fenestration have the ability to change its performance properties;
- The occupant can control manually or automatically their environment by tinting or darkening a window with the flip of a switch;
- Some windows and doors can change their performance automatically in response to a control or environmental signal;
- Sometime referred to as “Smart Windows.”

Title 24 Overview 63

Fenestration

Chromatic Glazing (Cont.):

Title 24 Overview 64

Fenestration

Window Film:

- There are 3 basic categories:
  1. Clear (Non-Reflective)
  2. Dyed (Non-Reflective)
  3. Vacuum Coated (Reflective)

Fenestration

Window Film (Cont.):

1. Clear (Non-Reflective):
   - ✓Clear films are used as safety films and to reduce ultraviolet (UV) light fading damaging rays;
   - ✓They are not used for solar control or energy savings.

Fenestration

Window Film (Cont.):

2. Dyed (Non-Reflective):
   - ✓Dyed films reduce both heat and light transmission, mostly through increased Absorptance;
   - ✓Can be used in applications where glare control is desired.

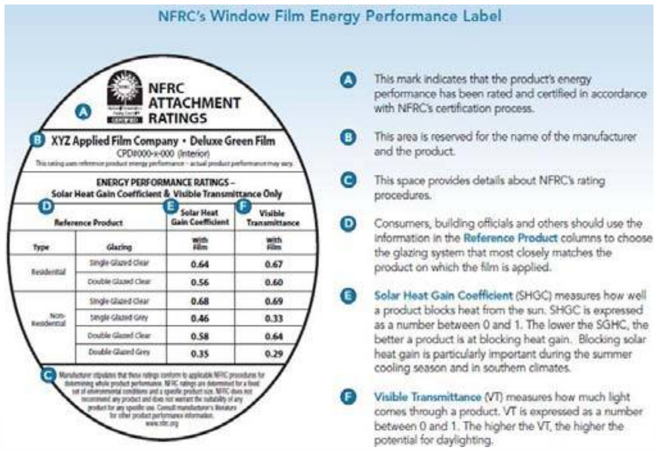
Fenestration

Window Film (Cont.):

3. Vacuum Coated (Reflective)
   - ✓Can be metalized or sputtered;
   - ✓Reflective films are the preferred film in most energy savings;
   - ✓They reduce transmission through reflectance;
   - ✓Manufactured to selectively reflect heat more than visible light through various combinations of metals.

Fenestration

Window Film (Cont.):



Fenestration

Shading devices:

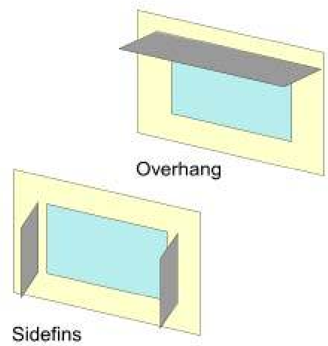
1. Fixed permanent shading
2. Exterior shading
3. Interior shading

CHEERS

Fenestration

Shading devices (Cont.):

1. Fixed Permanent shading:
   - ✓Offers compliance credit
   - ✓Shading devices that are part of the building designs
     - Overhangs
     - Cantilevers
     - Vertical fins



CHEERS

Fenestration

Shading devices (Cont.):

2. Exterior shading:
   - ✓Offers compliance credit
   - ✓Device has to be permanently attached

Exterior Shading Device	SHGC
Standard Bug (insect) Screen (default for windows)	0.76
Exterior Sunscreens with Weave 53 x 16/inch	0.30
Louvered Sunscreens w/Louvers as wide as Window Openings	0.27
Low Sun Angle Louvered Sunscreen	0.13
Vertical Roller Shades or retractable/Drop Arm/ Combination/Marquisette and Operable Awnings	0.13
Roll Down Blinds or Slats	0.13
None (for skylights only)	1.00

CHEERS

Fenestration

Shading devices (Cont.):

3. Interior shading
   - ✓Does not offer compliance credit;
   - ✓Still effective in reducing heat gains;
   - ✓The CEC considers interior shades in the category of home furnishings and not a feature of the house that is provided by the builder.

CHEERS

Fenestration

Advanced window design:

- Frame materials and configurations
- Number of panes of glazing
- Gap width between the panes
- Spacer materials
- Fill gases (Carbon Dioxide, Argon, Krypton)

Insulation & Roofing

Insulation & Roofing

Mandatory Measures:

- The following openings in the building envelope shall be caulked, gasketed, weather-stripped or otherwise sealed:
  - ✓Exterior joints between conditioned and unconditioned space;
  - ✓Openings for plumbing, electricity, and gas lines on exterior surfaces;
  - ✓Openings in the attic floor;
  - ✓Openings around exhaust ducts;

Insulation & Roofing

Mandatory Measures (Cont.):

- ✓Weather-stripping is required for all field fabricated operable windows and doors.
  - This includes doors between the garage and living space, and doors for HVAC closets and attic accesses in the living space
- ✓All other such openings in the building envelope
- Continuous stucco can be used as an alternative technique to meet mandatory caulking and sealing requirements

Insulation & Roofing

Mandatory Measures (Cont.):

- Exposed faced mineral fiber and mineral aggregate insulations use fire retardant facings certified not to exceed a flame spread of 25 and a smoke development rating of 45.

Insulation & Roofing

CHEERS

Wall Insulation:

Prescriptive Values

Insulation & Roofing

CHEERS

Wall Insulation (Cont.):

- Mandatory Min. R-13 in 2x4 walls;
- Mandatory Min. R-19 in 2x6 walls.

✓Both of these minimums do not apply to framed walls of conditioned basements/crawlspaces that are below grade;

AND

✓Rim joists between stories are allowed to have R13, regardless of wall size.

Insulation & Roofing

CHEERS

Wall Insulation (Cont.):

- Different values are used to meet the criteria for metal frame assemblies and mass walls;
  - ✓These separate criteria can be found in the Reference Joint Appendix JA4
- Batt and loose fill insulation should fill the wall cavity evenly;
- Insulation should extend into the perimeter floor joist cavities along the same plane as the wall.

Insulation & Roofing

CHEERS

Wall Insulation (Cont.):

- If a vapor retarder is required, It must be installed on the conditioned space side of the framing;
- The R-Value of the installed insulation should meet or exceed the values found in the CF1R.

Insulation & Roofing

Floor Insulation:

Prescriptive Values

Insulation & Roofing

Floor Insulation (Cont.):

- Mandatory minimum R-19;
- Different types of raised floors (basements, crawlspaces, etc.) have different insulation requirements;
  - ✓These separate requirements can be found in Reference Joint Appendix JA4

Insulation & Roofing

Floor Insulation (Cont.)

- Slab Insulation
  - ✓Prescriptively, R-7 slab insulation is required in CZ 16 - While not a Mandatory Measure, there is a product suitability requirement that can be found in Ch3 of the residential manual, section 3.1.22.
  - ✓When slab edge insulation is required by the prescriptive or performance approach, the minimum depth is 16 inch or to the top of the footing, whichever is less.

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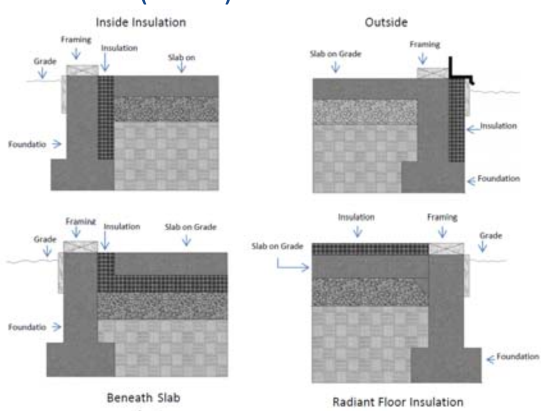
Insulation & Roofing

Floor Insulation (Cont.)

- Slab Insulation (Cont.)



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CHEERS

Insulation & Roofing

Floor Insulation (Cont.)

- Heated Slab Insulation
  - ✓ Radiant floor systems in concrete slabs must have insulation between the heated portion of the slab and the outdoors.

Location of Insulation	Orientation of Insulation	Installation Criteria	Climate Zone	Insulation R-value
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater? Insulation may stop at the top of the footing where this is less than the required depth. For below-grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or frost line, whichever is greater.	1-15	5
			16	10
Between heated slab and outside foundation wall	Vertical and Horizontal	Vertical insulation from the top of the slab at the inside edge of the outside wall down to the top of the horizontal insulation. Horizontal insulation from the outside edge of the vertical insulation extending 4 feet toward the center of the slab in a direction normal to the outside of the building in the plan view.	1-15	5
			16	10 vertical and 7 horizontal

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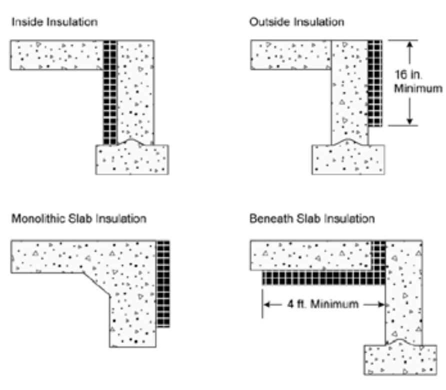
Insulation & Roofing

Floor Insulation (Cont.)

- Heated Slab Insulation (Cont.)



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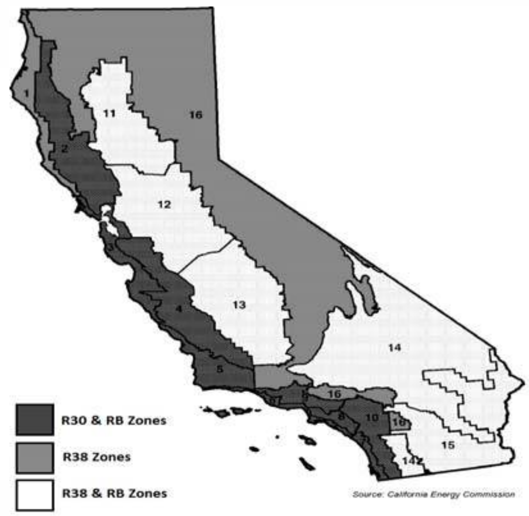
Insulation & Roofing

Ceiling & Roof
Insulation:
Prescriptive Values



CHEERS

Insulation & Roofing

Ceiling & Roof Insulation (Cont.):

- Mandatory minimum R30 for wood framed roofs
  - ✓Different standards for metal roof and other roof assemblies found in Reference Joint Appendix JA4
- There are 3 ways to meet the prescriptive requirements:
  1. Meet minimum prescriptive insulation standards;
  2. Use a different roof assembly found in JA4;
  3. Use the Energy Commission's EZ-Frame assembly calculator.

Insulation & Roofing

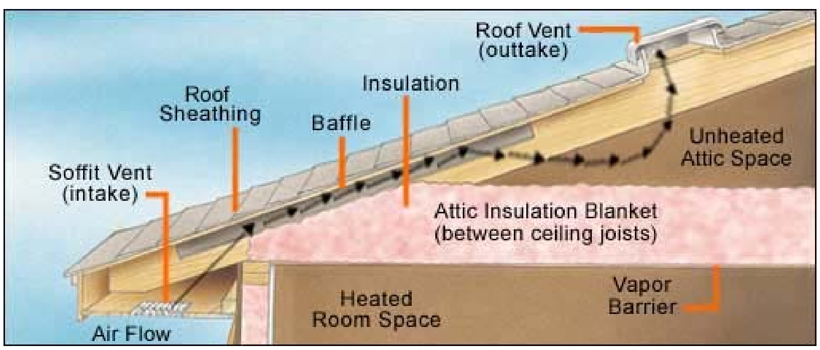
Ceiling & Roof Insulation (Cont.):

- Ceiling insulation should extend far enough to the outside walls to cover the bottom chord of the truss;
- Loose fill insulation must be blown evenly;
  - ✓It also needs to meet the specified weight per Ft2 for the corresponding R-Value for (fiberglass and mineral fiber only)
- Insulation should not block eave vents.
  - ✓Use baffles to keep vents unobstructed

Insulation & Roofing

Ceiling & Roof Insulation (Cont.):

- Example of Eave Vent Baffle Installation



Insulation & Roofing

Ceiling & Roof Insulation (Cont.):

- Types of Baffles

Insulation & Roofing

Ceiling & Roof Insulation (Cont.)

- Attic Ventilation
  - ✓ The California Building Code (CBC) requires a minimum vent area to be provided in roofs with attics, including enclosed rafter roofs creating cathedral or vaulted ceilings.
  - ✓ Attic ventilation, particularly in hotter climate zones, can provide an energy benefit. However, no energy credit is allowed for reducing the ventilation area below building code requirements.

Insulation & Roofing

Ceiling & Roof Insulation (Cont.)

- Attic Ventilation (Cont.)
  - ✓ Check with the local building jurisdiction to determine which of the two CBC ventilation requirements are to be followed:
    1. The net free ventilating area shall not be less than 1/150 of the area of the space ventilated;

OR

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Insulation & Roofing

Ceiling & Roof Insulation (Cont.)

- Attic Ventilation (Cont.)
  - ✓ Check with the local building jurisdiction to determine which of the two CBC ventilation requirements are to be followed (Cont.):
    2. This ratio may be reduced to 1/300 if:
       - ✓ A Class I or II vapor barrier is installed on the warm-in-winter side of the ceiling;

         OR
       - ✓ Between 50% and 80% of the total net free area in ventilators are installed at least 3 feet (914 mm) above the eave or cornice vents with the balance of the required ventilation provided by eave or cornice vents.

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Insulation & Roofing

Ceiling & Roof Insulation (Cont.)

- Attic Ventilation (Cont.)
  - ✓ In either situation, a minimum of 50% of the vents must be located in the upper portion of the space being ventilated at least 3 feet above eave or cornice vents.
  - ✓ Ventilated openings are covered with corrosion resistant wire cloth screening or similar mesh material.
  - ✓ When part of the vent area is blocked by meshes or louvers, the resulting "net free area" of the vent must be considered when meeting ventilation requirements.

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Insulation & Roofing

Ceiling & Roof Insulation (Cont.)

- Attic Ventilation (Cont.)
  - ✓ Different standards for ventilating solid rafter spaces:
    - Each framing cavity requires its own vent opening;
    - Different materials will call for different approaches;
    - At the discretion of the local building official.

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Insulation & Roofing

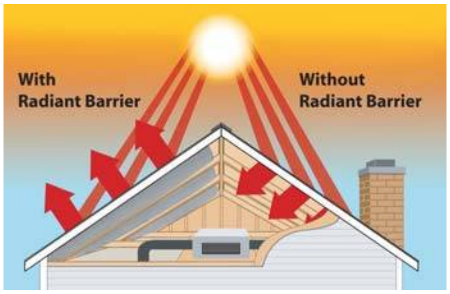
Additional insulation requirements are present for:

- Quality Insulation Installation (QII)
- Sprayed insulation
- Metal Framing
- Log Homes
- Straw Bale construction
- Structural Insulated Panels (SIPs)
- Insulating Concrete Forms (ICF)

Insulation & Roofing

Radiant Barrier:

- Prescriptively required in CZ 2-15;
- Reduce the radiant gain to air distribution ducts and insulation below the radiant barrier;
- Must meet installation criteria as specified in Residential Appendices RA4.2.2;
- Multiple variants of application.



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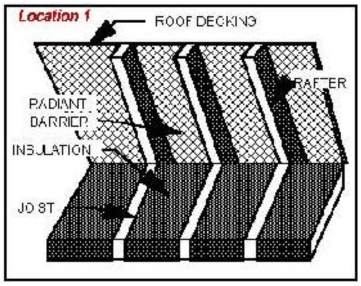
Insulation & Roofing

Radiant Barrier (Cont.):



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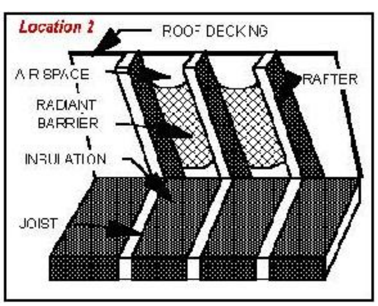
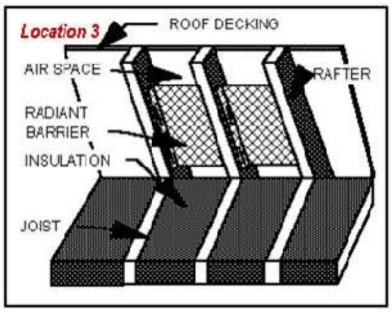
Insulation & Roofing

Radiant Barrier (Cont.):



Insulation & Roofing

Radiant Barrier (Cont.):



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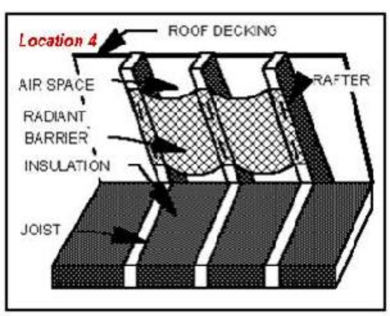
Insulation & Roofing

Radiant Barrier (Cont.):



Title 24 Overview 104

CHEERS

Insulation & Roofing

Cool Roofs:

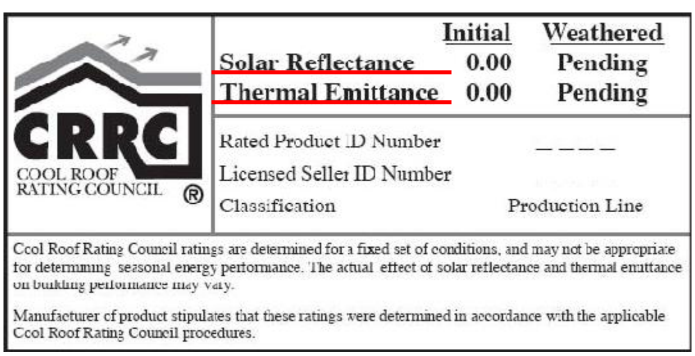
- Prescriptively required;
  - ✓Depends on the climate zone and the slope of the roof
- Two exceptions to the prescriptive requirements.
  - ✓The roof area has integrated PV panels
  - ✓Roof construction that has a thermal mass over the roof membrane with a weight of at least 25 lbs./ft2

CHEERS

Insulation & Roofing

Cool Roofs (Cont.):

- Products have to be listed in the Cool Roof Rating Councils (CRRC)directory and be labeled



CHEERS

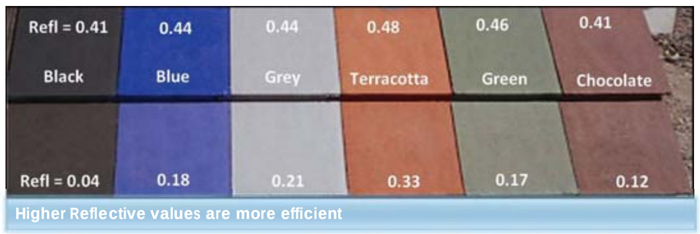
Insulation & Roofing

Cool Roofs (Cont.):

- Color VS. Performance

Cool Roofs

Regular Roofs



CHEERS

Insulation & Roofing

Solar Ready Requirement:

- Applies to:
  - ✓New single family residences in subdivisions with 10 or more residences;
  - ✓New low rise multifamily buildings;
  - ✓Projects or Subdivisions with tentative map approval after 1 January 2014.

Insulation & Roofing

CHEERS

Solar Ready Requirement (Cont.):

- Includes requirements for:
  - ✓Solar zone location
  - ✓Solar zone area
  - ✓Solar zone orientation
  - ✓Shading
  - ✓Electrical

Insulation & Roofing

CHEERS

Solar Ready Requirement (Cont.):

- **Solar zone location:**
  - ✓Roof of the building (SF, MF);
  - ✓Overhang of the building (SF, MF);
  - ✓Roof or overhang of other structure located within 250ft of primary building (MF);
  - ✓Covered parking installed within the project (MF);
  - ✓Trellises, Arbors, Patio Covers, Carports, Gazebos and similar accessory structures (MF).

Insulation & Roofing

Solar Ready Requirement (Cont.):

- **Solar zone area:**
  - ✓Must be clearly marked on the plans (SF, MF);
  - ✓May be comprised of multiple areas (SF);
  - ✓The total cannot be less than 250 ft^2 (SF);
  - ✓The total area cannot be less than 15% of the total roof area of the building after subtracting any skylights from the roof area (MF);
  - ✓Multiple exceptions are present in the code (SF, MF).

Insulation & Roofing

Solar Ready Requirement (Cont.):

- **Solar zone orientation**:
  - ✓If steep sloped roofs are used, they shall be oriented between 110 and 270 degrees of true north, for both SF & MF;
  - ✓For low sloped roofs, there are no orientation requirements.

Insulation & Roofing

Solar Ready Requirement (Cont.):

- **Shading:**
  - ✓The solar zone shall be free from roof penetrations and any obstructions;
  - ✓Each obstruction needs to be at a distance of at least two times it's height from the solar zone;
  - ✓Any obstruction oriented north of all points of the solar zone is not subject to these requirements;
  - ✓Any obstruction not located on the roof is not subject to these requirements.

Insulation & Roofing

Solar Ready Requirement (Cont.):

- **Electrical:**
  - ✓The following needs to be present on the construction plans:
    - A plan for the location of the inverters and metering equipment;
    - A pathway for routing conduit from the solar zone;
    - A pathway for routing plumbing for water heating.
  - ✓Single family residences need to have a main electrical service panel with a minimum busbar rating of 200 amps, and shall have a reserved, marked "For Future Solar Electric", space to allow installation of a double pole circuit breaker.

CHEERS

IAQ & Mechanical Ventilation

Title 24 Overview 115

CHEERS

IAQ & Mechanical Ventilation

The 2013 Standards include requirements for mandatory mechanical ventilation and for HERS verification of the installed performance of those ventilation systems.

California adopted ASHRAE 62.2-2010 an the Standard, with one exception. Although permitted by ASHRAE, California explicitly prohibits opening and closing windows as an acceptable option for providing whole-house ventilation.

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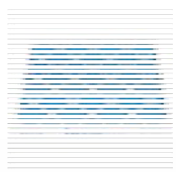
IAQ & Mechanical Ventilation

Additional General Requirements:

- The wall and openings between the house and the garage shall be sealed;
- Supply mechanical systems shall have MERV 6 filters or better;
- A CO alarm shall be installed in each dwelling unit in accordance with NFPA 720.



IAQ & Mechanical Ventilation

Mechanical Ventilation:

- Required on all new buildings and any additions to existing buildings over 1000 ft2 ;
- Kitchens and bathrooms shall be mechanically ventilated to the outdoors;
- Clothes dryers shall be vented to the outdoors;

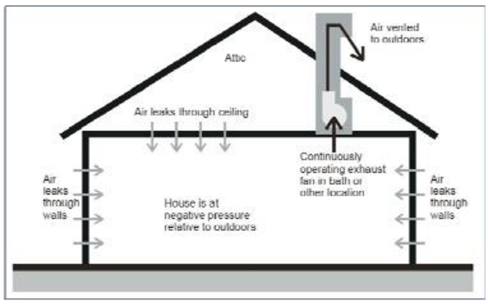
Note: In multi family units, dryers can be vented to the outside together as long as there is a damper present to prevent recirculation of exhaust air from one apartment to the other

- Combustion appliances shall be properly vented and air systems shall be designed to prevent back drafting;

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Types:

- Exhaust Ventilation



IAQ & Mechanical Ventilation

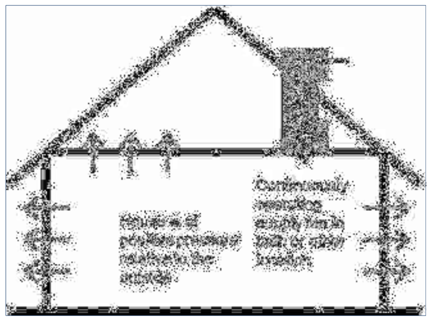
Whole House Mechanical Ventilation Types (Cont.):

- Exhaust Ventilation (Cont.)
  - ✓ Usually the most common solution
    - Pros: easy to install, specific source control (exhaust) of pollutants
    - Cons: makeup air from uncontrolled sources
  - ✓ One or more fans can meet the requirement
  - ✓ Can be a dedicated whole house system or can be for both local and whole house use.

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Types (Cont.):

- Supply Ventilation



Dedicated Fan

IAQ & Mechanical Ventilation

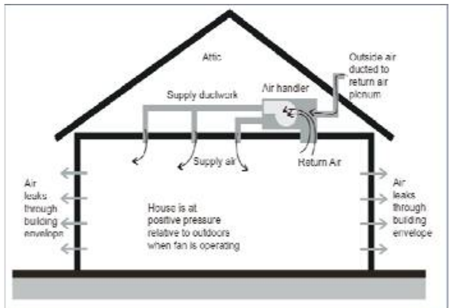
Whole House Mechanical Ventilation Types (Cont.):

- Supply Ventilation (Cont.):
  - ✓Works opposite of exhaust ventilation
    - Pros: controls source and delivery of makeup air, supply must be filtered
    - Cons: no source control (exhaust) of pollutants, can drive moisture into the building shell
  - ✓The outdoor air inlet must be placed to avoid known areas of contaminants.
  - ✓If a dedicated fan is used, care must be taken to avoid introducing too much outdoor air into one location

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Types (Cont.):

- Supply Ventilation (Cont.)



Central Fan Integrated (CFI) Supply Ventilator

IAQ & Mechanical Ventilation

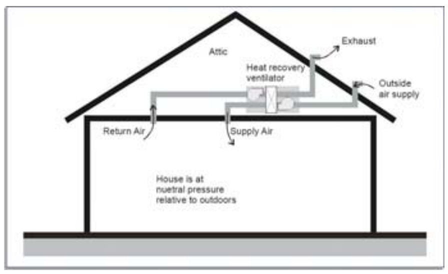
Whole House Mechanical Ventilation Types (Cont.):

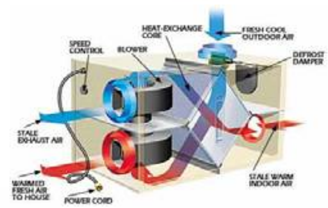
- Supply Ventilation (Cont.):
  - ✓A CFI system can be configured to function thru the central air system FAU;
    - Pros: simple design, outside air is mixed and distributed evenly throughout the house
    - Cons: uses very large central fan to bring in small amount of air, (high energy use), pressurizes home, can impact duct leakage test
  - ✓Must have an automatic damper installed that cannot be taped during Duct Leakage testing
  - ✓When a CFI system is used, the FV/DT for Fan Watt Draw is triggered for the ventilation system

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Types (Cont.):

- Combination or Balanced Ventilation





IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Types (Cont.):

- Combination or Balanced Ventilation
  - ✓Uses both exhaust and supply fans supplying the same airflow and creating neutral pressure in the house
    - Pros: source control of pollutants, opportunity for a heat recovery ventilator
    - Cons: cost, complexity
  - ✓Heat recovery ventilators (HRVs) provide balanced ventilation while recapturing heat from the exhaust air to temper the incoming supply air.

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- The whole-house ventilation system may operate continuously or intermittently;
- The whole-house ventilation rate is determined for continuous ventilation, and if the system is operated intermittently, an adjustment is made;
- Whole house mechanical ventilation rates (continuous and intermittent) have to be verified by a HERS rater.

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Continuous ventilation

	Bedrooms				
Floor Area (Ft2)	0-1	2-3	4-5	6-7	>7
≤ 1500	30	45	60	75	90
1501-3000	45	60	75	90	105
3001-4500	60	75	90	105	120
4501-6000	75	90	105	120	135
6001-7500	90	105	120	135	150
>7500	105	120	135	150	165

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Continuous ventilation (Cont.):
  - ✓ Can also be determined by using the formula below, which is what the previous table is based on:

Ventilation Rate (CFM)= (CFA/100) + (7.5 x [# of occupants])

CFA= Conditioned Floor Area

(# of occupants) = Number of Bedrooms + 1

- When a combination ventilation system is used, meaning both supply and exhaust fans are installed, the installed ventilation rate is the larger of either total supply or exhaust. You don't add them together.

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Continuous ventilation (Cont.):
  - ✓ **Example:** *what is the minimum required continuous ventilation rate for a 4 bedroom, 2000 Ft2 house?*
  - ✓ *CFM= (2000/100) + (7.5 x[4+1])*
  - ✓ *CFM= 20 + 37.5*
  - ✓ *CFM= 57.5*

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Intermittent Ventilation
  - ✓Is permitted as long as the ventilation airflow is increased to respond to the fewer hours of fan operation;
  - ✓The increased flow depends on the fraction of time the fans operate. Less time the fans operate, the greater the intermittent airflow will have to be;
  - ✓Intermittent ventilation systems have to be automatically controlled by a timer or other device that assures that they will operate the minimum amount of time needed to meet the ventilation requirement.

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Intermittent Ventilation (Cont.)
  - ✓The multipliers to determine intermittent rates from the continuous rate are determined from Equation 4-7 in the Residential Compliance Manual (RCM)

Equation 4-7: $Q_f = Q_r / (e \times f)$

Q_f = Fan Flow Rate (CFM)- Installed Performance

Q_r = Minimum Continuous Ventilation Air Requirement (CFM)

e = ventilation effectiveness (from table 4-15 RCM)

f = fractional on-time, defined as on-time for once cycle divided by the cycle time

IAQ & Mechanical Ventilation

Whole House Mechanical Ventilation Rates (Cont.):

- Intermittent Ventilation (Cont.)
  - ✓**Example:** *the required continuous ventilation rate is 70 CFM. If the ventilation fan runs 70% of the time, what must be the airflow be?*
  - ✓*For a fractional on-time f=0.7, the ventilation effectiveness e= 1 (from table 4-15)*
  - ✓*CFM= 70 / (0.7 x 1)*
  - ✓*CFM= 100*

IAQ & Mechanical Ventilation

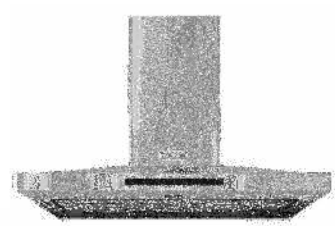
Whole House Mechanical Ventilation Controls:

- Must have an override control readily accessible to the occupants;
- Occupant must be able to modify the settings and override the system;
- Must be clearly labeled as the mechanical ventilation control;
- Instructions on how to use the system must be provided to the homeowner.

IAQ & Mechanical Ventilation

Local Mechanical Ventilation Rates:

- Intermittent Ventilation
  - ✓Kitchen 100 cfm **OR** 5 ACH
  - ✓Bathroom 50 cfm
- Continuous Ventilation
  - ✓Kitchen 5 ACH
  - ✓Bathroom 20 cfm



IAQ & Mechanical Ventilation

Local Ventilation Controls:

- The only requirement is that there must be a control
  - ✓Manual
    - Wall switches
  - ✓Automatic
    - Occupancy sensors
    - Delay off switches

IAQ & Mechanical Ventilation

Sound Rating:

- Whole house and local ventilation shall be rated meet the following guidelines for sound ratings:
  - ✓Continuous fans: 1.0 Sone
  - ✓Intermittent Whole House fans: 1.0 Sone
  - ✓Intermittent local fans: 3.0 Sone
- Kitchen hood rated for 400 CFMs or more do not need to meet the 3.0 Sone requirement.

IAQ & Mechanical Ventilation

Sound Rating (Cont.):

- Inline fans do not need to meet the Sone requirement if there is at least 4 feet of duct between the fan and intake grill.

Water Heating & Distribution

Water Heating & Distribution

Mandatory Requirements:

- Equipment certification
  - ✓Equipment must be listed in the California Energy Commission appliance database
- Equipment efficiencies
  - ✓Minimum equipment efficiencies can be found on table 5-1, Ch. 5, of the Residential Manual
- Storage tank insulation
  - ✓A minimum R-12 tank wrap is a mandatory requirement only for minimum efficiency storage water heaters
  - ✓Any unfired tanks must be either insulated externally to R-12 or show to have an internal insulation of R-16

Water Heating & Distribution

Mandatory Pipe Insulation Requirements:

- First 5 feet of pipe (hot and cold) from the water heater or storage tank;
- All piping with a nominal diameter of ¾ inch or larger;
- Piping from the heating source to a storage tank or between tanks.

Water Heating & Distribution

Mandatory Pipe Insulation Requirements (Cont.):

- Piping buried below grade;
- All hot water pipes from the heating source to the kitchen fixtures;
- All piping associated within a domestic hot water recirculation system regardless of the pipe diameter. This excludes branches off of the recirculation loop that are less than ¾ inch diameter or do not serve the kitchen.

Water Heating & Distribution

Mandatory Pipe Insulation Requirements

Exceptions:

- Pipes in exterior walls;
- Attic pipes buried in at least 4 in of ceiling insulation;
- Factory installed piping within space conditioning equipment;
- Piping that penetrates framing members unless metal framing;

Water Heating & Distribution

Single Dwelling Mandatory Requirements:

- High efficiency water heater ready:
  - ✓ A 120 V electrical receptacle that is within three feet of the water heater and accessible to the water heater with no obstructions;
  - ✓ A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed;
  - ✓ A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance;
  - ✓ A gas supply line with a capacity of to provide at least 200,000 Btu/hr to the water heater.

Water Heating & Distribution

Single Dwelling Prescriptive Requirements:

- Increased solar water heating requirement for electric resistance water heating systems;
- The minimum solar thermal water heating system size has a solar savings fraction of at least 50%.

Water Heating & Distribution

Single Dwelling Performance Options:

- Point of use credit
- Compact distribution credit
- Additional credits for pipe insulation
- Credit for a home run manifold within 5 feet of the water heater
- All of the items above require HERS verification

Water Heating & Distribution

Multi Family Mandatory Requirements

- For central multi-family systems all piping in the recirculation loop must be insulated - This applies to the distribution for each dwelling unit.

Water Heating & Distribution

Multi Family Prescriptive Requirements:

- Demand recirculation controls;
- Solar water heating is required for all climate zones;
- Water heating recirculation systems are required to be designed with two recirculation loops and verified by a HERS rater.

Water Heating & Distribution

Multi Family Performance Options:

- Changes/ additions to performance calculations;
- Options to modify prescriptive distribution design requirements.

Water Heating & Distribution

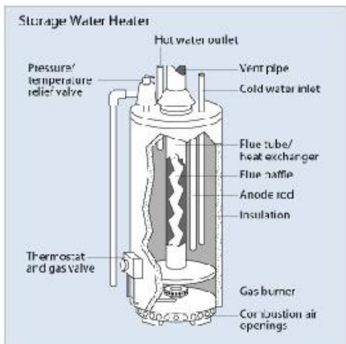
Water Heater Types:

- Storage
- Storage Heat Pump
- Tank less/ On Demand
- Supply Boiler
- Solar

Water Heating & Distribution

Water Heater Types (Cont.):

- Storage water heater



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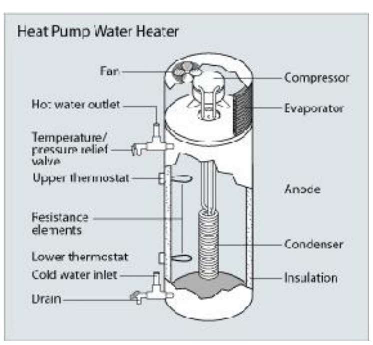
Water Heating & Distribution

Water Heater Types (Cont.):

- Storage Heat Pump



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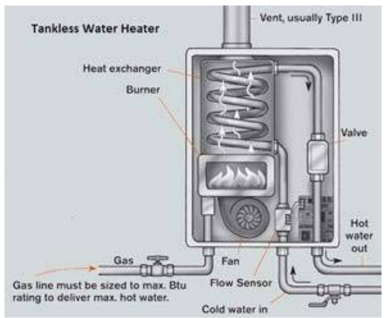
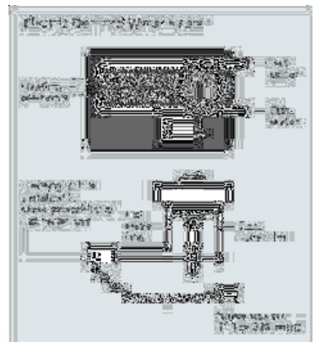
Water Heating & Distribution

Water Heater Types (Cont.):

- Tank less (on demand) heaters

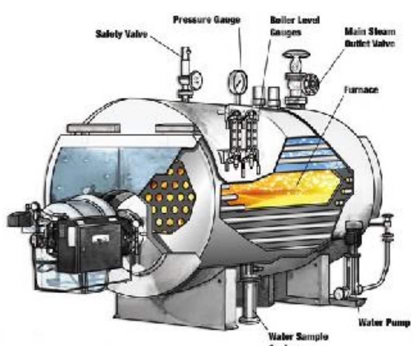




Water Heating & Distribution

Water Heater Types (Cont.):

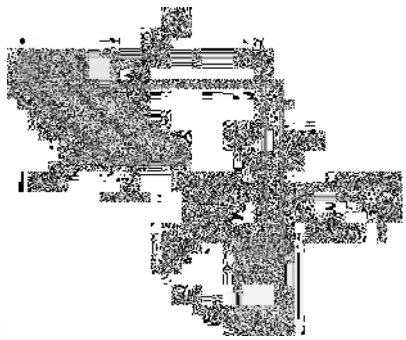
- Hot Water Supply Boiler



Water Heating & Distribution

Water Heater Types (Cont.):

- Solar water heating



Water Heating & Distribution

Single Dwelling Distribution System Types:

- Trunk and branch
- Central parallel piping
- Point of use
- Compact Design
- Recirculation
  - ✓Non Demand control
  - ✓Demand control

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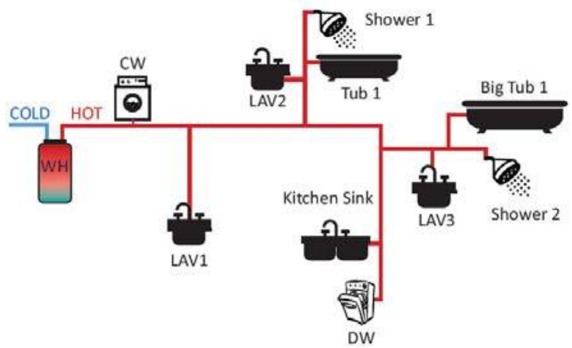
Water Heating & Distribution

Single Dwelling Distribution System Types (Cont.):

- Trunk and Branch:

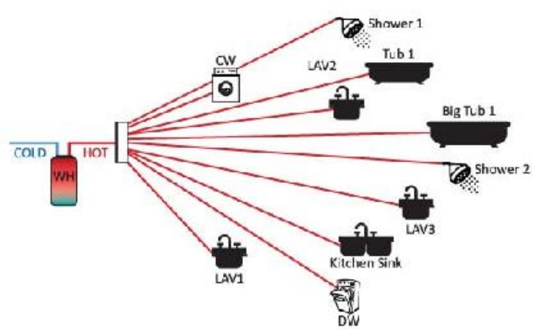


CHEERS

Water Heating & Distribution

Single Dwelling Distribution System Types (Cont.):

- Central Parallel Piping:



Water Heating & Distribution

Single Dwelling Distribution System Types (Cont.):

- Point of use:
  - ✓Requires
    - A good architectural design
    - An indoor mechanical closet **OR** the use of multiple water heaters
    - Distance between the water heater and any fixture cannot exceed the specifications of the table below:

Size Nominal (Inch)	Length of Pipe (Feet)
3/8"	15'
1/2"	10'
3/4"	5'

Water Heating & Distribution

Single Dwelling Distribution System Types (Cont.):

- Compact Design:
  - ✓Must meet the following criteria for pipe length based on floor area served:

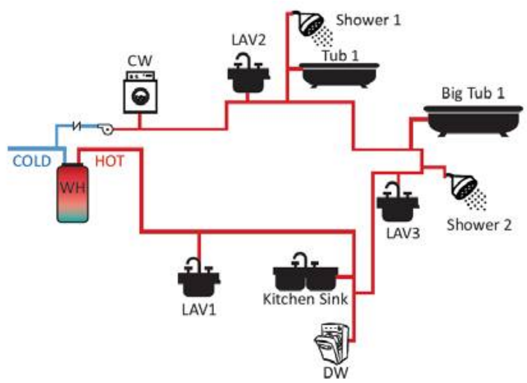
Floor Area Served (Ft2)	Maximum Water Heater To Use Point Distance (Ft)
< 1000	28'
1001-1600	43'
1601-2200	53'
2201-2800	62'
>2800	68'

CHEERS

Water Heating & Distribution

Single Dwelling Distribution System Types (Cont.):

- Recirculation System:



CHEERS

Water Heating & Distribution

Multiple Dwelling Distribution System Types:

- Default recirculation system
- Central demand recirculation
- Demand Controls
  - ✓Modulation control
  - ✓Continuous monitoring system
- Non-recirculating water heater system

Water Heating & Distribution

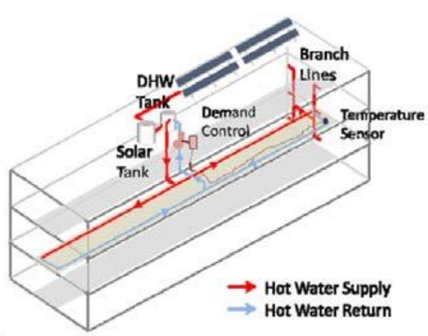
Multiple Dwelling Distribution System Types (Cont.):

- Default Recirculation
  - ✓Central recirculation water heating systems which use temperature, timer or no controls can use a default recirculation system type if performance compliance is used.

Water Heating & Distribution

Multiple Dwelling Distribution System Types (Cont.):

- Central demand recirculation



Water Heating & Distribution

Multiple Dwelling Distribution System Types (Cont.):

- Demand Controls
  - ✓Modulation control
    - Shall reduce the hot water supply temperature when hot water demand is determined to be low by the control system.
    - The control system may use a fixed or dynamic control schedule based on measurements of hot water demand.

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Water Heating & Distribution

Multiple Dwelling Distribution System Types (Cont.):

- Demand Controls (Cont.)
  - ✓Continuous Monitoring Systems
    - Shall record no less frequently than hourly measurements of key system operation parameters, including hot water supply temperatures, hot water return temperatures, and status of gas valve relays of water heating equipment.
    - It should automatically alert building operators of abnormalities identified from monitoring results.

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CHEERS

Water Heating & Distribution

Multiple Dwelling Distribution System Types (Cont.):

- Non Recirculating Water Heaters
  - ✓Multi-unit buildings may also use systems without a recirculation system;
  - ✓Only if the served dwelling units to be closely located so that the branch pipes between the water heating equipment and dwelling units are relatively short.

CHEERS

Swimming Pools & Spa Equipment

Swimming Pools & Spa Equipment

Mandatory Requirements:

- Minimum heating efficiencies
- On/Off switch outside the heater
- Permanent and weatherproof operating instructions
- No continuous pilot light
- No electric resistance heating
- Installed fitted cover

Swimming Pools & Spa Equipment

Pool Pump Requirements:

- All pumps and pump motors shall comply with the specifications of the Appliance Efficiency Regulations;
- If filtration system is shared between a pool and a spa, the pump must be multi-speed;
- Filtration pump motors with a capacity of 1 total-hp or more must be multi-speed.

Swimming Pools & Spa Equipment

Pool Pump Controls Requirements:

- A control mechanism must be installed that will allow all pumps to be set to run only during the off-peak electric demand period;
- Multi-speed pumps must have controls that default to the filtration flow rate when no auxiliary pool loads are operating;
- The controls must default to the filtration flow rate setting within 24 hours and must have a temporary override capability for servicing.

Swimming Pools & Spa Equipment

System Design:

- Before the pump there must be a length of straight pipe that is greater than or equal to at least 4 times the diameter of the pipe;
- Backwash valves must be sized to the diameter of the return pipe or two inches, whichever is greater;
- The pool must have directional inlets to adequately mix the pool water.

CHEERS

Swimming Pools & Spa Equipment

System Design (Cont.):

- Pool piping must be sized according to the maximum flow rate needed for all auxiliary loads.

Pool Volume (gallons)		Minimum Pipe Diameter (in)	
Min	Max	Return	Suction
-	13,000	1.5	1.5
13,000	17,000	1.5	2
17,000	21,000	2	2
21,000	30,000	2	2.5
30,000	42,000	2.5	3
42,000	48,000	3	3
48,000	65,000	3	3.5

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CHEERS

Swimming Pools & Spa Equipment

System Design (Cont.):

- Traditional hard 90 degree elbows are not allowed;
- Must be sweep elbows or a variant of.

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Swimming Pools & Spa Equipment

System Design (Cont.):

- If a pool does not currently use solar water heating, piping must be installed to accommodate any future installation, with one of three options:
  - ✓Provide at least 36 inches of pipe between the filter and the heater to allow for the future addition of solar heating equipment;
  - ✓Plumb separate suction and return lines to the pool dedicated to future solar heating;
  - ✓Install built-up or built-in connections for future piping to solar water heating. An example of this would be a capped off tee fitting.

Lighting

Lighting

Lighting requirements are all mandatory measures;

These requirements only apply to hardwired systems;

All lighting systems and controls have to be approved for use by the CEC.

Lighting

High Efficacy:

Luminaire Power Rating	Minimum Efficacy to Qualify as High Efficacy
5 watts or less	30 Lumens per watt
over 5 watts to 15 watts	45 Lumens per watt
over 15 watts to 40 watts	60 Lumens per watt
over 40 watts	90 Lumens per watt

Lighting

LEDs
- To qualify as high efficacy for compliance with the residential lighting Standards, an LED luminaire or light engine must be certified to the Energy Commission by the manufacturer.
- Also need to meet the efficacy standards of table 150.0

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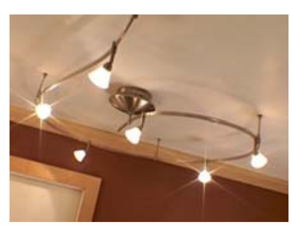
Lighting

Low efficacy
- Ballast adaptors or screw in CFL/LED do not qualify as High Efficacy.
- Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system do not qualify as high efficacy.



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Lighting

Hardwired Nightlights

- Nightlights will not consume more than 5W of power and do not need to be controlled by an occupancy sensor

Lighting

Recessed Can Light

- Recessed can lights shall be IC/AT Rated and be sealed between the housing and the ceiling

Lighting

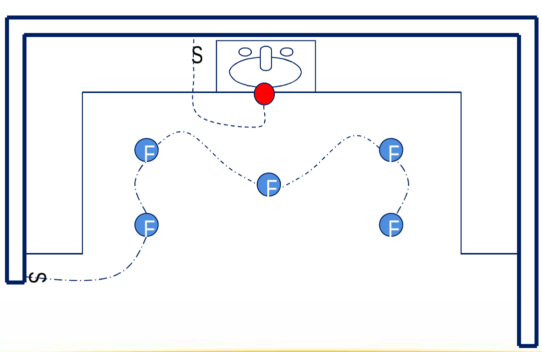
Control Equipment
Specifications:

- Vacancy Sensors:
  - ✓ Manual on, Automatic off
  - ✓ Cannot have an override to the sensor
- Dimmers:
  - ✓ Must match the lighting load it's supposed to dim
  - ✓ Failure to do so, may result in early equipment failure

Lighting

Kitchens:

- At least half of the wattage of luminaires in kitchens shall be high efficacy.



Lighting

Kitchens (Cont.):

- Lighting in areas adjacent to the kitchen, including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.

Lighting

Kitchens (Cont.):

- Ceiling electrical boxes finished with a blank cover or where no electrical equipment has been installed, shall be calculated as 180 watts of low efficacy lighting per electrical box.

Lighting

Kitchens (Cont.):

- Lighting that is internal to cabinets for the purpose of illuminating only the inside of the cabinets does not need to be included in the wattage calculations.

Lighting

Kitchens (Cont.):

- There is a residential kitchen lighting “tradeoff” option available when additional low efficacy lighting is needed, provided that other conditions are met;
- The additional low efficacy wattage may be installed provided that all lighting in the kitchen (including the high efficacy lighting) is controlled by vacancy sensors, dimmers, or by a lighting control system.

Lighting

Kitchens (Cont.):

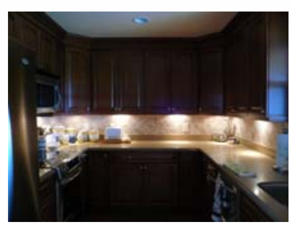
- Additional Low Efficacy Wattage Tradeoff

Size of Individual Dwelling Unit	Additional Low Efficacy Lighting Allowed in a Residential Kitchen
Less than or equal to 2500 ft2	Up to an additional 50W
Larger than 2500 ft2	Up to an additional 100W

Lighting

Kitchens (Cont.):

- Lighting mounted to a cabinet for the purpose of projecting light somewhere other than the inside of the cabinet shall be considered as kitchen lighting.



Lighting

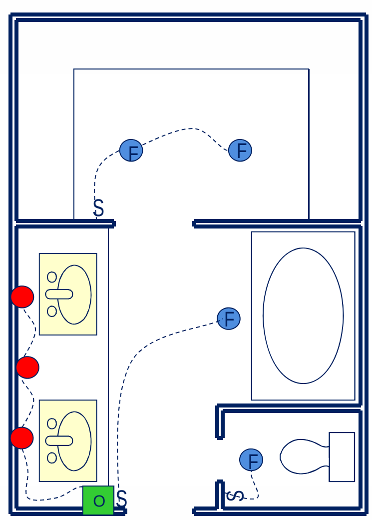
Kitchens (Cont.):

- Controls:
  - ✓High and low efficacy luminaires must be controlled separately;
  - ✓Lighting within each group (high and low efficacy) may be controlled together.

Lighting

Bathrooms:

- At least one luminaire in bathrooms shall be high efficacy;
- All other luminaires must be either high efficacy or controlled by an vacancy sensor;
- More than one circuit of luminaires may be attached to the same vacancy sensor.



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Lighting

Bathrooms (Cont.):

- Integrated fan lights must be separately switched

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Lighting

Garages, Laundry & Utility Rooms:

- All luminaires must be high efficacy;

AND

- Must be controlled by a vacancy sensor.

Lighting

Other Rooms:

- Include:
  - ✓Hallways
  - ✓Dining Rooms
  - ✓Family Rooms
  - ✓Club House
  - ✓Home Office
  - ✓Bedrooms
  - ✓Attic Spaces
  - ✓Closets

Lighting

Other Rooms (Cont.):

- All luminaires shall be high efficacy or controlled by an vacancy sensor or dimmer;
- Closets less than 70 ft^2 are exempt from this requirement;
- Lighting in detached storage buildings less than 1000 ft^2, when located on a residential site, do not need to comply with the above requirements;

Lighting

CHEERS

Outdoor Lighting-Single Family:

- Applicable to all lighting attached to the residence or to other buildings on the same lot
  - ✓Must be High Efficacy

    OR
  - ✓Controlled by a motion sensor **AND** a photocell or an astronomical time clock
- Lighting must be controlled by a manual on/off switch that does not override any automatic sensor to the "on" mode.

Lighting

CHEERS

Outdoor Lighting-Multi Family:

- Same requirements as single family if it has less than 4 dwelling units
- The following areas can comply with either residential or non-residential standards:
  - ✓Private patios
  - ✓Entrances
  - ✓Balconies
  - ✓Porches
  - ✓Parking lots with less than eight vehicles
- Parking lots with eight or more vehicles use non-residential standards

Lighting

Outdoor Lighting-Multi Family (Cont.):

- Outdoor lighting not attached to a building
  - ✓Less than 4 dwellings- Residential Standards
  - ✓4 or more dwellings- Non-Res Standards

Lighting

Common Areas in Multi Family:

- If the total interior common area of the building equals 20% or less of the floor area, common area lighting shall be high efficacy or controlled by a vacancy sensor
- If the total interior common area of the building equals more than 20% of the floor area, common area lighting shall meet the non-residential lighting requirements

Space Conditioning

Space Conditioning

Introduction:

- Most equipment installed in new homes is regulated by the National Appliance Efficiency Conservation Act (NAECA) standards and/or the California Appliance Efficiency Regulations (AER);
- Standards are applicable to equipment used in replacements, repairs or for any other purpose;
- Equipment not meeting NAECA standards cannot be sold in California.

Space Conditioning

Introduction (Cont.):

- The AER and NAECA are enforced at the point of sale, while the Energy Efficiency Standards are enforced by local enforcement agencies.
- The AER do not require certification for:
  - ✓Infrared Heaters;
  - ✓Electric Resistance Heaters;
  - ✓Oil-Fired Furnaces;
  - ✓Room Heaters.

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Space Conditioning

Heating Equipment:

- **Mandatory Measures:**
  - ✓Minimum efficiencies for central gas furnaces as outlined in Table 4-1, Ch. 4 of Res Manual
    - 78% AFUE for weatherized furnaces under 225,000 Btu/hr
    - 80% AFUE for non-weatherized furnaces under 225,000 Btu/hr
  - ✓Minimum efficiencies for non-central gas furnaces and space heaters are outlined in Table 4-2, Ch.4 of the Res Manual
    - Range between 57% and 74%

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Space Conditioning

Heating Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Minimum efficiencies for Heat Pumps as outlined on Table 4-3, Ch. 4 of the Res Manual
    - Effective 1/1/2014, 7.7 HSPF for both packaged and split units;
    - Effective 1/1/2015, 8.0 HSPF packaged units, 8.2 HSPF split units.
  - ✓Minimum efficiencies for Central Boilers as outlined on table 4-4, Ch. 4 of the Res Manual
    - Gas hot water boilers, 83% AFUE
  - ✓Heating loads must be calculated for new heating systems
    - Prepared by a mechanical engineer;

      OR
    - Someone who is qualified in the State to do so.

Space Conditioning

Heating Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Cannot have a continuous burning pilot light;
  - ✓Larger furnaces with input ratings ≥ 225,000 Btu/h must also have an intermittent ignition or interrupted device (IID), and either power venting or a flue damper;
  - ✓Heating system piping for heat pumps and hydronic or steam systems must meet the requirements of table 4-5, Ch. 4 of the Res Manual.

Space Conditioning

Heating Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Must be controlled by a setback thermostat or integrated into a Central Energy Management Control System (EMCS);
    - Only applicable to central heaters, including heat pumps
  - ✓Any heat pump with supplementary electric resistance heating must have controls that have two capabilities to limit the electric resistance heating.

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Space Conditioning

Heating Equipment (Cont.):

- **Prescriptive Requirement**:
  - ✓Gas heating systems or heat pumps must be installed;
  - ✓Supplemental heating can be installed in areas serviced by a main heater, as long as they meet certain efficiency values and are controlled by a time limiting device not exceeding 30 minutes.
- **Performance Compliance** Options:
  - ✓Electric resistance heating;
  - ✓Credit exists for High Efficiency equipment.

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Space Conditioning

Cooling Equipment:

- **Mandatory Measures:**
  - ✓Minimum efficiencies regulated by NAECA and AER standards
    - 13 SEER for central AC;
    - SEER for central AC, sold on/after 1 January 2015;
      - Any AC installed after 1 January 2015 lower than 14 SEER will penalize T24
    - Values for other types of equipment found in Table 4-6 and 4-7, Ch. 4 of the Res Manual.

Space Conditioning

Cooling Equipment (Cont.)

- **Mandatory Measures (Cont.):**
  - ✓Minimum efficiencies regulated by NAECA and AER standards (Cont.)
    - Installed on/after 1 January 2015
      - 12.2 EER for split systems rated cooling capacity less than 45,000 Btu/hr;
      - 11.7 EER for split systems rated cooling capacity more than 45,000 Btu/hr;
      - 11 EER for single package systems.

Space Conditioning

Cooling Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Cooling loads must be calculated for new cooling systems using ACCA Manual J, D and S or equivalent by
    - The documentation author and submitted to the mechanical contractor;

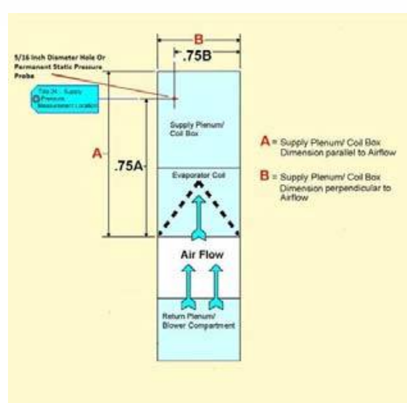
      OR
    - A Mechanical Engineer;

      OR
    - The mechanical contractor who is installing the equipment.

Space Conditioning

Cooling Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓A hole for the placement of a static pressure probe (HSPP) or permanently installed static pressure probe (PSPP) shall be installed down stream from the evaporator coil.



Space Conditioning

Cooling Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓The suction line has to be insulated to the specifications of Table 4-9 of the Residential Manual.

Space Conditioning

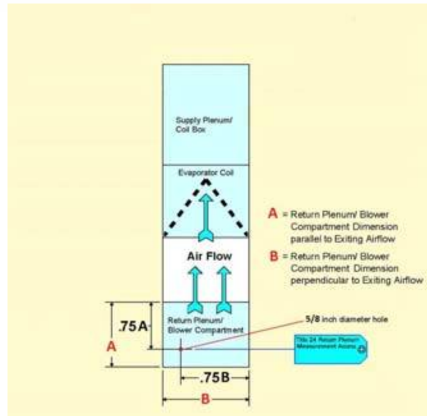
Cooling Equipment (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Condensing units shall not be placed within 5 feet of a dryer vent.

Space Conditioning

Cooling Equipment (Cont.):

- **Prescriptive Requirements:**
  - ✓Refrigerant charge required in CZ 2, 8-15 or CID;
  - ✓RCM requires installation of Measurement Access Holes (MAH).



Space Conditioning

Cooling Equipment (Cont.):

- **Performance Compliance** Options:
  - ✓High Efficiency Air Conditioner.

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Space Conditioning

Cooling Equipment (Cont.):

- **Performance Compliance** Options (Cont.):
  - ✓Air Handler Watt Draw and Cooling Coil Airflow.

CHEERS

Space Conditioning

Air Distribution System Ducts & Plenums:

- **Mandatory Measures:**
  - ✓Minimum Insulation of R-6, including ducts located in a concrete slab;
  - ✓Minimum standards for materials used to be build and seal a duct system;
  - ✓Duct installation must comply with 2010 California Mechanical Code sections 601-605 and California Building Energy Efficiency Standards;
    - 2013 Codes, effective 1 January 2014
  - ✓Duct sealing required in all CZs.

CHEERS

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Mandatory Measures (Cont.):**

✓Air Filtration

Applicable to any heating or cooling system with more than 10 feet of ducts (not evap coolers)

- System design criteria
- Air filter media efficiency criteria
- Air filter media pressure drop criteria
- Air filter media labeling criteria

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CHEERS

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Mandatory Measures (Cont.):**

✓Non-Zoned Systems

- Except for heating only or non-ducted systems, systems must comply with the Fan Watt Draw & Adequate Airflow;

OR

- May install return ducts and grills in accordance with tables 4-10 & 4-11 in the Residential Compliance Manual, or 150.0-C and 150.0-D in the Standards.

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Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Non-Zoned Systems (Cont.):
    - Table 4-10 in the RCM or 150.0-C in the BEES

Return Duct Sizing for Single Return Duct Systems		
System Total Nominal Cooling Capacity (ton)	Minimum Return Duct Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	16	500
2.0	18	600
2.5	20	800
*Not applicable to systems with nominal capacity greater than 2.5 tons or less than 1.5 ton		

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Non-Zoned Systems (Cont.):
    - Table 4-11 in the RCM or 150.0-D in the BEES

Return Duct Sizing for Multiple Return Duct Systems			
System Total Nominal Cooling Capacity (ton)	Minimum Return Duct 1 Diameter (inches)	Minimum Return Duct 2 Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4.0	18	18	1200
5.0	20	20	1500
*Not applicable to systems with nominal capacity greater than 5.0 tons or less than 1.5 ton			

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Mandatory Measures (Cont.):**
  - ✓Non-Zoned Systems (Cont.):
    - Return Duct Design specifications (In lieu of Fan Watt Draw and Adequate Airflow)
      - Return is within 30 feet of plenum;
      - When bends are needed, metal bends are desirable;
      - Each return cannot have more than 180 degrees of bend and no more than 90 degrees of bend can be flex duct.

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

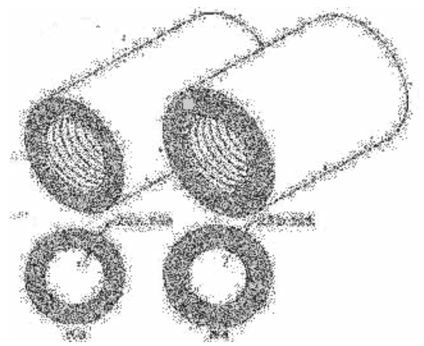
- **Mandatory Measures (Cont.):**
  - ✓Zonally controlled central systems:
    - In every zonal control mode the system shall provide at least 350 CFM per ton thru the return grill;

      AND
    - Must draw less energy than .58 W/CFM.

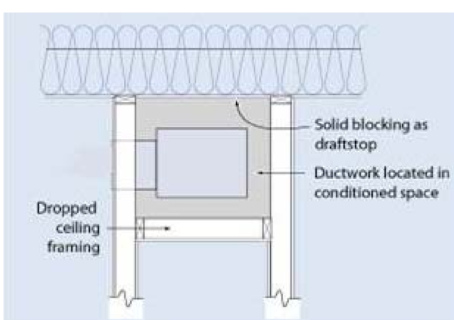
Space Conditioning

Air Distribution System
Ducts & Plenums (Cont.):

- **Prescriptive requirements**:
  - ✓ R-6 insulation in CZs 1-10, 12, 13;
  - ✓ R-8 insulation in CZs 11, 14-16.



Space Conditioning



Air Distribution System
Ducts & Plenums (Cont.):

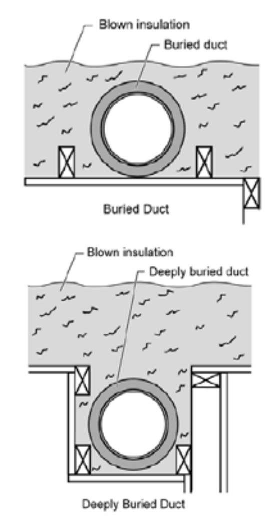
- **Performance Compliance** Options:
  - ✓ Supply Duct Location.

CHEERS

Space Conditioning

Air Distribution System Ducts & Plenums (Cont.):

- **Performance Compliance** Options (Cont.):
  - ✓Buried ducts;
  - ✓Deeply buried ducts.



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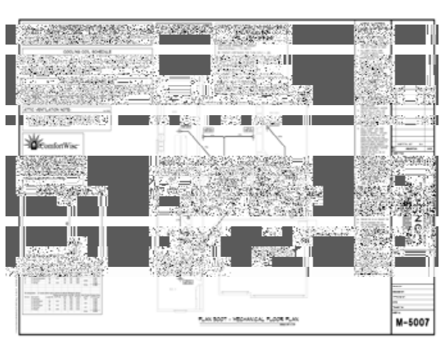
Space Conditioning



Air Distribution System Ducts & Plenums (Cont.):

- **Performance Compliance** Options (Cont.):
  - ✓Diagnostic supply duct location, surface area & R-value.

Space Conditioning

Controls:

- **Performance Compliance** Options
  - ✓A zonal control credit may be taken
    - Could consist of multiple systems or one system with zoning capabilities;
    - While the credit only requires one living zone and one sleeping zone, more than two zones may exist;
    - Each zone must be controlled by a central automatic dual setback thermostat;
    - Each zone must be served by a return air register located entirely within the zone;
    - Must have less than 40 ft2 of non closeable openings between zones.

Space Conditioning

Whole House Fans

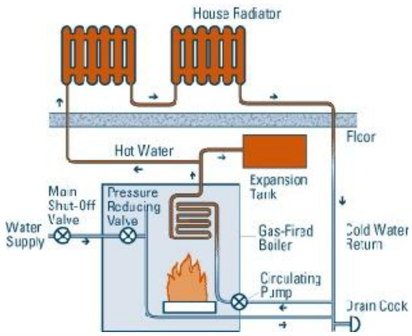
- **Prescriptive Requirements:**
  - ✓ Required in CZs 8-14;
  - ✓ Equipment requirements;
  - ✓ Minimum attic net free vent area to outdoors of 1ft2 for every 375CFM of rated airflow;
  - ✓ Homeowners need to be educated on how to use it;
  - ✓ Listed airflow of at least 2cfm/Ft2 of house CFA.

DO NOT CONFUSE WITH THE MANDATORY WHOLE HOUSE VENTILATION REQUIREMENT

Space Conditioning

Alternative Systems:

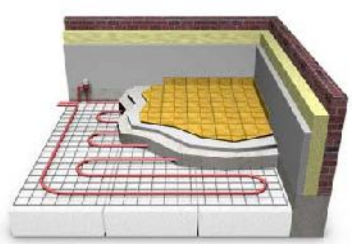
- Hydronic Heating Systems



ELO 10- Space Conditioning

Alternative Systems (Cont.):

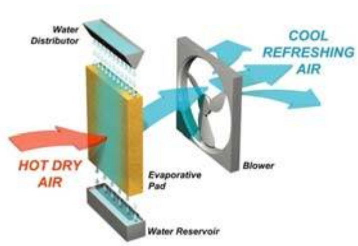
- Radiant floor Systems



Space Conditioning

Alternative Systems (Cont.):

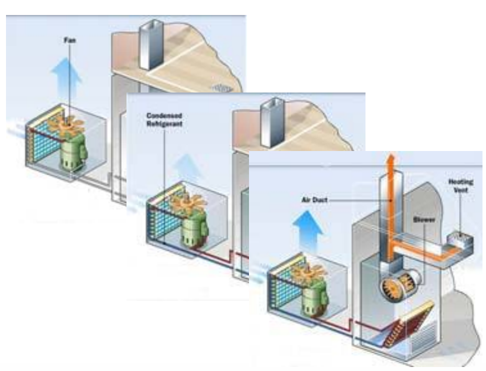
- Evaporative Cooling



Space Conditioning

Alternative Systems (Cont.)

- Heat Pump



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Space Conditioning

Alternative Systems (Cont.):

- Ground Source Heat-Pumps

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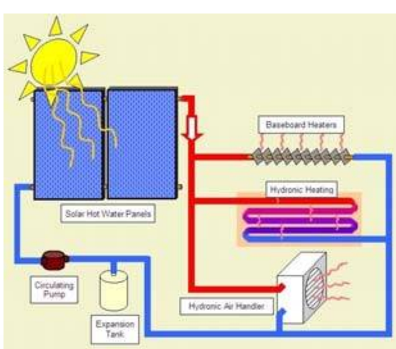
Space Conditioning

Alternative Systems (Cont.):

- Solar Space Heating



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Space Conditioning

Alternative Systems (Cont.):

- Wood Space Heating

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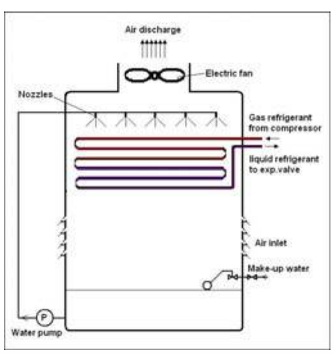
Space Conditioning

Alternative Systems (Cont.):

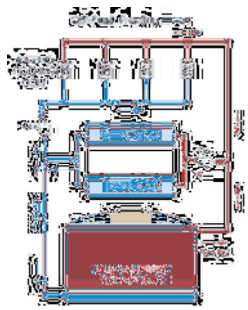
- Evaporative Cooled Condensers

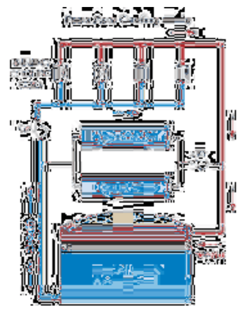


Space Conditioning

Alternative Systems (Cont.):

- Ice Storage Air Conditioners

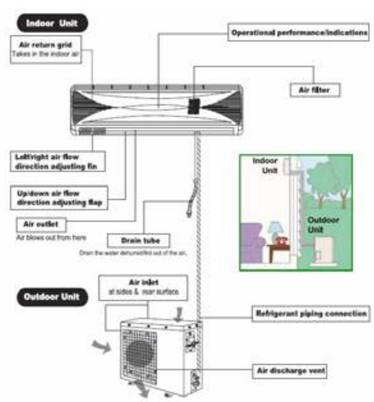




Space Conditioning

Alternative Systems (Cont.):

- Non-ducted Systems (Mini Splits)



Training Sections

Section 1- Methods of Compliance
Section 2- Compliance Documentation
Section 3- HERS Diagnostic Inspections
Section 4- Fenestration
Section 5- Insulation and Roofing
Section 6- IAQ & Mechanical Ventilation
Section 7- Water Heating & Distribution
Section 8- Swimming Pools & Spa Heating
Section 9- Lighting
Section 10- Space Conditioning

Overall Training Goal

Gain a broad understanding of the California Title 24 code, and how it interacts with national standards, other State codes and local jurisdictions.

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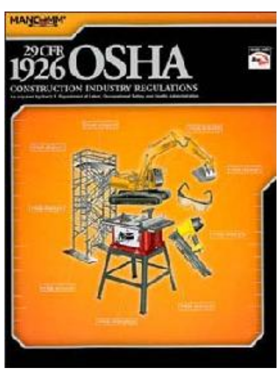
QUESTIONS

RATER & JOB SAFTEY

2013 HERS I Training

Rater & Job Safety

References



- OSHA Manual- Subsection 1926
- Cal/OSHA

  http://www.dir.ca.gov/dosh/

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Introduction

Safety is everyone's responsibility;

Your safety precautions can ensure that you never cause an accident to happen. All the safety guidelines in the world will never protect you from an accident;

Your attitude, actions, attention to detail and quick thinking can reduce the chance of an accident happening to you or the ones around you.

CHEERS

Overall Training Goal

Understand the importance of safety and safety awareness on the jobsite for yourself, your employees, and your customers.

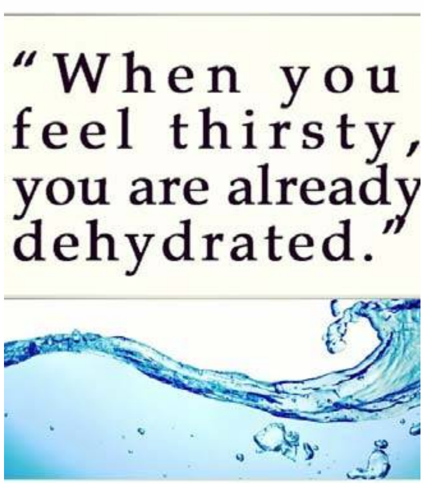
Job Site Safety

Use good safety practices on a constant basis;

Make good use of protective clothing and equipment:

- Eye and ear protection
- Dust masks/ respirators
- Coveralls/ gloves/ kneepads
- Hard Hats
- Appropriate footwear

Heat Exhaustion and Heat Stroke



Working in hot weather may lead to heat casualties.

- When working in an attic the potential is even greater

To prevent heat casualties:

- Work in short shifts;
- Drink 10-15 glasses of water daily to replace lost fluids;
- Pace yourself during exceptionally hot days.

Heat Exhaustion and Heat Stroke (Cont.)

Symptoms:

- Skin is either hot and dry or cold and clammy;
- Pulse is fast;
- Headache;
- Dizziness;
- Nausea or Vomiting;
- Victim may be unconscious.

HEAT STROKE IS A MEDICAL EMERGENCY

Heat Exhaustion and Heat Stroke (Cont.)

First aid Procedures for Heat Exhaustion:

- Seek medical help at once;
- Move the injured to a shady, cool place;
- Loosen or remove excess clothing;
- Apply cold packs to the head;
- Do not give any stimulants.

First Aid

Basic Do’s and Don’ts:

- Call for medical help;
- Do not move the victim unless absolutely necessary;
- Check for breathing;
- Check for bleeding;
- Keep them warm and as comfortable as possible;
- Do not give the victim liquid or food;
- Document as much information as possible about the accident, to pass on to appropriate emergency response personnel.

Calls for Medical Help

Do not hang up until asked to do so;

Give the following information to the dispatcher:

- Name;
- Telephone number;
- Location;
- Type of emergency.

Safety in a Customer's Home

Remember: YOU ARE A GUEST

Keep in consideration:

- Hazards outside of the house;
- Hazards inside of the house;
- Potential dirty clothing/ equipment;
- Furniture/ upholstery;
- Pets/ Children;
- Anything else that might be a danger to you or the homeowner.

Safety Tips in The Home

Don't lean ladders against walls;

Don't place ladders on loose rugs;

Avoid sudden turns when carrying the ladder in the home;

Watch for overhead objects;

Watch your step when entering the attic;

Don't carry everything in one trip;

Beware of wires and extension cords on the floor.

CHEERS

Attics

Extra care is needed when working in an attic:

- Do not throw your equipment ahead across the attic; it can crack the ceiling;
- Walk only on the joists;
- Don’t try to balance without 4 points of contact;
- Crawling is not only ok, it’s smart;
- Per OSHA requirements, ladders are supposed to extend 2 feet past the attic access into the attic;
- Be careful of knob and tube or other types of exposed wiring.

Rater & Job Safety 13

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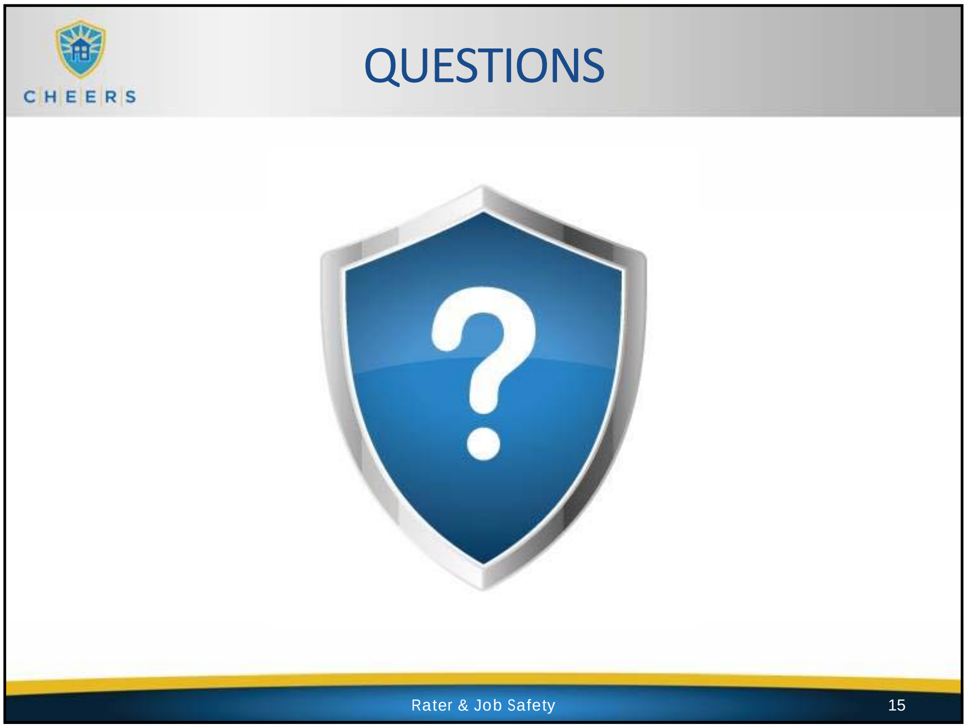
Overall Training Goal

Understand the importance of safety and safety awareness on the jobsite for yourself, your employees, and your customers.

Rater & Job Safety 14


CHEERS
QUESTIONS
Rater & Job Safety
15

CHEERS

Unmatched Service with Integrity

DUCT LEAKAGE

CHEERS
Unmatched Service with Integrity

2013 HERS I Training

Duct Leakage

RA3.1- Residential Appendices

CHEERS

References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.1
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Diagnostic Duct Leakage

- Used by installers and raters to verify that total leakage meets the criteria for any sealed duct system specified in the compliance documents.

Overall Training Goal

Familiarize yourself with Duct Leakage Testing Equipment, Protocols and Forms.

Training Sections

Section 1- Equipment Specifications

Section 2- Duct Leakage and Delivered BTUs

Section 3- Determining Airflow

Section 4- Procedures

- Total Duct Leakage
- Leakage to Outside

Section 5- Forms

Equipment Specifications

Equipment Specifications

Pressure Measurements

- Shall be measured with equipment having an accuracy equal to or better than ± 1% of pressure reading or ± 0.2 Pa., whichever is greater;
- All pressure measurements within the duct system shall be made with static pressure probes such as Dwyer A303 or equivalent.

Equipment Specifications

DG700

DG3

DM-2 or DM-2A

DM 32

Airflow Measurements

- Shall be measured with equipment that has an accuracy equal to or better than ± 3 percent of reading or ± 1 cfm, whichever is greater.

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Equipment Specifications

Calibration

- All equipment shall be calibrated yearly, in accordance with specification in Section RA3.1.2.

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Equipment Specifications

Equipment for Duct Pressurization

- Shall consist of a duct pressurization and flow measurement device meeting the specifications in Section RA3.1.2.

Minneapolis

Retrotech

Equipment Specifications

Minneapolis

Retrotech

Additional Equipment for Duct Leakage to Outside

- In addition to the duct blaster, duct leakage to outside shall include a fan that is capable of maintaining the pressure within the conditioned spaces in the house at 25 Pa relative to the outdoors.

Equipment Specifications

Smoke Machines

- Shall be able to introduce controllable non-toxic smoke;
- The means for generating smoke shall have sufficient capacity to ensure that any accessible leaks will emit visibly identifiable smoke.

Duct Leakage and Delivered BTUs

Duct Leakage and Delivered BTUs

Why is Duct Leakage Important?

- Duct Leakage Reduces Delivered BTUh and Reduces System Efficiencies.
- This translates into a higher energy use and a higher cost to the homeowner.
- The formula to calculate delivered BTUs is

$$\mathbf{1.08 \times CFM \times \Delta T = BTUh}$$

CHEERS

Duct Leakage and Delivered BTUs

Delivered BTUs Formula

- 1.08 x CFM x ΔT
  - 1.08= multiplier
  - CFM= The delivered (supply) amount of air by the system
  - ΔT= The dry bulb temperature difference between supply and return

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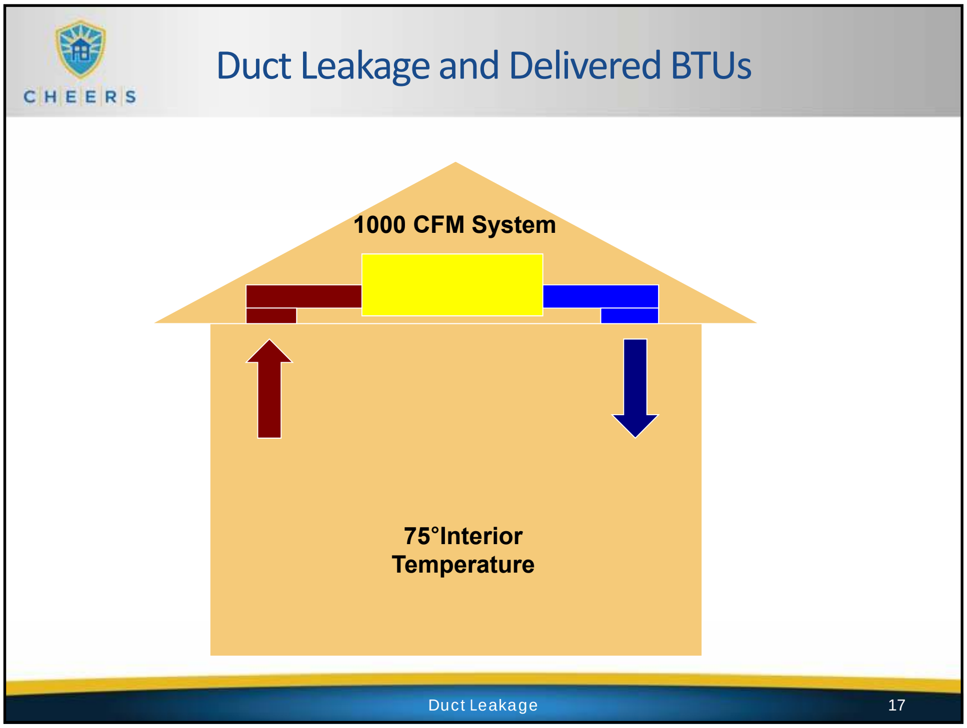
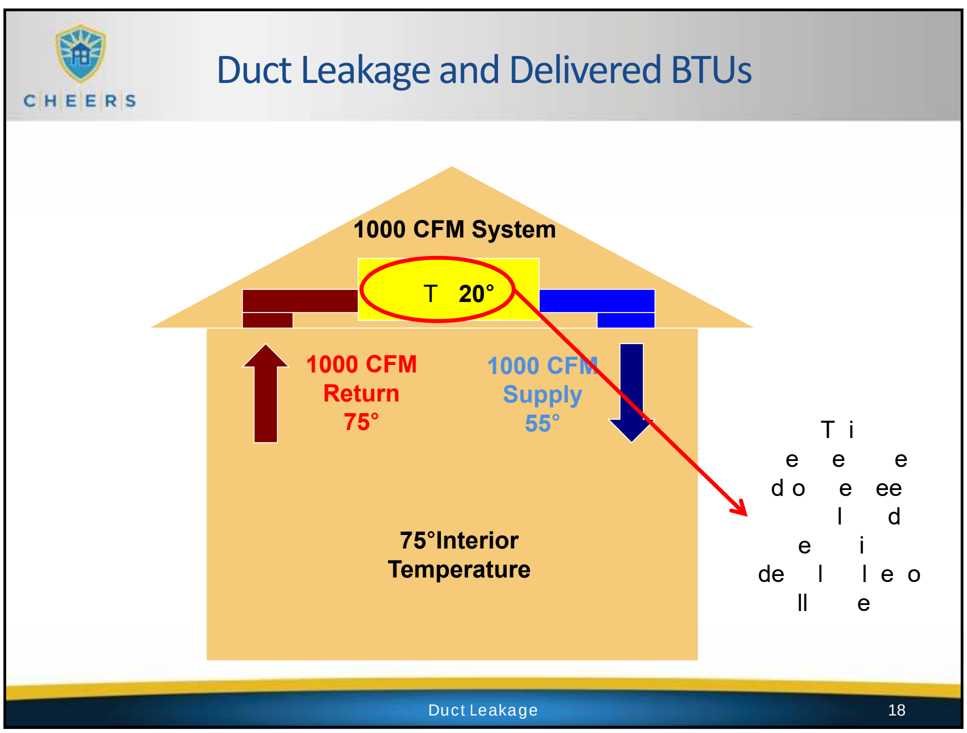
Duct Leakage and Delivered BTUs

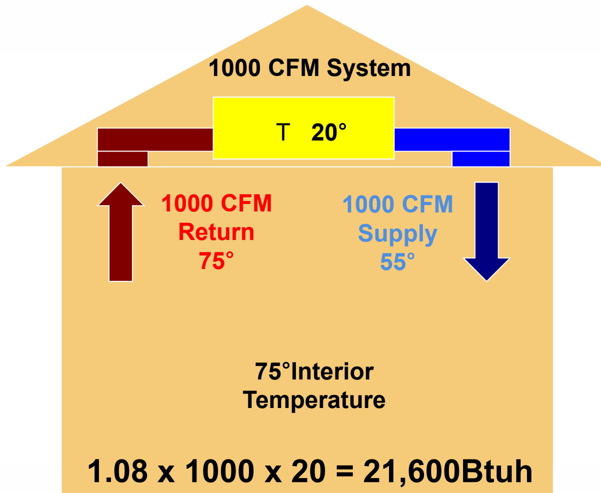
Example 1

No leakage


CHEERS
Duct Leakage and Delivered BTUs
1000 CFM System
75°Interior
Temperature
Duct Leakage
17


CHEERS
Duct Leakage and Delivered BTUs
1000 CFM System
T 20°
1000 CFM
Return
75°
1000 CFM
Supply
55°
75°Interior
Temperature
Duct Leakage
18

Duct Leakage and Delivered BTUs



Duct Leakage and Delivered BTUs

Example 2

Supply-side leakage

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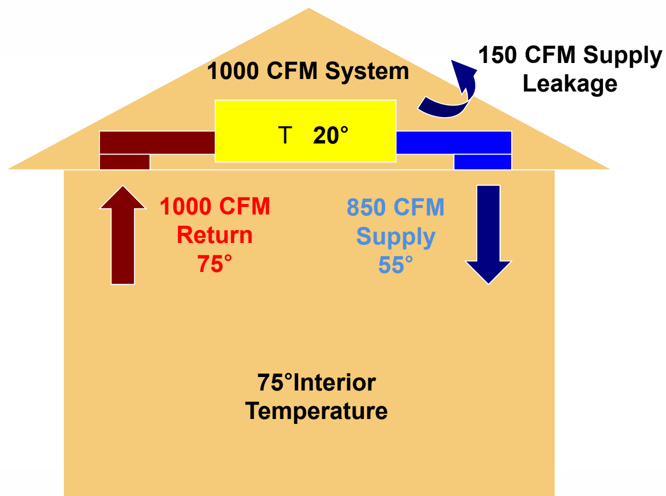
Duct Leakage and Delivered BTUs



Duct Leakage 21

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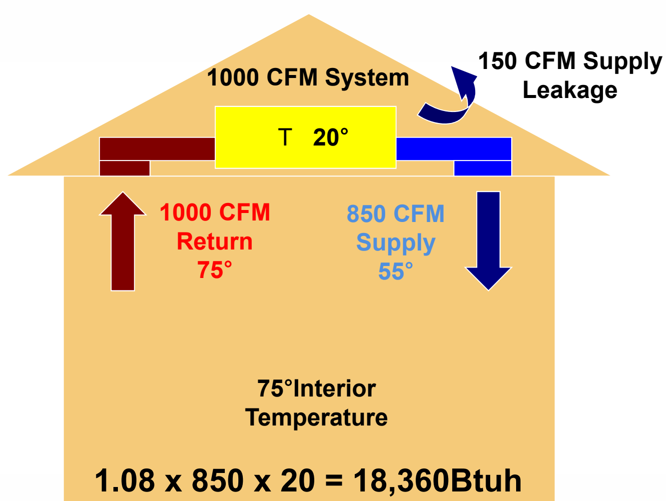
Duct Leakage and Delivered BTUs



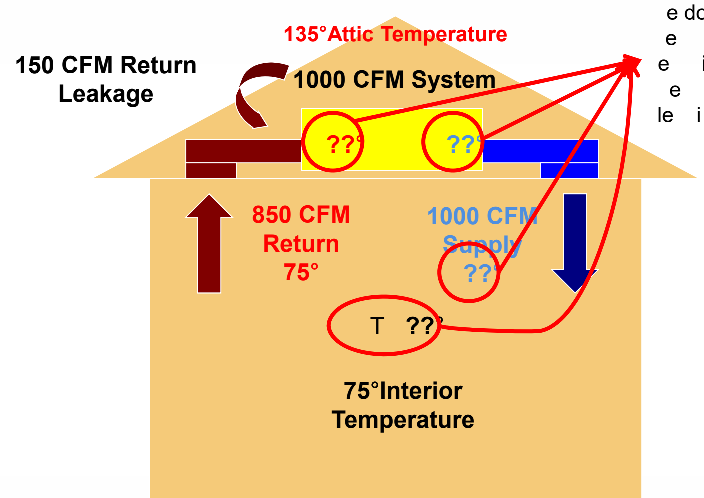
Duct Leakage 22

Duct Leakage and Delivered BTUs

Example 3

Return-side leakage

Duct Leakage and Delivered BTUs



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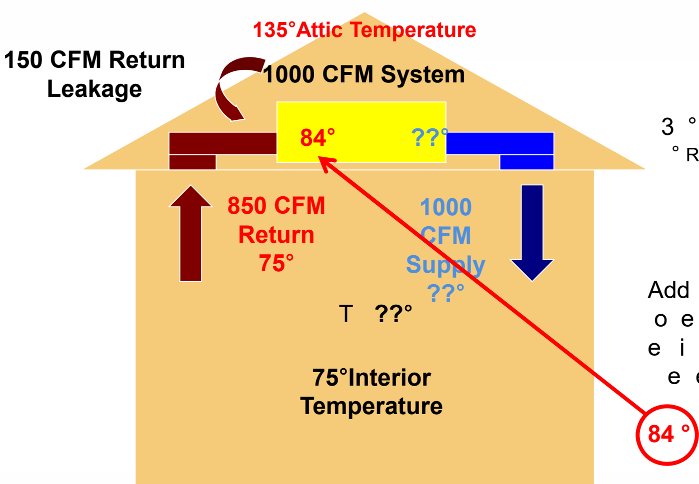
CHEERS

Duct Leakage and Delivered BTUs

- If a 1000 CFM system is leaking 150 CFM, that equates to 15% leakage;
- In this example, the system is pulling 15% of its nominal capacity from the attic;
- This leaves only 85% coming from the living space of the house (the actual return grill);
- We have to calculate the system temperatures based on the percentage of leakage being introduced into the system, from the unconditioned space;
- The leakage % will vary in every system.

CHEERS

Duct Leakage and Delivered BTUs



Re Le e
Re C i

3 ° A i Te e e
° Re o e Te e e

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Add e o e e e
o e e T i i e
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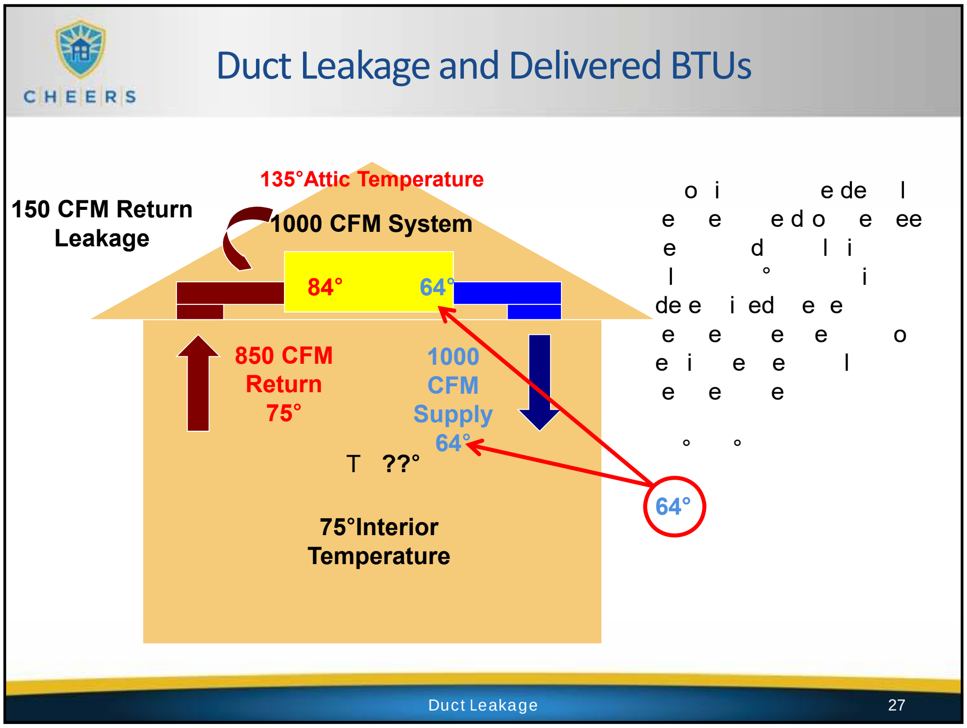
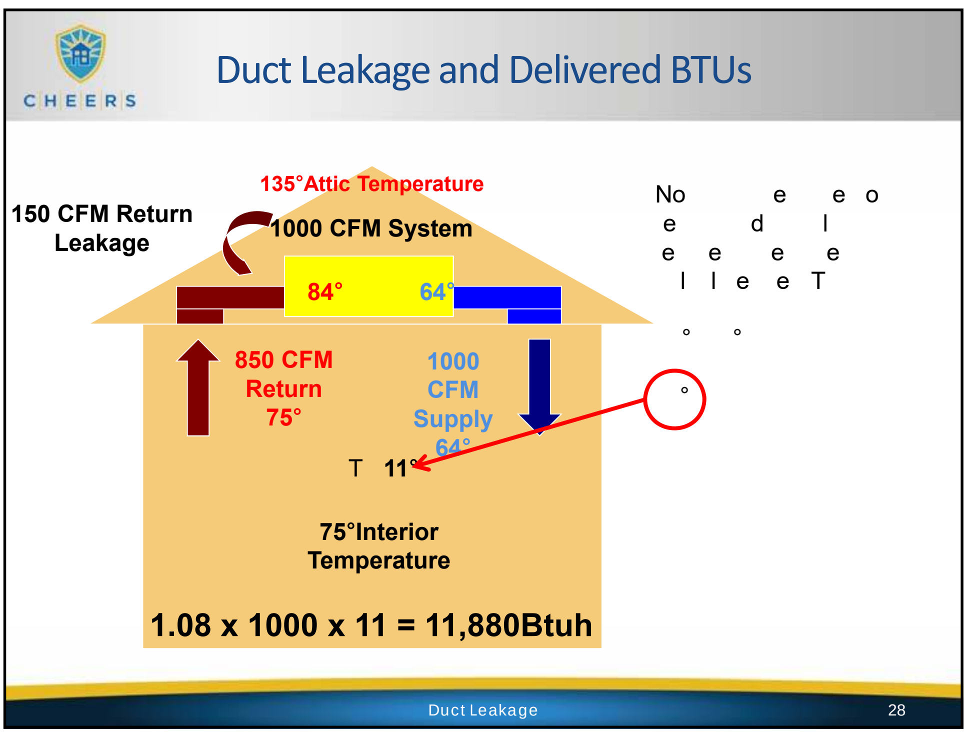

CHEERS
Duct Leakage and Delivered BTUs
135°Attic Temperature
150 CFM Return Leakage
1000 CFM System
84°
64°
850 CFM Return 75°
1000 CFM Supply 64°
T ??°
75°Interior Temperature
64°
Duct Leakage
27


CHEERS
Duct Leakage and Delivered BTUs
135°Attic Temperature
150 CFM Return Leakage
1000 CFM System
84°
64°
850 CFM Return 75°
1000 CFM Supply 64°
T 11°
75°Interior Temperature
1.08 x 1000 x 11 = 11,880Btuh
Duct Leakage
28

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Duct Leakage and Delivered BTUs

Example 4

Return & Supply-side leakage

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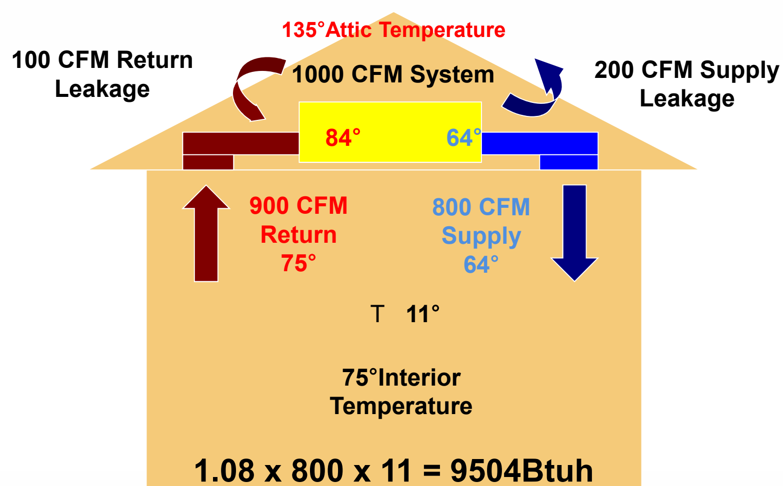
Duct Leakage and Delivered BTUs



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Duct Leakage and Delivered BTUs

In conclusion

- A leaky system will only deliver a percentage of its system capacity maximizing energy costs and decreasing the life of the unit.
- For our examples:
  - *Example 1*- 21,600 BTUh= 100% Capacity (Ideal)
  - *Example 2*- 18,360 BTUh= 85% Capacity
  - *Example 3*- 11,880 BTUh= 55% Capacity
  - *Example 4*- 9504 BTUh= 44% Capacity

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Duct Leakage and Delivered BTUs

Typical Duct Leakage Locations:

Improperly sealed duct connections

Gaps between Register boots and drywall

Unsealed penetrations in the cooling coil

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Determining Airflow

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Determining Airflow

In order to determine the duct leakage, you must first determine the System Airflow;

- This is done via two possible means
  1. Nominal Air Handler Airflow;
  2. Measured System Airflow.

Airflow is measured in CFM.

Determining Airflow

Nominal Air Handler Airflow

- Heating Method: 21.7 X kBtu/Hr of rated heating output capacity

OR

- Cooling Method: 400 X ton of condensing unit

✓Use which ever method gives the greater airflow
✓A Heating only system has to use the heating method

Determining Airflow

Nominal Air Handler Airflow (Cont.)

- Heating Method Example:

- *Furnace has 80,000 Btu of output*
- *80,000 Btu = 80 kBtu*
- *21.7 x kBtu output capacity = 21.7 x 80*
- *Airflow= 1736 CFM*

Determining Airflow

Nominal Air Handler Airflow (Cont.)

- Cooling Method Example:

- *Condenser is rated as 4 tons of cooling*
- *400 x tons of cooling capacity*
- *400 x 4*
- *Airflow= 1600 CFM*

Determining Airflow

Measured System Airflow

- The airflow will be measured with the same procedure as the adequate airflow procedure from RA3.1.4.2.1;
- The airflow will be the actual CFM measurement recorded when conducting the procedure;
- This procedure will be covered in detail later in the Adequate Airflow Section, including typical reasons for low measured system airflow.

Procedures

Procedures

The test protocol you need to use are determined by the situation you are in;

Different test criteria, based on the scope of work you are conducting, are outlined in Table RA3.1-2 of the Residential Appendices.

Procedures

Table RA3.1-2

Case	User Application	Leakage Compliance Criteria (% of Air Handler Airflow)	Procedure(s)
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Final HERS Rater Testing	6%	RA3.1.4.3.1
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Rough-in, Air Handling Unit Installed	6% Installer Inspection at Final	RA3.1.4.3.2 RA3.1.4.3.2.1 RA3.1.4.3.3
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Rough-in, Air Handling Unit Not Installed	4% Installer Inspection at Final	RA3.1.4.3.2 RA3.1.4.3.2.2 RA3.1.4.3.3
Sealed and tested new duct systems in multi-family homes regardless of duct system location.	Installer Testing at Final HERS Rater Testing	12%Total Duct Leakage	RA3.1.4.3.1
Sealed and tested new duct systems in multi-family homes regardless of duct system location.	Installer Testing at Final HERS Rater Testing	6% Leakage to Outside	RA3.1.4.3.4

Duct Leakage 41

Procedures

Table RA3.1-2 (Cont.)

Case	User Application	Leakage Compliance Criteria (% of Air Handler Airflow)	Procedure(s)
Verified Low Leakage Air Handler with Sealed and Tested Duct System Compliance Credit	Installer Testing at Final HERS Rater Testing	compliance target values 6% or less as specified on the Certificate of Compliance	RA3.1.4.3.1 and RA3.1.4.3.9
Verification of ducts located entirely in directly conditioned space, and Low leakage ducts in conditioned space compliance credit.	Installed Testing HERS Rater Testing	25 CFM Leakage to Outside	RA3.1.4.3.8

Duct Leakage 42

Procedures

The Standards make a distinction between two types of HVAC situations:

1. Entirely New or Complete Replacement Space Conditioning Systems;
2. Altered Space Conditioning Systems.

Note: *the definitions of these systems is found in the additions and alterations section*

There are two ways of testing an entirely new or complete replacement duct system

1. Total Duct Leakage;
2. Duct Leakage to Outside.

Procedures

Total Duct Leakage

- Determined by pressurizing the entire duct system to a positive pressure of 25 Pa with respect to outside;
- The following procedure shall be used for the fan pressurization tests.

Procedures

CHEERS

Total Duct Leakage (Cont.)

1. Visually verify that the air handler, supply and return plenums and all the connectors, transition pieces, duct boots and registers are installed and sealed.
   - ✓ The entire duct system shall be included in the total leakage test.
   - ✓ No temporary taping is allowed (IE. Fresh air vent dampers), however motorized dampers can be set to the closed position during testing.
   - ✓ System must be tested in its normal operating condition.

Procedures

CHEERS

Total Duct Leakage (Cont.)

2. For newly installed or altered ducts visually verify that:
   - ✓ Cloth backed rubber adhesive duct tape has not been used; If it has been used it was covered with mastic and draw bands
   - ✓ Building cavities are NOT being used as ducts (IE. belly cavity returns.)
   - ✓ All supply and return register boots have to be sealed to the drywall.

Procedures

Total Duct Leakage (Cont.)

3. Seal all the supply registers and return grilles except for one large centrally located return grille or the air handler cabinet access panel.

Note: *When sealing registers, make sure than you are sealing the tape to the surrounding material (drywall) and not the register itself.*

Duct Leakage 47

Procedures

Total Duct Leakage (Cont.)

4. Remove the filter from the return as required by manufacture's instructions.
5. Attach the fan flow meter device to the duct system at the unsealed return grille or the air handler cabinet access panel.

Duct Leakage 48

Procedures

Total Duct Leakage (Cont.)

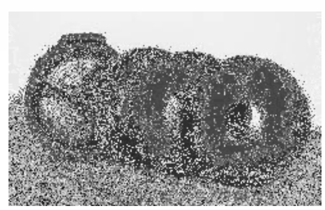
6. Install a static pressure probe at a supply register located close to the air handler, or at the supply plenum.

Procedures

Total Duct Leakage (Cont.)

7. Set appropriate ring on duct blaster based on manufacturer specifications. Ring size will affect the airflow being pushed thru the system.

Note: *Refer to equipment guides for ring selection.*



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Refer to The Manometer Reference Guides In the Back of The Manual for actual Monometer Setup

Procedures

Total Duct Leakage (Cont.)

8. Pressurize the ducts to 25 Pa with respect to the outside or with respect to the building space with the entry door open to the outside.

Procedures

Total Duct Leakage (Cont.)

9. Record the flow through the flow meter; this is the leakage flow at 25 Pa (0.1 inches water).

Procedures

Total Duct Leakage (Cont.)

10. Calculate Leakage
    - ✓ Divide measured flow (step 9) by nominal or system airflow determined previously;
    - ✓ Convert result to percentage.

Procedures

Total Duct Leakage (Cont.)

10. Calculate Leakage Example

- *Measured Flow (Step 9) / Nominal or System Airflow (ELO 2)*
- *80 CFM / 1600 CFM*
- *0.05*
- *0.05 x 100*
- *5%*

Procedures

Total Duct Leakage (Cont.)

10. Calculate Leakage (Cont.)
    - ✓ If the leakage flow percentage is equal to or less than the compliance criterion from Table RA3.1-2 (Slide 40-41) the system passes.

Procedures

Duct Leakage to Outside- LTO

- The objective of this test is to determine the amount of duct leakage to outside the air barrier for the conditioned space;
- This measurement is utilized to verify that duct systems are located entirely within conditioned space;
- The duct leakage to outside shall be determined by pressurizing the ducts and the conditioned space of the house to 25 Pa (0.1 inches water) with respect to outside;
- The following procedure shall be used for the fan pressurization test of leakage to outside.

CHEERS

Procedures

Duct Leakage to Outside- LTO (Cont.)

1. Setup the duct blaster as previously described.




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Procedures

Duct Leakage to Outside- LTO (Cont.)

2. Attach a blower door to an external doorway.


Procedures

Duct Leakage to Outside- LTO (Cont.)

3. If any ducts are located in an unconditioned basement, all doors or accesses between the conditioned space and the basement shall be closed, and at least one operable door or window (if it exists) between the basement and outside shall be open during the test.

Procedures

Duct Leakage to Outside- LTO (Cont.)

4. If the ducts are located in a conditioned basement, any door between the basement and the remaining conditioned space shall be open, and any basement doors or windows to outside must be closed during the test.

CHEERS

Procedures

Duct Leakage to Outside- LTO (Cont.)

5. Adjust the ***blower door fan*** to provide positive 25 Pa pressure in the conditioned space with respect to outside.

Duct Leakage 61

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Procedures

Duct Leakage to Outside- LTO (Cont.)

6. Adjust the ***fan/flow meter*** to maintain a zero pressure difference (plus or minus 0.5Pa) between the ducts and the conditioned space.

Duct Leakage 62

Procedures

Duct Leakage to Outside- LTO (Cont.)

7. Calculate Leakage
   - ✓ Divide the leakage flow from the ***fan/ flow meter*** by the nominal or system airflow determined in ELO 2, and convert to a percentage, as previously described;
   - ✓ If the leakage flow percentage is less than or equal to the criterion from Table 3.1-2 the system passes.

Duct Leakage 63

Procedures

Duct Leakage to Outside- LTO (Cont.)

- The same visual verifications apply as explained before in the total duct leakage section.

Duct Leakage 64

Procedures

Altered Space Conditioning Systems Duct Sealing Requirements are tested in the same manner as new systems with the following differences:

1. < 15 % Total Duct Leakage (instead than <6%), or
2. < 10 % Leakage to Outside, or
3. If option 1 cannot be met, contractor will seal all *accessible* leaks by using smoke and will be visually verified by a HERS rater. When using this option sampling is not allowed.

✓Contractors or rater must try option 1 first

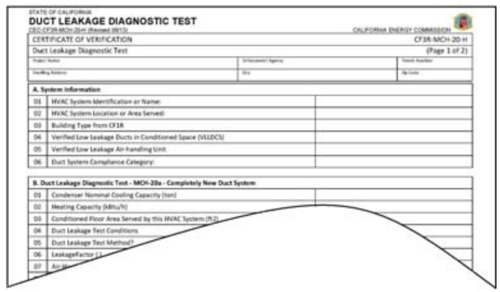
Procedures

Altered Space Conditioning Systems

EXCEPTIONS: Duct Sealing not required when any of the following conditions apply:

- ✓ They system is not ducted;
- ✓ There are less than 40Ft of ducts total in unconditioned space including plenums and FAU;
- ✓ The ducts are insulated or sealed with asbestos;
- ✓ The system was previously tested and certified by a HERS Rater, it's documented thru a CF3R or 4R, and no more than 40 Ft of ducts have been added or replaced since the original verification.

Forms


STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CALIFORNIA ENERGY COMMISSION
CERTIFICATE OF VERIFICATION CF3R-MCH-20-H
Duct Leakage Diagnostic Test (Page 1 of 2)

A. System Information		
01	HVAC System Identification or Name	
02	HVAC System Location or Area Served	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor (-)	
07	Air Ha	

Forms

CF3R-MCH-20H

- MCH-20a
- Completely New Duct Systems
- 3 Pages


DUCT LEAKAGE DIAGNOSTIC TEST

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Forms

CF3R-MCH-20H

- MCH-20d
- Complete Replacement or Altered Duct System
- 3 pages

Duct Leakage 69

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Forms

CF3R-MCH-20H

- MCH-20e
- Sealing accessible leaks using smoke test for Altered Systems
- 3 Pages

Duct Leakage 69

Training Sections

Section 1- Equipment Specifications

Section 2- Duct Leakage and Delivered BTUs

Section 3- Determining Airflow

Section 4- Procedures

- Total Duct Leakage
- Leakage to Outside

Section 5- Forms

Overall Training Goal

Familiarize yourself with Duct Leakage Testing Equipment, Protocols and Forms.

QUESTIONS

C|H|E|E|R|S

Unmatched Service with Integrity

BUILDING AIR LEAKAGE

2013 HERS I Training

Building Air Leakage

RA3.8- Residential Appendices

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References

- Residential Reference Appendices- May 2012 w/June ‘14 Errata
- RA 3.8
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Building Air Leakage

- The purpose of this test procedure is to measure the air leakage rate through a building enclosure measured in cubic feet per minute at a -50 Pa pressure difference (CFM50).

Overall Training Goal

Familiarize yourself with Building Air Leakage Testing Equipment, Protocols and Forms.

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Training Sections

Section 1- Equipment Specifications

Section 2- Preparing the Building for Testing

Section 3- Procedures

- Single Point Test
- Multiple Point Test
- Repeated Single Point Test

Section 4- Forms

CHEERS

Equipment Specifications

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Equipment Specifications

DG700

DG3

DM-2 or DM-2A

DM 32

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.

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Equipment Specifications

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Blower Door

- Fans used for building air leakage testing shall measure airflow (after making any necessary air density corrections) with an accuracy of +/- 5%.

Equipment Specifications

Calibration

Blower door and associated pressure testing instruments shall be tested annually for calibration using a standard for field testing of calibration provided by the equipment manufacturer. The HERS rater shall maintain a written log of the annual calibration check to verify all equipment accuracy for a period of three (3) years.

Preparing the Building for Testing

Preparing the Building for Testing

There are certain components of a house that you will have to prepare for building air leakage testing:

- Doors and Windows
- Attached Garages
- Crawlspaces
- Attics
- Interior Doors
- Vents and Dampers
- Whole house Fans
- Supply Registers and Return Grilles
- Window Vents & Thru the Wall Vents
- Combustion Appliances

Preparing the Building for Testing

Door and Windows

- Doors and windows that separate conditioned space from unconditioned space shall be closed and latched.

Preparing the Building for Testing

Attached Garages

- If the blower door is installed between the house and the garage, the garage shall be opened to outside by opening at least one exterior garage door.

Preparing the Building for Testing

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.

Preparing the Building for Testing

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.

Preparing the Building for Testing

Interior Doors

- Shall be open within the Conditioned Space Boundary.

Preparing the Building for Testing

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.

Preparing the Building for Testing

Combustion Appliance Flue Gas Vents:

- Combustion appliance flue gas vents shall be left in their normal appliance-off condition.

Preparing the Building for Testing

Fans

- Any fan or appliance capable of inducing airflow across the building enclosure shall be turned off ;
- This includes, but it is 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.

Preparing the Building for Testing

Motorized Dampers Which Connect the Conditioned Space to the Exterior:

- The damper shall be placed in its closed position and shall not be further sealed.

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Preparing the Building for Testing

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.

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Preparing the Building for Testing

Un-dampened, Fixed Dampers, or Intentional Openings, Between Conditioned Space and the Exterior or Unconditioned Spaces

- Shall be left open or fixed position; however, temporary blocking shall be removed.

Preparing the Building for Testing

Un-dampened or Fixed Damper Intentional Openings Between Conditioned Space and the Exterior or Unconditioned Spaces (Cont.)

- **EXCEPTION**
  - ✓Un-dampened 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.

Preparing the Building for Testing

Whole Building Fan Louvers/Shutters:

- Whole building fan louvers/shutters shall be closed;
- If there is a seasonal cover, it shall be installed.

Preparing the Building for Testing

Evaporative Cooler

- The opening to the exterior shall be placed in its off condition;
- If there is a seasonal cover, it shall be installed.

Preparing the Building for Testing

Operable Window Trickle-Vents and Through-The-Wall Vents

- Operable window trickle vents and through-the-wall vents shall be closed and/or sealed.

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Preparing the Building for Testing

Supply Registers and Return Grilles

- Supply registers and return grilles shall be left open and uncovered.

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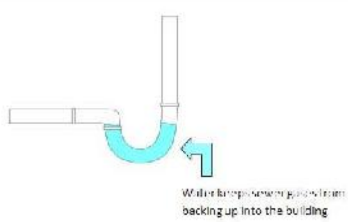
Preparing the Building for Testing



Plumbing Drains With P-Traps:

- Plumbing drains with P-traps shall be sealed, or filled with water if empty.

Preparing the Building for Testing

Combustion Appliances

- Combustion appliances shall remain off during the test;
- If during the test, induced pressures affect operable dampers, seasonal covers, etc., reestablish the set-up and consider reversing direction of fan flow.

Procedures

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Procedures

WARNING

- 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.

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Procedures

Blower Door Setup

- Unless other wise stated, we will cover **depressurization** testing;
- 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.

CHEERS

Procedures

Blower Door Setup (Cont.)

- 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 this case, be sure to open all exterior windows and doors of the unconditioned space to the outdoors.

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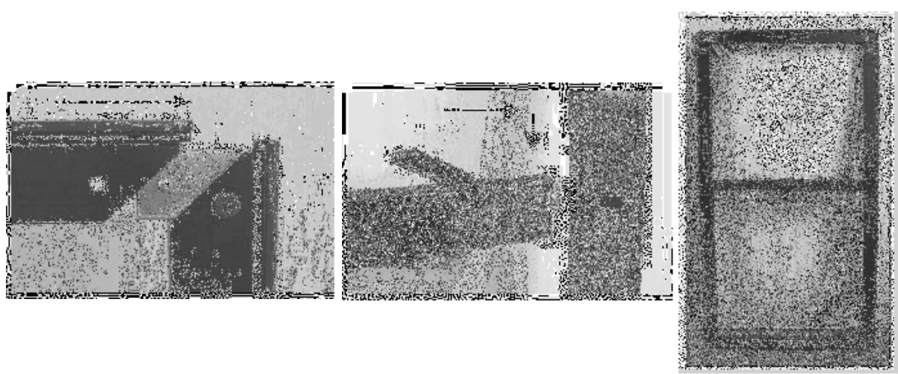
Procedures

Blower Door Setup (Cont.)

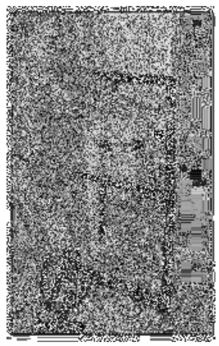
1. Build the frame



Procedures

Blower Door Setup (Cont.)

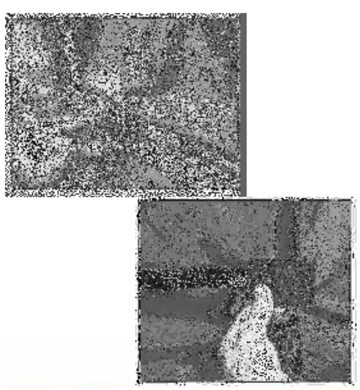
2. Fit the frame to the opening

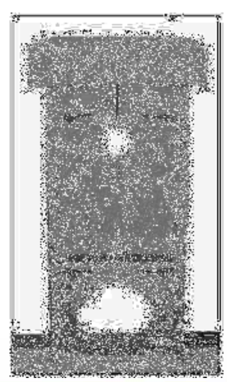


Procedures

Blower Door Setup (Cont.)

3. Attach the tarp to the frame

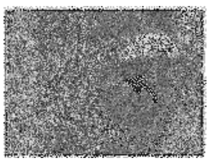


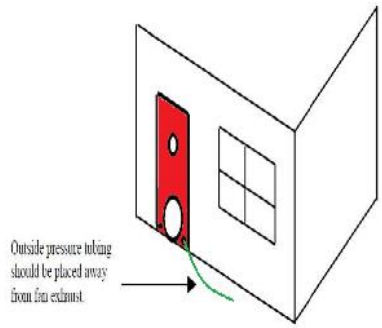


Procedures

Blower Door Setup (Cont.)

4. Install the Frame to the opening

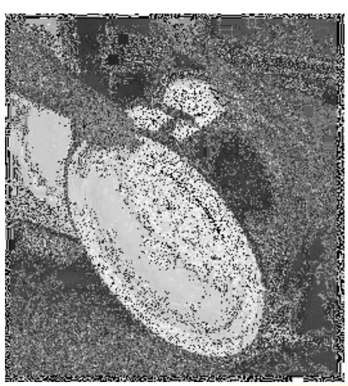




Procedures

Blower Door Setup (Cont.)

5. Install the fan on the frame



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Procedures

Blower Door Setup (Cont.)

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

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Procedures

Blower Door Setup (Cont.)

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Refer to The Manometer Reference Guides In the Back of The Manual for actual Monometer Setup

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Procedures

Preliminary Recordings

- Record the indoor and outdoor temperatures in degrees F to an accuracy of 5 degrees F;
- Record the elevation of the building site within 1000 feet for buildings at elevations above 5000 feet above sea level.

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Procedures

Levels of Accuracy

- **Standard**
  - ✓Level of accuracy that produces test results that can be used in approved modeling software to determine performance compliance with the Standards;
- **Reduced**
  - ✓Level of accuracy that may require surpassing the threshold value by an amount which will account for the added uncertainty as defined in the following sections. Software that uses test results with a reduced level of accuracy shall internally adjust the calculation in accordance with these procedures.

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Procedures

There are three acceptable air leakage test procedures

1. Single-Point Test
2. Repeated Single-Point Test
3. Multi-Point Test

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Procedures

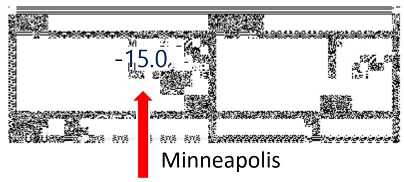
Single Point Test

- Measuring air leakage one time, at a single pressure difference as described in Section RA3.8.6.

Procedures

Single Point Test (Cont.)

- A single-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;
- The induced building pressure is the pressure of the building, while the blower door is running.



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These numbers will be the induced building pressure when the blower door is running.

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Procedures

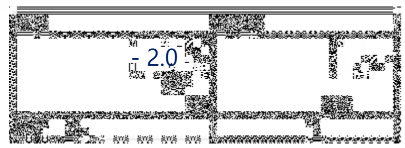
Single Point Test (Cont.)

- If the maximum induced building pressure is more than -15 Pa, recheck that the house set up is correct and determine if any basic repairs are needed prior to further testing;
- 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.

Procedures

Single Point Test (Cont.)

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



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Procedures

Single Point Test (Cont.)

3. Subtract the smallest baseline measurement from the largest recorded in Step 2 and record this as the <u>*baseline range*</u>.
   - ✓ Record the level of accuracy for the test as *Standard* or *Reduced*:
     - Air tightness tests with a baseline range less than 5.0 Pa, will be considered a *Standard Level of Accuracy Test*;
     - Air tightness tests with a baseline range between 5.0 Pa - 10 Pa will be considered a *Reduced Level of Accuracy Test* and the results will be adjusted using Section RA3.8.4.2;
   - ✓ A Single-Point test cannot be performed under this standard if the baseline range is greater than 10.0 Pa;
   - ✓ The baseline test may be repeated employing a longer time averaging period in order to meet the desired level of accuracy.

Procedures

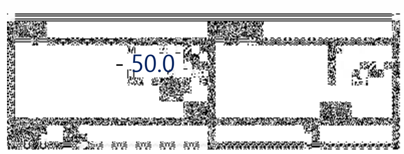
Single Point Test (Cont.)

4. Conduct and accept a baseline measurement with the digital gauge for a period of at least 30 seconds.
   - ✓ If desired for greater accuracy, a longer time averaging period may be used;
   - ✓ Most digital gauge will automatically adjust their readings once you accept the baseline measurement.

Procedures

Single Point Test (Cont.)

5. Unseal the blower door fan;
6. Turn on and adjust the fan to create an induced building pressure of approximately -50 Pa;
   - ✓ 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.



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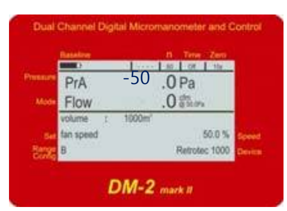

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Procedures

Single Point Test (Cont.)

7. Record the following information:
   - ✓ Induced building pressure
   - ✓ Nominal CFM50
   - ✓ Fan configuration
   - ✓ Fan and manometer model
   - ✓ Fan and manometer serial numbers

Building Air Leakage 51

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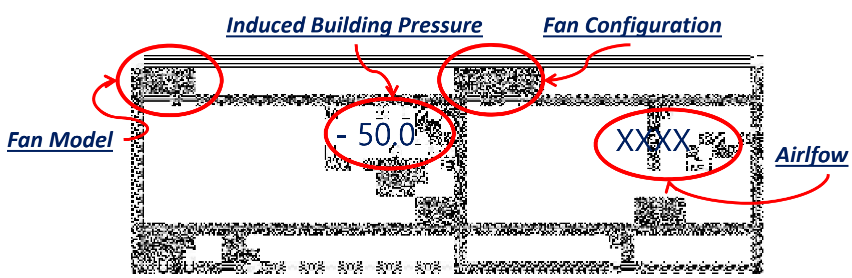
Procedures

Single Point Test (Cont.)

7. Record the following information (Cont.):



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Building Air Leakage 52

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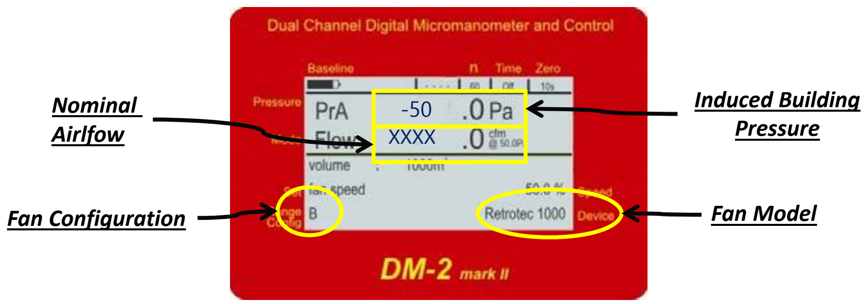
Procedures

Single Point Test (Cont.)

7. Record the following information (Cont.):



Retrotech DM-2

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Procedures

Single Point Test (Cont.)

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

Corrected CFM50 = Nominal CFM50 x altitude correction factor x temperature correction factor;

Altitude correction factor = 1 + (.000006 x altitude)

NOTE: altitude is in feet;

Temperature correction factors are listed in Tables RA3.8-2 and RA3.8-3.

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Procedures

Single Point Test (Cont.)

- Temperature correction factor **for pressurization tests**- Table RA 3.8-2.

		Inside Temperature (F)								
		50	55	60	65	70	75	80	85	90
Outside Temp (F)	-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	0.997	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

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Procedures

		Inside Temperature (F)								
		50	55	60	65	70	75	80	85	90
Outside Temp (F)	-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	09.17	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	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	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	0.998	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

Single Point Test (Cont.)

- Temperature correction factor **for <u>depressurization</u> tests**- Table RA 3.8-3.

CHEERS

Procedures

Single Point Test (Cont.)

- Calculating Corrected CFM50 Example

Nominal CFM50 = 1300
Altitude = 6000 ft.
Inside Temperature = 80 degrees
Outside Temperature = 40 degrees

Altitude Correction Factor = 1 + (.000006 x 6000 (altitude in ft.))=
= 1 + .036=
= 1.036

CHEERS

Procedures

Single Point Test (Cont.)

- Calculating Corrected CFM50 Example (Cont.)

Inside Temperature = 80 degrees
Outside Temperature = 40 degrees

Temperature Correction Factor = 0.942

		Inside Temperature (F)							
		50	55	60	65	70	75	80	85
Outside Temp (F)	-20	0.865	0.861	0.857	0.853	0.849	0.845	0.841	0.837
	-15	0.874	0.870	0.866	0.862	0.858	0.854	0.850	0.846
	-10	0.883	0.879	0.874	0.870	0.866	0.862	0.858	0.854
	-5	0.892	0.887	0.883	0.879	0.875	0.871	0.867	0.863
	0	0.900	0.896	0.892	0.887	0.883	0.879	0.875	0.871
	5	0.909	0.905	0.900	0.896	0.892	0.888	0.883	0.879
	10	0.918	0.913	0.909	0.905	0.900	0.896	0.892	0.888
	15	0.927	0.922	0.918	0.913	0.909	0.905	0.900	0.896
	20	0.935	0.931	0.926	0.922	09.17	0.913	0.909	0.905
	25	0.944	0.939	0.935	0.930	0.926	0.922	0.917	0.913
	30	0.952	0.948	0.943	0.939	0.934	0.930	0.926	0.921
	35	0.961	0.956	0.952	0.947	0.943	0.938	0.934	0.930
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938
	45	0.978	0.974	0.961	0.964	0.960	0.955	0.951	0.946
	50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955

Procedures

Single Point Test (Cont.)

- Calculating Corrected CFM50 Example (Cont.)

Corrected CFM50 = Nominal CFM50 x altitude correction factor x temperature correction factor

1300 (Nominal CFM50) x 1.036 (altitude correction factor) x .942 (temperature correction factor)

1300 X 1.036 X .942=

Corrected CFM50 = 1269 (round up)

Procedures

Repeated Single Point Test

- This 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 RA3.8.8.

Procedures

Repeated Single Point Test (Cont.)

- The single point test will be repeated at least 5 times using the same protocols as previously described;
- The fan and manometer configuration will be the same each time;
- Every repeat of the test needs to have an induced building pressure of no more than -15 Pa.

Procedures

Repeated Single Point Test (Cont.)

1. Calculate the *Average Nominal CFM50* by summing the individual nominal CFM50 readings and dividing by the number of readings (tests).

EXAMPLE:

Test 1: 1345 CFM50	*1345+1440+1399+1405+1360 = 6949*
Test 2: 1440 CFM50	*6949 / 5 (number of tests)*
Test 3: 1399 CFM50	***1390 CFM50***
Test 4: 1405 CFM50	*1390 is the Average Nominal CFM50*
Test 5: 1360 CFM50	

Procedures

Repeated Single Point Test (Cont.)

2. Calculate the *Average Corrected CFM50* if the altitude is more than 5000 ft., or the difference between inside and outside temperature is more than 30 degrees F, as previously described.

Building Air Leakage 63

Procedures

Repeated Single Point Test (Cont.)

3. Estimate the precision of uncertainty using one of the two following methods:
   - ✓ Standard Statistical Process;
   - ✓ Software Program.

Building Air Leakage 64

Procedures

CHEERS

Repeated Single Point Test (Cont.)

3. Estimate the precision of uncertainty using one of the two following methods (Cont.):
   - ✓ Standard Statistical Process
     - Calculate the Standard Deviation of the repeated *Nominal CFM50* readings;
       - Try using a preset online calculator for this *http://easycalculation.com/statistics/standard-deviation.php*
     - Divide this Standard Deviation by the square root of the number of readings.

Procedures

CHEERS

Repeated Single Point Test (Cont.)

3. Estimate the precision of uncertainty using one of the two following methods (Cont.):
   - ✓ Standard Statistical Process (Cont.)
     - Multiply the result by the t-statistic in Table RA3.8-1 corresponding to the number of readings taken;
     - Convert this result to a percentage of the *Average Nominal CFM50.*

Number of Readings	t-statistic
5	2.78
6	2.57
7	2.45
8	2.37
9	2.31

Procedures

Repeated Single Point Test (Cont.)

3. Estimate the precision of uncertainty using one of the two following methods (Cont.):
   - ✓ Software Program (FanTestic, TECTITE)
     - It shall at minimum calculate and report:
       1. *Average CFM50*, corrected for altitude and temperature;
       2. Record the *percent of uncertainty* of the *measured CFM50* at the 95% confidence level, as calculated in Standard Statistical Process;
       3. *ACH50 (air changes per hour @ 50 Pa)* = (CFM50 x 60) / building volume (in cubic feet).

Procedures

Repeated Single Point Test (Cont.)

3. Estimate the precision of uncertainty using one of the two following methods (Cont.):
   - ✓ If the reported uncertainty of the CFM50 is
     - Less than or equal to 10.0%, then the air tightness test shall be classified as a *Standard Level of Accuracy Test;*
     - Greater than 10.0%, the air tightness test shall be classified as a *Reduced Level of Accuracy Test.*

Procedures

Multi Point Test

- Measuring air leakage at multiple induced pressures differences as described in Section RA3.8.7;
  - ✓Equipment that can automatically perform a Multi-Point Test may be used to perform the following steps.

Procedures

Multi Point Test (Cont.)

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.

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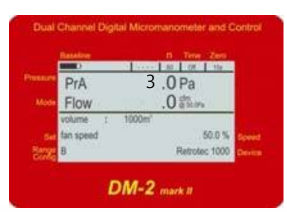


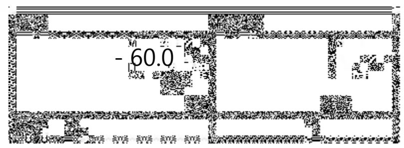
Retrotech

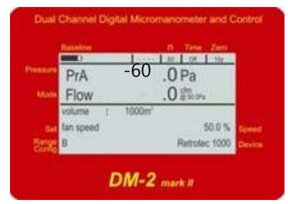
Procedures

Multi Point Test (Cont.)

2. Unseal the blower door fan;
3. 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.

Minneapolis





Retrotech

Procedures

Multi Point Test (Cont.)

4. Measure and record using the same time-averaging period as previously used:
   - ✓ Unadjusted building pressure (without baseline adjustment, with 0.1 Pa resolution);
   - ✓ Nominal fan flow (without altitude or temperature correction, with 1 CFM resolution);
   - ✓ Fan configuration, model and serial number. Assure that the fan is being operated according to the manufacturer's instructions.

Procedures

Multi Point Test (Cont.)

5. Take and record a minimum of seven (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.

Procedures

Multi Point Test (Cont.)

6. Turn off and seal the blower door fan;
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 1 and shall have a resolution of 0.1 Pa.

Procedures

Multi Point Test (Cont.)

8. Estimate the precision of the test
   - ✓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;
     - The percent uncertainty in the corrected CFM50, at the 95% confidence level;
       - ✓ NOTE: To avoid a higher percent uncertainty than desired, the HERS rater may choose a larger, time-averaging period and start over at step 1.

Procedures

Multi Point Test (Cont.)

9. Estimate the precision of the test (Cont.):
   - ✓If the reported uncertainty of the CFM50 is:
     - Less than or equal to 10.0%, then the air tightness test shall be classified as a *Standard Level of Accuracy Test;*
     - Greater than 10.0%, the air tightness test shall be classified as a *Reduced Level of Accuracy Test.*

Procedures

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy*

- An adjustment shall be used to improve the probability that the tested building meets the required performance threshold.

Procedures

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

- Adjusted CFM50 value shall be used when:
  - ✓Determining whether a building meets an air tightness; threshold as stated on compliance forms;
- Adjusted CFM50 value shall NOT be used when:
  - ✓Calculating the air tightness of a retrofit building;
  - ✓Calculating an energy audit;
  - ✓Assessing the air tightness of a group of buildings.

Procedures

CHEERS

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

Adjusted CFM50 = extending factor x corrected CFM50

Single Point Test extending factor = 1 + 0.1 x (50 / the induced pressure)

Multi-Point Test extending factor = 1 + (% uncertainty / 100)

Procedures

CHEERS

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

- Single Point Test EXAMPLE

Induced Pressure = 50

Corrected CFM50 = 1300

Single Point Test extending factor = 1 + 0.1 x (50 / the induced pressure)

= 1 + 0.1 x (50 / 50 (the induced pressure))

Single Point Test extending factor = 1.1

Procedures

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

- Single Point Test EXAMPLE (Cont.)

Adjusted CFM50 = extending factor x corrected CFM50

1.1 (extending factor) x 1300 (corrected CFM50)

Adjusted CFM50= ***1430***

Procedures

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

- Multi Point Test EXAMPLE

% of uncertainty = 37

Corrected CFM50 = 1300

Multi-Point Test extending factor = 1 + (% of uncertainty / 100)

= 1 + (37(% of uncertainty / 100)

Multi-Point Test extending factor = 1.37

CHEERS

Procedures

Adjusting the CFM50 for tests with a *Reduced Level of Accuracy* (Cont.)

- Multi Point Test EXAMPLE (Cont.)

Adjusted CFM50 = extending factor x corrected CFM50

1.37 (extending factor) x 1300 (corrected CFM50)

Adjusted CFM50= ***1781***

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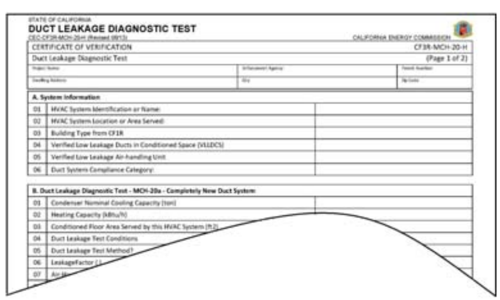
Forms



STATE OF CALIFORNIA

DUCT LEAKAGE DIAGNOSTIC TEST

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

A. System Information

01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System

01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor (…	
07	Air …	

Forms

CF3R-ENV-20a

- Building Envelope Air Leakage-Single Point Test-Manual Meter
- 2 Pages

Forms

CF3R-ENV-20b

- Building Envelope Air Leakage-Single Point Test-Automatic Meter
- 3 Pages

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Forms

CF3R-ENV-20c

- Building Envelope Air Leakage-Multi Point Air Tightness Test
- 3 Pages

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Forms

CF3R-ENV-20d

- Building Envelope Air Leakage-Repeated Single Point Test- Manual Meter
- 3 Pages

Forms

CF3R-ENV-20e

- Building Envelope Air Leakage-Repeated Single Point Test- Automatic Meter
- 3 Pages


BUILDING LEAKAGE DIAGNOSTIC TEST

Training Sections

Section 1- Equipment Specifications

Section 2- Preparing the Building for Testing

Section 3- Procedures

- Single Point Test
- Multiple Point Test
- Repeated Single Point Test

Section 4- Forms

Overall Training Goal

Familiarize yourself with Building Air Leakage Testing Equipment, Protocols and Forms.

QUESTIONS

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Unmatched Service with Integrity

FORCED AIR SYSTEM, FAN WATT DRAW AND FAN EFFICACY

2013 HERS I Training

Forced Air System Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

RA3.3- Residential Appendices

References

- Residential Reference Appendices- May 2012 w/June ‘14 Errata
- RA 3.3
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Improved system airflow rate (cfm) and reduced fan power (Watt) draw is achieved through improved air distribution system design, including more efficient motors and ducts that have less resistance to airflow;

These design and verification criteria are applicable to ducted split and packaged space conditioning systems serving low-rise residential buildings;

Determination of fan efficacy (Watt/cfm) utilizes simultaneous measurement of Air Handler Fan Watt Draw and airflow rate.

Overall Training Goal

Gain an understanding of Forced Air System Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy Testing Equipment, Protocols and Forms.

Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- System Air Flow Rate
- Fan Watt Draw

Section 3- Forms

Equipment Specifications

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Equipment Specifications

Pressure Measurements

- Shall be measured with equipment having an accuracy equal to or better than ± 1% of pressure reading or ± 0.2 Pa., whichever is greater;
- All pressure measurements within the duct system shall be made with static pressure probes such as Dwyer A303 or equivalent.

Dwyer A-303 Static Pressure Probe

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Equipment Specifications

Airflow Rate Measurements

- Shall be made with an airflow rate measurement apparatus (i.e., sensor plus data acquisition system) having an accuracy of ± 7% of reading or ± 5 cfm, whichever is greater.

Equipment Specifications

Fan Watt Draw Measurements

- Shall be made with true power measurement systems (i.e., sensor plus data acquisition system) having an accuracy of ± 2% of reading or ± 10 watts, whichever is greater.

Equipment Specifications

Authorized Diagnostic Equipment

- System airflow rate shall be measured using one of following type of apparatuses:
  - ✓Fan Flow Meter (Duct Blaster);
  - ✓Flow Grid;
  - ✓Traditional Flow Capture Hood;
  - ✓Powered Flow Capture Hood Airflow Measurement Device.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Fan Flow Meter (Duct Blaster)
  - ✓ Shall consist of a duct pressurization and flow measurement device, and a static pressure measurement device meeting the specifications as previously described.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Flow Grid
  - ✓ Shall consist of an approved flow grid and a digital pressure measurement device that meets the specifications as previously described.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Traditional Flow Capture Hood
  - ✓ Shall meet the applicable instrumentation specifications as previously described;
  - ✓ May be used to verify the system airflow rate if it has a capture area at least as large as the system grille in all dimensions.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Powered Flow Capture Hood Airflow Measurement Device
  - ✓ A device that that has the capability to balance the flow capture static pressure difference between the room and the flow capture hood enclosure, and meets the applicable instrumentation specifications as previously described ;
  - ✓ May be used to verify the airflow , as long as a flow capture area at least as large as the system register/grille in all dimensions;
  - ✓ The fan adjustment needed to balance the flow capture static pressure difference shall be provided by either an automatic or manual control.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Watt Draw Measurements shall be measured using one of following type of apparatuses:
  - ✓Portable Watt Meter;
  - ✓Analog Utility Revenue Meter;
  - ✓Digital Utility Revenue Meter.

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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Portable Watt Meter
  - ✓Shall consist of a wattmeter meeting the applicable instrumentation specifications as previously described.

Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Analog Utility Revenue Meter
  - ✓ Shall consist of the utility revenue meter meeting the applicable instrumentation specifications as previously described and a stopwatch that provides measurements in units of seconds.

Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Digital Revenue Utility Meter
  - ✓ Shall consist of the digital utility revenue meter meeting the applicable instrumentation specifications as previously described, that provides direct digital display of the Watt draw.

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Procedures

CHEERS

Procedures

EXCEPTIONS: Airflow Rate, Fan Watt Draw and Determination of Fan Efficacy is not required when any of the following conditions apply:

- ✓ The system is not ducted
- ✓ The system does not have air conditioning

Note: *Non-zoned systems may install return ducts and grills in accordance with tables 4-10 & 4-11 in the Residential Compliance Manual, or 150.0-C and 150.0-D in the Standards, in lieu of conducting the AA and FWD, as previously discussed in the T24 Overview section.*

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Procedures

There are two tests covered in this section:

- System Air Flow Rate;
- Fan Watt Draw.

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Procedures

System Air Flow Rate

- For systems utilizing an intentional ducted ventilation airflow from outside the conditioned space into the return system, the outside airflow may be included in the system airflow if that flow occurs in all operating modes of the HVAC system.

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Procedures

System Air Flow Rate (Cont.)

- For multi-zone systems the airflow must be measured for each and every operating mode of the system;
  - ✓This must be accomplished without bypasses from the supply ductwork to the return ductwork;
- All airflow measurements shall be performed with the fan set at the speed used for air conditioning.

CHEERS

Procedures

System Air Flow Rate (Cont.)

- Can be measures with one of the methods below:
  - ✓Plenum Pressure Matching method;
  - ✓Flow Grid method;
  - ✓Powered Flow Capture Hood method;
  - ✓Traditional Flow Capture Hood method.

Procedures

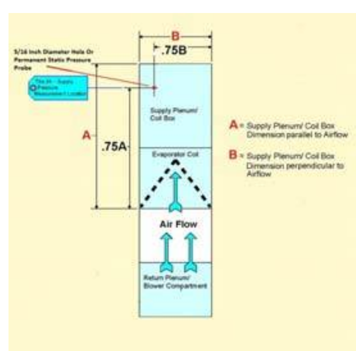
System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method
  - ✓When supply plenum pressure measurements are used for plenum pressure matching measurements, a 5/16 inch (8 mm) diameter hole for a static pressure probe (HSPP) or a permanently affixed static pressure probe (PSPP) shall be provided as shown in Figure RA3.3-1.

Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓The hole location shown in Figure RA3.3-1 can be applied to any one of the four sides of the coil box or supply plenum. The hole location shall be labeled "Title 24 – Supply Plenum Measurement Access" in at least 12-point type.



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Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓Systems that cannot conform to the specifications for the hole location shown in Figure RA3.3-1 shall not be required to have holes;
  - ✓However, if supply plenum pressure measurements are required for compliance, an alternate location that provides access for making an accurate supply plenum pressure measurement shall be used.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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CHEERS

Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓The fan flow meter shall be attached at the inlet to a return duct from the conditioned space with grille and filter removed;
    - If multiple returns are present, block off the ones not being used for this test.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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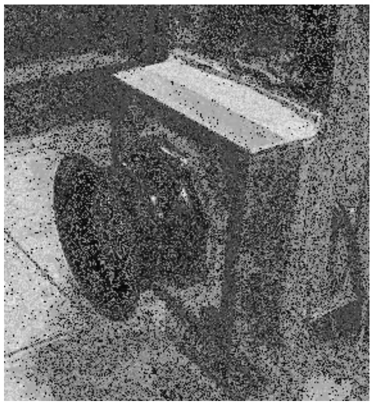
Procedures



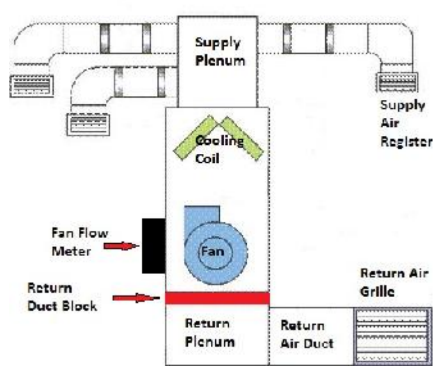
System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓ If the system **IS NOT** a multi-zoned automatic dampened system, the fan flow meter **MAY** be attached at the air handler blower compartment door as an alternative.
    - The fan flow meter shall be attached at a point where all the airflow through the system will flow through it.

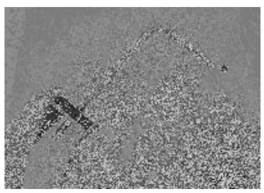
Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓ When the air handler blower compartment door attachment alternative is used, an air barrier must block the air handler inlet(s) from the return duct system.



Procedures



System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓ All registers shall be in their normal operating condition;
  - ✓ The static pressure probe shall be fixed to the supply plenum at the location previously specified so that it is not moved during this test.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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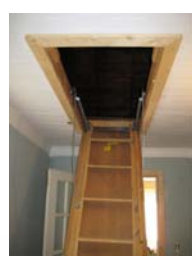
Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  - ✓ If the fan flow meter is to be connected to the air handler outside the conditioned space, then the door or access panel between the conditioned space and the air handler location shall be opened.



Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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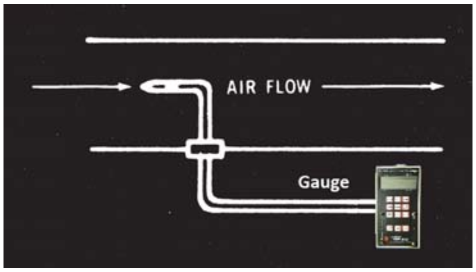
Procedures

CHEERS

System Air Flow Rate (Cont.)



- Plenum Pressure Matching Method (Cont.)
  1. Place the pressure probe in the Supply Pressure Measurement hole described previously;
  2. Adjust the probe to achieve the highest pressure and then firmly attach the probe to ensure that it does not move during the system airflow test.

Procedures

CHEERS

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  3. With the system fan on at the maximum speed (cooling speed) measure the pressure difference (in Pa) between the supply plenum and the conditioned space.
     - The recorded pressure is the target pressure to be maintained during the system airflow tests.
     - This is the “Psp” variable you’ll see in the equation coming up in a couple of slides.

Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  4. Attach the flow meter to one of the previously described locations;
  5. Turn on the fan flow meter;
  6. Adjust the fan flow meter until the pressure between supply plenum and conditioned space matches the pressure measured in Step 3.

Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  7. Record the flow through the fan flow meter;
     - This is the diagnostic system airflow (Qah);
     - In some systems, system fan and fan flow meter combinations may not be able to produce enough flow to reach matching pressures;
     - In this case record the maximum system flow (Qmax) and pressure (Pmax) between the supply plenum and the conditioned space.

Procedures

CHEERS

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  7. Record the flow through the fan flow meter (Cont.)
     - The following equation shall be used to correct measured system flow and pressure (Qmax and Pmax) to operating condition at operating pressure (Psp).

Air Handler Flow (Qah)= Qmax x [(Psp/Pmax) ^0.5]

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Procedures

CHEERS

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  7. Record the flow through the fan flow meter (Cont.)

Psp = pressure difference (in Pa) between the supply plenum and the conditioned space

Qah = Air Handler Flow

Qmax = Maximum System Flow

Pmax = Maximum System Pressure

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  7. Record the flow through the fan flow meter (Cont.)

EXAMPLE

Psp = 20 Pa

Pmax = 19 Pa

Qmax = 1600 cfm

Air Handler Flow (Qah)= Qmax (Maximum System Flow)x [Psp (Pressure Difference Between Supply Plenum and Conditioned Space) / Pmax (Maximum System Pressure) ^0.5]

Procedures

System Air Flow Rate (Cont.)

- Plenum Pressure Matching Method (Cont.)
  7. Record the flow through the fan flow meter (Cont.)

EXAMPLE

Air Handler Flow (Qah)= 1600 x [(20 / 19) ^0.5]

= 1600 x (1.05)^0.5

= 1600 x 1.03

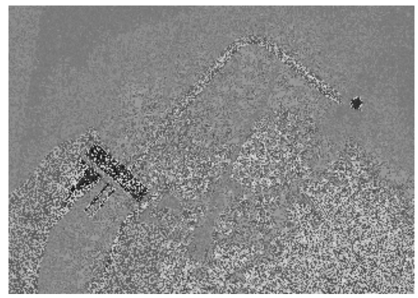
Air Handler flow (Qah) = 1648

CHEERS

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method
  - ✓ Supply Pressure Measurement holes are required as previously described.



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Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  - ✓ The flow grid shall be attached at a point where all the system air flows through the flow grid.

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  - ✓ All registers shall be in their normal operating condition.

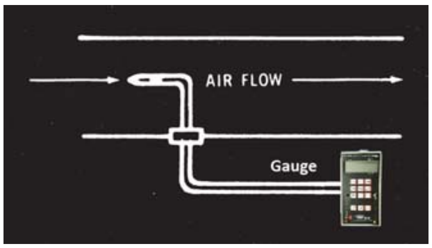
Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  - ✓ If there are multiple return grilles in the duct system, flow grids may be used to measure airflow at the return grilles, but only by installing a flow grid in each return grill and making simultaneous measurements of all return grill airflows.

CHEERS

Procedures



System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  1. Place the pressure probe in the Supply Pressure Measurement hole described previously;
  2. Adjust the probe to achieve the highest pressure and then firmly attach the probe to ensure that it does not move during the system airflow test.

CHEERS

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  3. With the system fan on at the maximum speed (cooling speed) measure the pressure difference (in Pa) between the supply plenum and the conditioned space.
     - This is the “Psp” variable you’ll see in the equation coming up in a couple of slides.
     - The recorded pressure is the target pressure to be maintained during the system airflow tests.

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  4. Re-measure the system operating pressure with the flow grid in place.
  5. Measure the airflow through the flow grid and the test pressure.
     - If multiple flow grids are present, sum the flows through each of the flow grids.

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)
  6. The following equation for air handler flow shall be used to correct flow through the flow grid (Qgrid) and pressure (Ptest) to operating condition at operating pressure (Psp).

Air Handler Flow (Qah) = Qgrid x [(Psp/Ptest) ^0.5]

Procedures

CHEERS

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)

Psp = pressure difference (in Pa) between the supply plenum and the conditioned space

Qah = Air Handler Flow

Qgrid = Airflow thru the Flow Grid

Ptest = Test Pressure with Flow Grids in Place

Procedures

CHEERS

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)

EXAMPLE

Psp = 20 Pa

Ptest = 19 Pa

Qgrid = 1600 cfm

Air Handler Flow (Qah)= Qgrid (Airflow Thru The Grids) x [Psp (Pressure Difference between The Supply Plenum and the Conditioned Space) / Ptest (Test Pressure with Flow Grids in Place) ^0.5]

Procedures

System Air Flow Rate (Cont.)

- Flow Grid Method (Cont.)

EXAMPLE

Air Handler Flow (Qah) = 1600 x [(20 / 19) ^0.5]

= 1600 x (1.05)^0.5

= 1600 x 1.03

Air Handler flow (Qah) = 1648

Procedures

System Air Flow Rate (Cont.)

- Powered Flow Capture Hood Method;
  - ✓ All registers shall be fully open;
  - ✓ The air filter shall be installed;
  - ✓ The flow capture area has to be at least as large as the return grille in all dimensions.

Procedures

System Air Flow Rate (Cont.)

- Powered Flow Capture Hood Method (Cont.)
  1. Turn on the system fan at the cooling speed and measure the airflow at the return grille(s) to determine the total system return air flow.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy
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Procedures

System Air Flow Rate (Cont.)

- Powered Flow Capture Hood Method (Cont.)
  2. For multiple return systems, the total system return airflow (Qah, cfm) shall be the sum of the airflow measurements at each of the system's return grilles.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy
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CHEERS

Procedures

System Air Flow Rate (Cont.)

- Traditional Flow Capture Hood Method;
  - ✓ All registers shall be fully open;
  - ✓ The air filter shall be installed;
  - ✓ The flow capture area has to be at least as large as the return grille in all dimensions.

CHEERS

Procedures

System Air Flow Rate (Cont.)

- Traditional Flow Capture Hood Method (Cont.)
  1. Turn on the system fan at the cooling speed and measure the airflow at the return grille(s) to determine the total system return air flow.

Procedures

System Air Flow Rate (Cont.)

- Traditional Flow Capture Hood Method (Cont.)
  2. For multiple return systems, the total system return airflow (Qah, cfm) shall be the sum of the airflow measurements at each of the system's return grilles.

Procedures

Typical Reasons for Low Measured System Airflow:

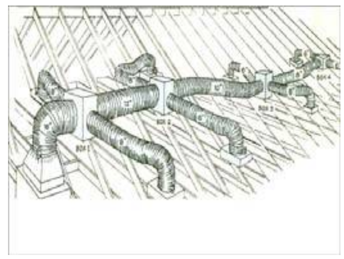
Fan Setting not Set on High When Testing

Return Duct Leakage

Procedures

Typical Reasons for Low Measured System Airflow (Cont):

Damage/Blockage
to Return Ducts



Oversized/Undersized
Return Ducts and/or
Return Grilles

Procedures

Fan Watt Draw

- Can be measured with one of the methods below:
  - ✓Portable Watt Meter;
  - ✓Analog Utility Revenue Meter;
  - ✓Digital Utility Revenue Meter.

CHEERS

Procedures

Fan Watt Draw (Cont.)

- Portable Watt Meter
  - ✓ Registers shall be fully open;
  - ✓ The air filter shall be installed.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Procedures

Fan Watt Draw (Cont.)

- Portable Watt Meter (Cont.)
  1. Turn on the system fan at the maximum speed (usually the cooling speed);
     - Include the outdoor air introduction if ventilation is provided through the return duct system.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Procedures

Fan Watt Draw (Cont.)

- Portable Watt Meter (Cont.)
  2. Take measurement of the fan watt draw (Wfan), directly from the metering device.

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Procedures

Fan Watt Draw (Cont.)

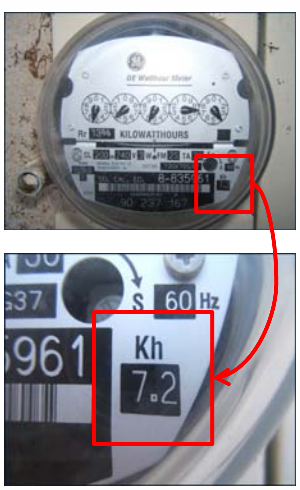
- Analog Utility Revenue Meter
  - ✓ All registers shall be fully open;
  - ✓ The air filter shall be installed;
  - ✓ Turn off every circuit breaker except the one exclusively serving the air handler.

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  1. Turn on the system fan at the maximum speed (usually the cooling speed);
     - Include the outdoor air introduction if ventilation is provided through the return duct system.

Procedures



Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  2. Record the Kh factor on the revenue meter

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  3. Count the number of full revolutions of the meter wheel over a period exceeding 90 seconds;
     - Always count full revolutions;
  4. Record the number of revolutions and time period used during the count, in seconds.

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  5. Compute the air handler watt draw using the following formula:

$$Wfan = (Kh \times Nrev \times 3600) / Trev$$

CHEERS

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  5. Compute the air handler watt draw using the following formula (Cont.):

Wfan = Air Handler Fan Watt Draw

Kh = Kh Factor from Utility Meter

Nrev = Number of Meter Revolutions (whole numbers)

Trev = Time Used to Count Revolutions (in seconds)

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Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  5. Compute the air handler watt draw using the following formula (Cont.):

EXAMPLE

Kh = 7.2

Nrev = 3

Trev = 90 (seconds)

Wfan (Fan Watt Draw) = (Kh(From the Utility Meter) x Nrev(Number of Revolutions) x 3600) / Trev(Time Used to Count Revolutions)

CHEERS

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  5. Compute the air handler watt draw using the following formula (Cont.):

EXAMPLE

Wfan = (7 x 3 x 3600) / 90

= 75600 / 90

Wfan = 840 W

CHEERS

Procedures

Fan Watt Draw (Cont.)

- Analog Utility Revenue Meter (Cont.)
  6. Return all circuit breakers to their original positions.

Procedures

Fan Watt Draw (Cont.)

- Digital Utility Revenue Meter
  - ✓ All registers shall be fully open;
  - ✓ The air filter shall be installed;
  - ✓ Turn off every circuit breaker except the one exclusively serving the air handler.

Procedures

Fan Watt Draw (Cont.)

- Digital Utility Revenue Meter (Cont.)
  1. Turn on the system fan at the maximum speed (usually the cooling speed);
     - Include the outdoor air introduction if ventilation is provided through the return duct system.

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Procedures

Fan Watt Draw (Cont.)

- Digital Utility Revenue Meter (Cont.)
  2. Read the Watt draw from the digital utility meter digital display.

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Procedures

Fan Watt Draw (Cont.)

- Digital Utility Revenue Meter (Cont.)
  3. Return all circuit breakers to their original positions.

Procedures

Determination of Forced Air System Airflow Requirements

- The measured value for airflow (cfm) shall be converted to cfm per ton by dividing the measured system airflow rate by the nominal tons of condensing unit cooling capacity for the air conditioner.

EXAMPLE

Measured System Airflow Rate: 1600

AC Tonnage: 4 Tons

Cfm/ton= Measured System Airflow Rate / AC Tonnage

= 1600 / 4

Cfm/ton = 400

Procedures

Determination of Forced Air System Fan Efficacy

- Requires simultaneous measurement of the System Airflow Rate and Fan Watt Draw as previously described.

Procedures

Determination of Forced Air System Fan Efficacy (Cont.)

- The measured value for fan Watt draw (Watt) shall be divided by the measured value for airflow rate (cfm) to determine the fan efficacy (Watt/cfm).

EXAMPLE

Watt Draw = 600 Watts

Airflow Rate = 1800 cfm

Fan Efficacy = Watt Draw / Airflow Rate

= 600 / 1800

Fan Efficacy = .33 Watt/ cfm

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy 79

Procedures

Compliance Criteria

- In order to comply with either the system airflow requirement, or the fan efficacy requirement, the following criteria shall be met:
  1. The system airflow (cfm/ton) shall meet or exceed the system airflow compliance criteria specified in the Standards or on the Certificate of Compliance as applicable;
     - The standard design minimum target for new systems is 400 cfm/ton.
     - The standard design minimum target for altered systems is 350 cfm/ton.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy 80

Procedures

Compliance Criteria (Cont.)

- In order to comply with either the system airflow requirement, or the fan efficacy requirement, the following criteria shall be met (Cont.):
  2. The calculated value for fan efficacy (Watt/cfm) shall be equal to or less than the fan efficacy compliance criterion specified in the Standards or on the Certificate of Compliance as applicable;
     - The standard design maximum target is .58 Watt/cfm.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy 81

Procedures

Compliance Criteria (Cont.)

- In order to comply with either the system airflow requirement, or the fan efficacy requirement, the following criteria shall be met (Cont.):
  3. For Single zone air distribution systems with multi-speed compressor systems or variable speed compressor systems:
     - Shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation in cooling mode at the maximum compressor speed and the maximum air handler fan speed.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy 82

CHEERS

Procedures

Compliance Criteria (Cont.)

- In order to comply with either the system airflow requirement, or the fan efficacy requirement, the following criteria shall be met (Cont.):
  4. Zoned air distribution systems:
     - Shall meet both the airflow (cfm/ton) and fan efficacy (Watt/cfm) criteria in every zonal control mode;
     - Multi-speed compressor systems or variable speed compressor systems shall only be required to verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation in cooling mode at maximum compressor capacity and maximum system fan speed and with all zones calling for conditioning.

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Procedures

Zoned Air Distribution System

- The following are characteristics of most zonally controlled systems that utilize dampers:
  1. Motorized or actuated zone dampers on the supply ducts;
  2. Multiple thermostats or temperature sensors in area served by a single system;
  3. A control board on or near the air handler with low voltage wires going to the thermostats/temperature sensors and to each damper;
  4. Bypass duct and damper.

Procedures

Zoned Air Distribution System (Cont.)

- The following are characteristics of most zonally controlled systems that utilize dampers (Cont.):
  1. Motorized or actuated zone dampers on the supply ducts;

Procedures

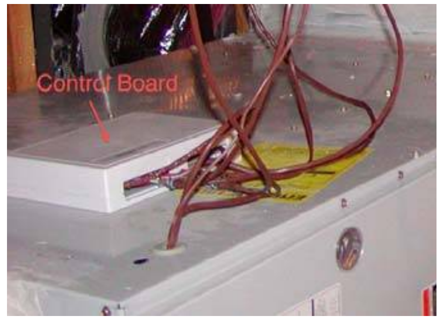
Zoned Air Distribution System (Cont.)

- The following are characteristics of most zonally controlled systems that utilize dampers (Cont.):
  2. Multiple thermostats or temperature sensors in area served by a single system;

Procedures

Zoned Air Distribution System (Cont.)

- The following are characteristics of most zonally controlled systems that utilize dampers (Cont.):
  3. A control board on or near the air handler with low voltage wires going to the thermostats/temperature sensors and to each damper;



Procedures

Zoned Air Distribution System (Cont.)

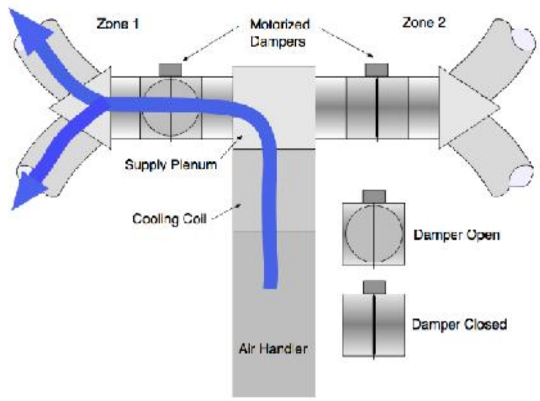
- The following are characteristics of most zonally controlled systems that utilize dampers (Cont.):
  4. Bypass duct and damper.

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

Procedures

Zoned Air Distribution System (Cont.)

- Example



Procedures

Zoned Air Distribution System (Cont.)

- When a zonally controlled forced air system is installed, the following shall be verified to determine compliance:
  1. A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used

     OR

  2. If the Certificate of Compliance indicates an allowance for use of a bypass duct, the bypass duct shall conform to the specifications given on the Certificate of Compliance.

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Procedures

Multispeed/ variable speed compressors

- If this type of compressor is modeled, it must be installed and verified;
- There are several features that can indicate that a condenser is multi-speed:
  1. Product tags, labels and marketing names that indicate two-stage, dual-stage, multistage, etc.
  2. Two compressors observed by looking down through the condenser fan;
  3. High and low capacities or nominal tonnages indicated on nameplate.
- The only definitive way to determine if the condenser is multi-speed or variable speed is to record the make and model number and find the manufacturer's specifications.

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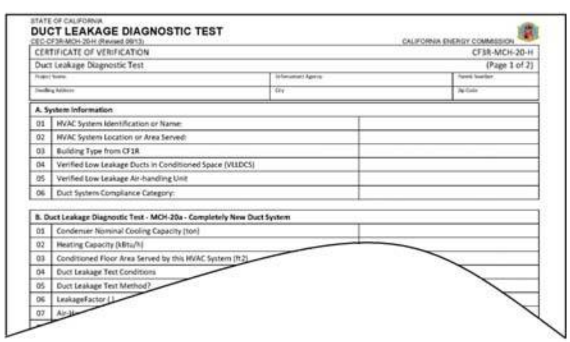
Forms


STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-CF3R-MCH-20-H (Revised 09/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

A. System Information

01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System

01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor ( )	
07	Air-H	

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Forms

CF3R-MCH-22-H

- Fan Efficacy (Fan Watt Draw)
- 2 Pages


FAN EFFICACY (FAN WATT DRAW)

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Forms


SPACE CONDITIONING SYSTEM AIRFLOW RATE

CF3R-MCH-23-H

- Space Conditioning System Airflow Rate
- 2 Pages

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- System Air Flow Rate
- Fan Watt Draw

Section 3- Forms

Overall Training Goal

Gain an understanding of Forced Air System Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy Testing Equipment, Protocols and Forms.

QUESTIONS

Airflow Rate, Fan Watt Draw, and Determination of Fan Efficacy

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C|H|E|E|R|S

Unmatched Service with Integrity

REFRIGERANT CHARGE

C|H|E|R|S
Unmatched Service with Integrity

2013 HERS I Training

Refrigerant Charge for Air Conditioners & Heat Pumps

RA3.2- Residential Appendices

C|H|E|R|S

References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.2
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Refrigerant Charge for Air Conditioners & Heat Pumps 2

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Introduction

Refrigerant Charge

- This test is designed to verify the refrigerant charge in the HVAC system and identify potential refrigeration system faults.

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Overall Training Goal

Familiarize yourself with Refrigerant Charge Testing Equipment, Protocols and Forms.

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Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- Standard Charge Verification Procedure
- Winter Setup Verification Procedure
- Weigh In Charging Procedure

Section 3- Forms

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Equipment Specifications

Equipment Specifications

Temperature Measurements:

- Shall be made utilizing digital temperature measurement instrumentation (combined sensor plus device for data acquisition, processing and reporting) that shall have dual channel capability in Celsius or Fahrenheit and conform to the following specifications:
    1. Accuracy: ± 2°F.
    2. Resolution: 0.2°F.

Equipment Specifications

Hygrometer:

- Shall have a probe of at least 3 inches in length;
- Shall be able to take both dry and wet bulb measurements;
- Accuracy of ± 2°F wet-bulb temperature, or a calculated wet-bulb temperature based on accuracies of ± 3% RH and ± 2.0 degree F Dry bulb temperature;
- Resolution: 0.2°F

Equipment Specifications

Pipe Temperature Measurements

- Temperature measurement of suction or liquid refrigerant lines using sensor mounting styles such as pipe-clamp sensors, Velcro strap-on, or an equivalent sensor device or sensor mounting method shall meet the following specifications:
  1. Accuracy: ± 2°F.
  2. Resolution: 0.2°F.

Equipment Specifications

Temperature Sensors Response Time Specifications:

- All previously described sensors shall produce an accurate reading within 90 seconds of insertion into the test environment.

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Equipment Specifications

Refrigerant Gauges

- Shall be digital;
- Shall meet the following specifications:
    1. Liquid Line Pressure Accuracy: ± 7.0 psi
    2. Suction Line Pressure Accuracy: ± 3.5 psi

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Equipment Specifications

Refrigerant Gauges (Cont.)

- As an alternative to the use of refrigerant gauges, two saturation pressure measurement sensors (SPMS) may be permanently installed by the equipment manufacturer, or in a manner and location approved by the equipment manufacturer for use to measure the saturation pressure of the refrigerant in the evaporator coil and in the condenser coil;
- The pressure measurement instrumentation shall have an accuracy of ±3 percent of discharge pressure and ±1.0 psig suction pressure.

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Equipment Specifications

Refrigerant Scale:

- Shall be electronic;
- Shall have an accuracy equal to or better than ±0.5 oz. or ± 0.5% of the measured value.

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Equipment Specifications

Condenser Outlet Air Restrictor

- Used for the Winter Setup Procedure;
- A device which restricts the free area of the outlet from the condenser fan to reduce the air flow, but does not interfere with air entering the condenser coil;
- The amount of restriction shall be adjustable.

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Equipment Specifications

Calibration

- All temperature sensors (except hygrometers) and refrigerant gauges shall be calibrated monthly, in accordance with specification in Section RA3.2.2.4;
- A sticker with the calibration check date shall be affixed to each instrument calibrated.

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Equipment Specifications

Calibration (Cont.)

- Hygrometers shall be calibrated according to the manufacturer's recommended time intervals and procedures;
- A sticker with the calibration check date shall be affixed to each instrument calibrated.

Equipment Specifications

Calibration (Cont.)

- Refrigerant scales shall be calibrated according to the manufacturer's recommended time intervals and procedures;
- A sticker with the calibration check date shall be affixed to each instrument calibrated.

Procedures

CHEERS

Procedures

EXCEPTIONS: Refrigerant Charge is not required when any of the following conditions apply:

- The system does not have AC installed;
- The system is a new package unit with factory certification of charge. The minimum airflow still needs to be verified. The Rater will still need to retain the AHRI certification number and enter it on the CF3R-MCH-25;
- The system has an approved and verified CID as described in the HVAC Components and Devices section.

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Procedures

There are two methods to conduct a refrigerant charge verification on a system:

1. Standard Charge Verification Procedure;
   - The winter time setup procedure is a modified version of the standard verification, allowed on manufacturer approved AC equipment.
2. Weigh In Charging Procedure.

Procedures

Standard Charge Verification Procedure

- Applicable to:
  - ✓ Ducted split system air-cooled air conditioners;
  - ✓ Ducted split system air-source heat pumps;
- *May be* applicable to:
  - ✓ Packaged air-cooled air conditioners;
  - ✓ Packaged air-source heat pumps.

Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements
  - ✓ Requires visual verification (for applicable systems) that the metering device (Fixed, TXV, or EXV) is operating properly.

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Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements (Cont.)
  - ✓ May be used only when the outdoor air temperature is 55°F or above;
  - ✓ The return air dry bulb temperature shall be maintained above 70°F during the test.

Refrigerant Charge for Air Conditioners & Heat Pumps

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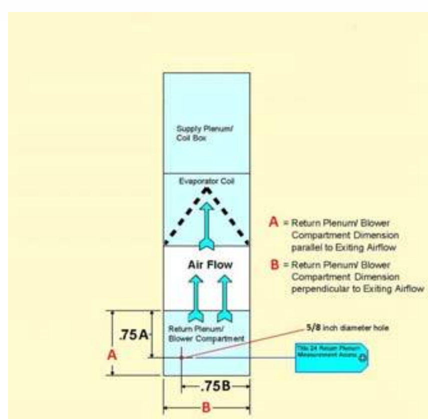
CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- General requirements (Cont.)
  - ✓ Measurement Access Holes (MAH)
    - When return plenum measurements are necessary for compliance with refrigerant charge verification requirements, a 5/8 inch (16mm) diameter hole shall be provided as shown.



Refrigerant Charge for Air Conditioners & Heat Pumps

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Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements (Cont.)
  - ✓Measurement Access Holes (MAH) (Cont.)
    - Shall be sealed to prevent leakage after the measurements have been completed;
    - Can be applied to any one of the four sides of the return plenum;
    - Shall be labeled "Title 24 – Return Plenum Measurement Access" in at least 12-point type.

Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements (Cont.)
  - ✓ Measurement Access Holes (MAH) (Cont.)
    - For air-handling units with the return located entirely within conditioned space the return plenum measurement access hole is not required, and in this case the return air temperature measurements shall be taken at the return grill.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements (Cont.)
  - ✓ Measurement Access Holes (MAH) (Cont.)
    - Systems that cannot conform to the MAH requirements shall not be required to have holes as previously described;
    - However, if return plenum measurements are required for compliance, an alternate location that provides access for making an accurate return plenum measurement shall be used.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- General Requirements
  - ✓ Requires verification of the Air System Airflow Rate as described in previous lessons.

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements
  - ✓Compliance with the standard refrigerant charge verification procedures requires that the system meet minimum system airflow rate criteria, measured as previously explained in the Adequate Airflow section.
  - ✓Standards of compliance very between new systems and altered systems
    - New Systems: 350 cfm/ ton
    - **Altered Systems** : 300 cfm/ ton

    Note: *the definition of an altered system will be discussed in the additions & alterations section*

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)**
    - When an altered space conditioning system fails to demonstrate compliance with the required 300 cfm per ton of minimum system airflow, the installer shall perform the following remedial actions.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓ Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    1. Check to determine that the air filter media is clean. If the air filter media is dirty, then replace it with clean filter media.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓ Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    2. Open all registers and dampers and remove any obstructions.

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓ Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)

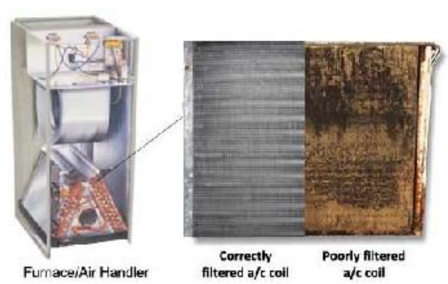
3. Replace crushed, blocked or restricted ducts if possible.

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓ Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)

4. Check to determine that the evaporator coil is clean, or that there are no obstructions to airflow through the evaporator coil. If the evaporator coil is dirty or blocked with debris, if possible, clean the evaporator coil using a method approved by the manufacturer.



Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓ Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    5. Set the air handler fan to high speed for cooling, and ensure that the blower wheel and motor are operating properly, within manufacturers specifications.

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    6. Check to determine whether the return duct system or return filter grille is sized too small for the installed system. If the return duct or return grille is sized too small, if possible, perform applicable alterations work on the return duct system or return grille in order to improve the system airflow rate.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    - For each of the listed remedial actions, the HVAC installer shall certify that the remedial action was performed, and indicate whether the action was, or was not, completed successfully;
    - When a remedial action was not completed successfully the installer shall indicate on the installation certificate the reason the action was not completed successfully.

Refrigerant Charge for Air Conditioners & Heat Pumps

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CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    - If these remedial actions fail to bring the system into compliance with the 300 cfm per nominal condensing unit ton airflow requirement, the installer shall complete the refrigerant charge verification utilizing the best airflow rate attainable.

Refrigerant Charge for Air Conditioners & Heat Pumps

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Procedures

CHEERS

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    - The HERS Rater shall review the information submitted on the installation certificate and perform follow-up communications with the HVAC installer or the homeowner;
    - The system complies if the HERS Rater determines the remedial actions have been performed, and the information reported on the installation certificate is valid.

Procedures

CHEERS

Standard Charge Verification Procedure (Cont.)

- Minimum System Airflow Rate Requirements (Cont.)
  - ✓Remedial Actions **(ALTERED SYSTEM ONLY)** (Cont.)
    - If the system complies thru the use of remedial actions, the system cannot be used for sampling.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure
  - ✓ Operate the air conditioner in cooling mode for at least 15 minutes to allow the temperatures and pressures to stabilize before taking any measurements.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  - ✓ While the system is stabilizing, proceed with setting up the equipment;
  - ✓ Be sure that all cabinet panels that affect airflow are in place before making measurements;
  - ✓ The temperature sensors shall remain attached to the system until the final charge is determined;
  - ✓ Wet Bulb measurements shall be taken using distilled water.

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  1. Follow the manufacturer's directions and adhere to the manufacturer's limitations on indoor ambient air temperature (T_{indoor} air) and outdoor ambient air temperature ($T_{outdoor}$ air) applicable to this procedure.

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  2. Connect the refrigerant gauges to the service ports using low loss fittings, taking normal precautions to not introduce air into the system.

Procedures

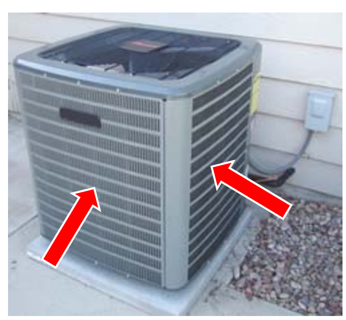
Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  3. Attach one pipe temperature sensor to the suction line and one to the liquid line near the service valve. The sensors should be positioned to make good contact with the surface of the refrigerant line.

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  4. Measure and record the dry-bulb temperature of the air entering the condenser ($T_{condenser, db}$). The sensor shall be placed so that it records the average condenser air entering temperature and is shaded from direct sun .



Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  5. Using the "Title 24 – Return Plenum Measurement Access" as previously described, Measure and record the return air dry-bulb temperature ($T_{return, db}$).

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  6. If the system has a fixed metering device, using the same return plenum access hole used in Step 5, measure and record the return air wet-bulb temperature ($T_{return, wb.}$) Make sure the dry bulb sensor does not get wet.

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  7. Using the refrigerant gauge, measure and record the suction line (low side) pressure.

Low Side Pressure

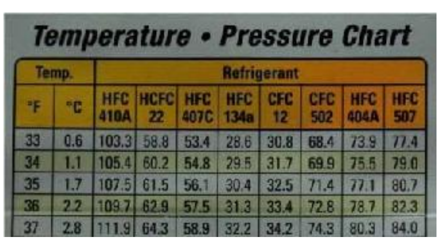
Blue = Low side (Suction)

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  8. Use a conversion chart to convert the pressure measured in step 7 to its equivalent temperature ($T_{evaporator, sat}$).



Temperature • Pressure Chart

Temp.		Refrigerant							
°F	°C	HFC 410A	HCFC 22	HFC 407C	HFC 134a	CFC 12	CFC 502	HFC 404A	HFC 507
33	0.6	103.3	58.8	53.4	28.6	30.8	68.4	73.9	77.4
34	1.1	105.4	60.2	54.8	29.5	31.7	69.9	75.5	79.0
35	1.7	107.5	61.5	56.1	30.4	32.5	71.4	77.1	80.7
36	2.2	109.7	62.9	57.5	31.3	33.4	72.8	78.7	82.3
37	2.8	111.9	64.3	58.9	32.2	34.2	74.3	80.3	84.0

CHEERS

Procedures

Low Side Temperature

Blue = Low side (Suction)

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  9. Measure and record the suction line (low side) temperature ($T_{suction}$).

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  10. Using the refrigerant gauge, measure and record the liquid line (high side) pressure.

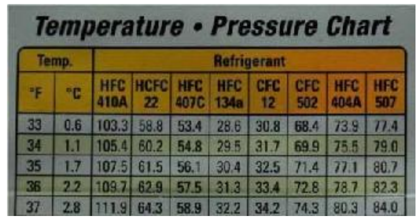
High Side Pressure

Red = High Side (Liquid)

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  11. Use a conversion chart to convert the pressure measured in step 10 to its equivalent temperature ($T_{condenser, sat}$).



Temperature • Pressure Chart

Temp.		Refrigerant							
°F	°C	HFC 410A	HCFC 22	HFC 407C	HFC 134a	CFC 12	CFC 502	HFC 404A	HFC 507
33	0.6	103.3	58.8	53.4	28.6	30.8	68.4	73.9	77.4
34	1.1	105.4	60.2	54.8	29.5	31.7	69.9	75.5	79.0
35	1.7	107.5	61.5	56.1	30.4	32.5	71.4	77.1	80.7
36	2.2	109.7	62.9	57.5	31.3	33.4	72.8	78.7	82.3
37	2.8	111.9	64.3	58.9	32.2	34.2	74.3	80.3	84.0

Procedures

Standard Charge Verification Procedure (Cont.)

- Procedure (Cont.)
  12. Measure and record the liquid line temperature (T_{liquid}).

Procedures

Standard Charge Verification Procedure (Cont.)

- Metering Device Calculations
  - ✓The following steps describe the calculations to determine if the system meets the required refrigerant charge and metering device function using the measurements you just collected;
  - ✓If a system fails, then remedial actions must be taken by the HVAC system installer.

Procedures

Standard Charge Verification Procedure (Cont.)

- Metering Device Calculations (Cont.)
  - ✓**Superheat** Charging Method for systems **with fixed metering devices;**

OR

  - ✓**Subcooling** Charging Method for systems **with Variable Metering Devices**, such as Thermostatic Expansion Valves (TXV) or Electronic Expansion Valves (EXV).

Procedures

Standard Charge Verification Procedure (Cont.)

- Fixed Metering Devices
  ✓Superheat Charging Method
  1. Calculate Actual Superheat as the suction line temperature minus the evaporator saturation temperature.

$$Actual\ Superheat = T_{suction} - T_{evaporator,\ sat}$$

Procedures

Standard Charge Verification Procedure (Cont.)

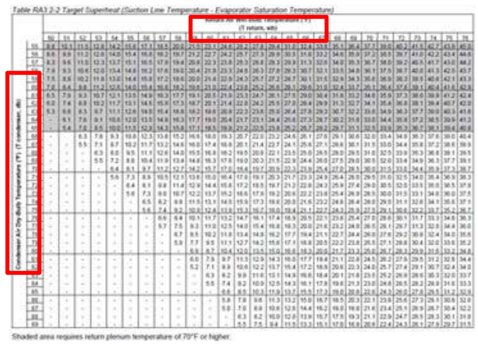
- Fixed Metering Devices (Cont.)
  ✓Superheat Charging Method (Cont.)
  2. Determine and record the Target Superheat using Table RA3.2-2 or the manufacturer's superheat chart, using the return air wet-bulb temperature ($T_{return,\ wb}$) and condenser air dry-bulb temperature ($T_{condenser,\ db}$).

CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Fixed Metering Devices (Cont.)
  - ✓ Superheat Charging Method (Cont.)
    - Table RA3.2-2



CHEERS

Procedures

Standard Charge Verification Procedure (Cont.)

- Fixed Metering Devices (Cont.)
  - ✓ Superheat Charging Method (Cont.)
    - If a dash mark is read from Table RA3.2-2, the target superheat is less than 5°F. Note that **a valid refrigerant charge verification test cannot be performed under these conditions**;
    - The usual reason for a target superheat determination of less than 5°F is that outdoor conditions are too hot and the indoor conditions are too cool;
    - You can do one of the following so a target superheat value can be obtained from Table RA3.2-2.

      1) Turn on the space heating system and/or open the windows to warm up indoor temperature;

      OR

      2) Retest at another time when conditions are different.

Procedures

Standard Charge Verification Procedure (Cont.)

- Fixed Metering Devices (Cont.)
  - ✓Superheat Charging Method (Cont.)

3. Calculate the difference between actual superheat (Step 1) and target superheat (Step 2)

Actual Superheat – Target Superheat

Procedures

Standard Charge Verification Procedure (Cont.)

- Fixed Metering Devices (Cont.)
  - ✓Superheat Charging Method (Cont.)

4. Determine if the system complies
   - If the difference in superheat is within ± 8°F of the specified target, the system complies.

Procedures

CHEERS

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices
  - ✓Subcooling Charging Method
    1. Calculate Actual Subcooling as the condenser saturation temperature minus the liquid line temperature.

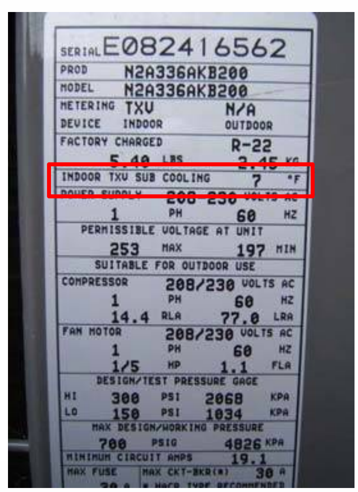
$$\textit{Actual Subcooling} = T_{condenser,\ sat} - T_{liquid}$$

Procedures

CHEERS

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices (Cont.)
  - ✓Subcooling Charging Method (Cont.)
    2. Determine the Target Subcooling specified by the manufacturer.



Procedures

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices (Cont.)
  - ✓Subcooling Charging Method (Cont.)
    3. Calculate the Deviation of the Actual Subcooling value from the Target Subcooling value.

Subcooling Deviation = Actual Subcooling - Target Subcooling.

Procedures

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices (Cont.)
  - ✓Subcooling Charging Method (Cont.)
    4. Determine if the system complies
       - If the difference in Subcooling is within $\pm$ 6°F of the specified target, **AND** the Subcooling is $\geq$ 2°F, the system complies.

Procedures

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices (Cont.)

  ✓Subcooling Charging Method (Cont.)

  5. Calculate Actual Superheat as the suction line temperature minus the evaporator saturation temperature.

$$\textit{Actual Superheat} = T_{suction} - T_{evaporator,\ sat}$$

Procedures

Standard Charge Verification Procedure (Cont.)

- Variable Metering Devices (Cont.)

  ✓Subcooling Charging Method (Cont.)

  6. Determine if the system complies
     - If possible, determine the Superheat Range specified by the manufacturer.
     - If the superheat meets the Manufacturer's specifications or the super heat is between 3°F and 26°F, the system complies.

Procedures

CHEERS

Winter Setup Verification Procedure

- Applicable to
  - ✓ Ducted split system central air-cooled air conditioners and ducted split system central air-source heat pumps for which the system manufacturer has specified that this procedure may be used to verify the refrigerant charge;
  - ✓ Only units with variable metering devices (TXV, EXV).
  - ✓ Only systems approved by the manufacturer for this procedure.

Procedures

CHEERS

Winter Setup Verification Procedure (Cont.)

- The Standard Charge Measurement Procedure calls for the outdoor temperature to be 55°F or higher.
- The Winter Charge Setup creates the right conditions at the unit being tested for outdoor temperatures above 37°F and below 71°F that allow the system to operate in the same range of pressure differences between the low side pressure and the high side pressure as occurs during warm outdoor temperatures.

Procedures

Winter Setup Verification Procedure (Cont.)

- The Winter Charge Setup achieves an appropriate high side - low side pressure differential to conduct the Standard Charge Verification Procedure, by restricting the airflow at the condenser fan outlet through the use of a Condenser Outlet Air Restrictor.

Procedures

Winter Setup Verification Procedure (Cont.)

- Procedure
  1. Install the condenser outlet air restrictor on the outlet from the condenser fan;
     - Position the restrictor so it does not interfere with the inlet airflow to the condenser.

Procedures

Delta -P

Winter Setup Verification Procedure (Cont.)

- Procedure (Cont.)
  2. Start the air conditioner or heat pump in the cooling mode and restrict the outlet until the difference between the high and low side pressure is:
     - Between 160 psi and 220 psi for R-410A
     - Between 100 psi and 145 psi for R-22

Procedures

Winter Setup Verification Procedure (Cont.)

- Procedure (Cont.)
  3. Allow the unit to stabilize for 15 minutes, watching the pressures to make sure the differential achieves and remains within the thresholds described in Step 2.

Procedures

Winter Setup Verification Procedure (Cont.)

- Procedure (Cont.)
  4. Follow the test procedures as previously described for the Standard Measurement and Variable Metering Device Calculations to determine compliance.
  5. Compliance with the Winter Setup Verification Procedure still requires the system meeting the minimum system airflow rate criteria, measured as previously explained.

Procedures

Weigh in Charging Procedure

- Applicable to:
  - ✓ Air-cooled air conditioners;
  - ✓ Air-source heat pumps;
  - ✓ Mini Splits.
    - Airflow verification not required for mini-splits.

Procedures

CHEERS

Weigh in Charging Procedure (Cont.)

- General Requirements
  - ✓ May be utilized during any outdoor temperature.

Refrigerant Charge for Air Conditioners & Heat Pumps

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Procedures

CHEERS

Weigh in Charging Procedure (Cont.)

- General Requirements (Cont.)
  - ✓ Requires verification of the Air System Airflow Rate as described in previous lessons.

Refrigerant Charge for Air Conditioners & Heat Pumps

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Procedures

Weigh in Charging Procedure (Cont.)

- General Requirements (Cont.)
  - ✓This procedure shall be used by the installer when the outdoor temperature is below 55°F, and there is no applicable special case refrigerant charge verification protocol available for use.
  - ✓When this procedure is used by the installer, the HERS Rater may not use the applicable system for sampling.
  - ✓HERS Raters may not use this procedure to verify the refrigerant charge, and will have to test using the standard method when climate conditions allow.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure
  - ✓There are two methods to conduct the Weigh in charging procedure:
    1. Weigh in Charge Adjustment;

       OR

    2. Weigh in Total Charge.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓Weigh in Charge Adjustment
    - This option is applicable to a new system or existing system when a new outdoor unit is installed (with factory charge in outdoor unit);
    - The HVAC installer shall weigh in lineset and indoor coil charge adjustment, after evacuation of lineset and indoor coil;
    - The documentation shall include the calculated charge adjustment for the lineset.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓Weigh in Total Charge
    - This option is applicable to all systems;
    - The installer shall weigh in the total system charge after refrigerant recovery and evacuation of the entire system;
    - The total system charge includes the nameplate charge for the outdoor unit, and any adjustment for the lineset dimensions and indoor coil in accordance with the manufacturer's instructions;
    - The documentation shall include the nameplate charge and the calculated lineset adjustment.

CHEERS

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓The weigh-in procedure shall be performed in accordance with all manufacturer specifications to confirm:
    1. The system is braised with dry nitrogen in the lines and indoor coil;
    2. The system is evacuated to 500 microns or less and, when isolated, rises no more than 300 microns over five minutes;
    3. The lineset correction is calculated based on the length and diameter of the lineset.

CHEERS

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓The weigh-in procedure shall be performed in accordance with all manufacturer specifications to confirm (Cont.):
    4. The indoor coil correction to refrigerant weight is used if it is supplied by the manufacturer;
    5. The amount of charge calculated for the lineset correction (and indoor coil correction if available) is added or removed, or the total charge based on the lineset, indoor coil, and standard label charge is installed.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓ The HVAC Installer shall certify on the Certificate of Installation that the manufacturer's specifications for these procedures have been met.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓ HERS Rater Observation
    - When the Standards indicate this procedure is required, or is an option for compliance, the HERS Rater shall coordinate with the HVAC Installer to observe the weigh-in charging procedure.

Procedures

Weigh in Charging Procedure (Cont.)

- Procedure (Cont.)
  - ✓HERS Rater Observation (Cont.)
    - The HERS Rater shall observe and confirm:
      1. The system is evacuated to 500 microns or less and, when isolated, rises no more than 300 microns over five minutes.
      2. The lineset correction is calculated based on the length and diameter of the lineset.
      3. The indoor coil correction to refrigerant weight is used if it is supplied by the manufacturer.
      4. The installer adds or removes the amount of charge calculated for the lineset correction or installs the total charge based on lineset, indoor coil, and standard label charge.

Refrigerant Charge for Air Conditioners & Heat Pumps

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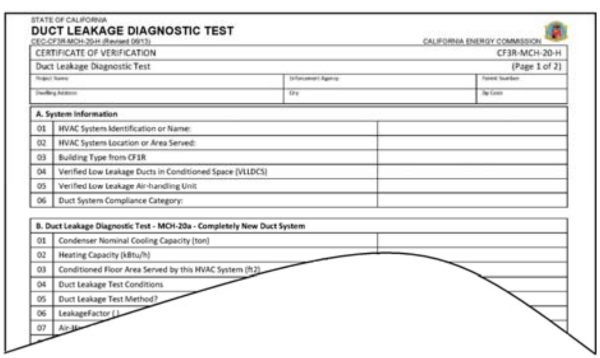
Forms



STATE OF CALIFORNIA

DUCT LEAKAGE DIAGNOSTIC TEST

CEC-CF3R-MCH-20-H (Revised 06/13)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor ( )	
07	Air-...	

Refrigerant Charge for Air Conditioners & Heat Pumps

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Forms

CF3R-MCH-25a

- Standard Refrigerant Charge Verification – Super Heat Method
- 3 Pages

Forms

CF3R-MCH-25b

- Standard Refrigerant Charge Verification – Subcooling Method
- 3 Pages

CHEERS

Forms

CF3R-MCH-25c

- Weigh In Charging Procedure HERS Rater Observation
- 2 Pages

CHEERS

Forms

CF3R-MCH-25e

- Refrigerant Charge Winter Setup Verification Procedure
- 3 Pages

CHEERS

Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- Standard Charge Verification Procedure
- Winter Setup Verification Procedure
- Weigh In Charging Procedure

Section 3- Forms

CHEERS

Overall Training Goal

Familiarize yourself with Refrigerant Charge Testing Equipment, Protocols and Forms.

QUESTIONS

Refrigerant Charge for Air Conditioners & Heat Pumps

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INSTALLED HVAC SYSTEM COMPONENTS AND DEVICES

2013 HERS I Training

Installed HVAC System Components & Devices

RA3.4- Residential Appendices

References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.4
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

The purpose of these procedures is to verify that residential space cooling systems and heat pumps have the required components to achieve the energy efficiency claimed in the compliance documents.

Overall Training Goal

Identify HVAC system components and devices requiring HERS inspections, and familiarize yourself with testing procedures and associated paperwork.

Training Sections

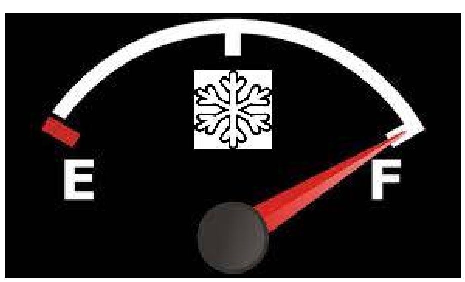
Section 1- Charge Indicator Display (CID)

Section 2- Time Delay Relay (TDR)

Section 3- Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

Section 4- Forms

Charge Indicator Display (CID)



Charge Indicator Display (CID)

The CID verification can be taken in lieu of the Refrigerant Charge Verification.

Note: *any CID equipment used for this purpose has to be submitted by the manufacturer for certification to, and approved by, the CEC.*

Charge Indicator Display (CID)

This verification procedure shall consist of:

- Confirming CID device is installed on the system;
- Confirming CID device meets CEC specifications;
- Confirming the space conditioning system complies with one of the following procedures:
  1. CID with "self diagnostic reporting“ functionality when outdoor air temperature is less than 55F;
  2. CID without "self diagnostic reporting" functionality when outdoor air temperature is less than 55F;
  3. CID when the outdoor air temperature is equal to or greater than 55F.

Charge Indicator Display (CID)

CID with "self diagnostic reporting“ functionality when outdoor air temperature is less than 55F:

- Installer shall use the weigh-in method when confirming the refrigerant charge;
- HERS Rater will verify installation of the CID and that the “self diagnostic reporting function” is working within correct equipment parameters.

Charge Indicator Display (CID)

CID that does not have "self diagnostic reporting" functionality when outdoor air temperature is less than 55F;

- Installer shall use the weigh-in method when confirming the refrigerant charge;
- HERS Rater will delay verification until temperature rises above 55F, then they will run the cooling system for at least 15 minutes and verify that the CID reports the system operating within acceptable parameters.

CHEERS

Charge Indicator Display (CID)

CID when the outdoor air temperature is equal to or greater than 55F;

- Installer may use the weigh-in or standard method when confirming the refrigerant charge;
- HERS Rater will run the cooling system for at least 15 minutes and verify that the CID reports the system operating within acceptable parameters.

CHEERS

Time Delay Relay (TDR)

Time Delay Relay (TDR)

When a system rating specification includes a time delay relay, the installation of the time delay relay shall be verified.

Time Delay Relay (TDR)

Procedure

1. Turn on the cooling system;
2. Turn up the thermostat so that the compressor stops running;
3. Verify that the air handler continues to run for at least 30 seconds.

If the air handler turns off ***before*** 30 seconds, the verification fails.

CHEERS

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

CHEERS

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

When the installation of a specific matched system equipment is necessary for compliance, with requirements for higher than minimum values for system EER or SEER, the installed system equipment shall be verified by a HERS Rater.

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

Procedure:

- Collect make and model number of the installed outdoor unit;
- Collect make and model number of the installed inside coil;
- Collect make and model of the installed furnace or air handler when necessary;
- Verify TXV or EXV when necessary;
- Verify TDR when necessary.

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

The verification shall utilize certified rating data from the AHRI Directory of Certified Product Performance.

http://www.ahridirectory.org

The information collected in the previous slide will be used to verify SEER/EER compliance.

CHEERS

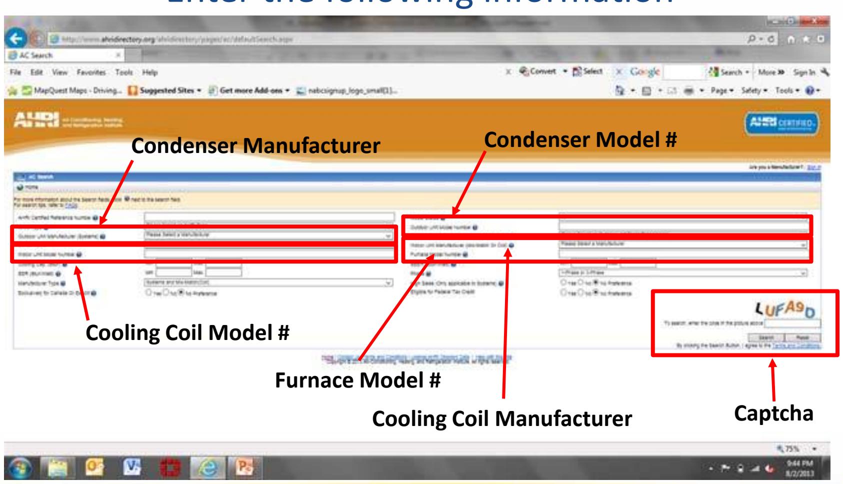
Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

Under the Residential section select whatever equipment type you are trying to verify.

CHEERS

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

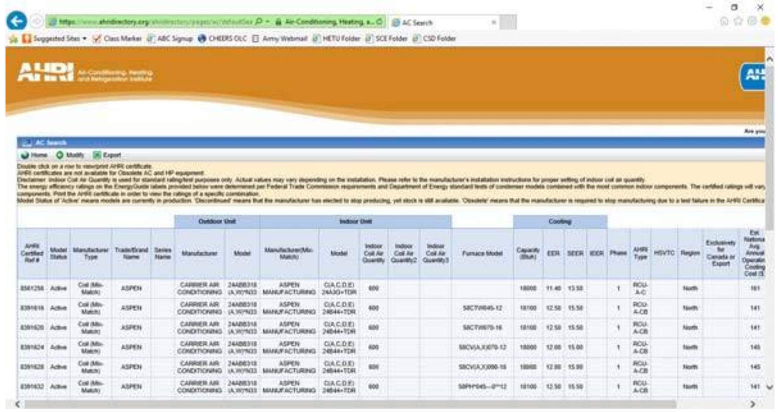
Enter the following information



CHEERS

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

Select whichever equipment combination matches what was installed



CHEERS

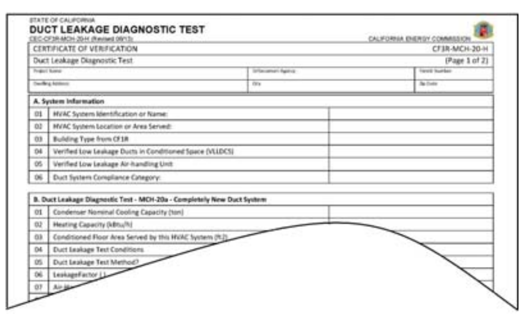
Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

- The AHRI website will produce a unique certificate based on the equipment information entered.
- The SEER/EER values need to match the targets on the CF1R and what was listed on the CF2R.
- You'll need to make note of the AHRI number found on the certificate and enter it in the CF3R.

Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

- Complete the additional learning activity to gain additional practice and experience with the verification of equipment efficiencies on the AHRI directory.

Forms


STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-CF3R-MCH-20-H (Revised 08/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION CF3R-MCH-20-H
Duct Leakage Diagnostic Test (Page 1 of 2)

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor	
07	Air	

CHEERS

Forms

CF3R-MECH-25d

- CID
- 2 Pages

CHEERS

Forms

CF3R-MCH-26H

- SEER
- EER
- TXV
- TDR
- 2 Pages

CHEERS

Training Sections

Section 1- Charge Indicator Display (CID)

Section 2- Time Delay Relay (TDR)

Section 3- Energy Efficiency Ratio (EER) & Seasonal Energy Efficiency Ratio (SEER)

Section 4- Forms

CHEERS

Overall Training Goal

Identify HVAC system components and devices requiring HERS inspections, and familiarize yourself with testing procedures and associated paperwork.

QUESTIONS

CHEERS

Unmatched Service with Integrity

AIR DISTRIBUTION SYSTEMS

2013 HERS I Training

Air Distribution Systems

RA3.1- Residential Appendices

References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.1
- Found at:
  http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

The performance compliance calculations allow credit for duct systems that are designed to be in advantageous locations, that have reduced supply duct surface areas, and/or that provide higher R-values for portions of the system.

Overall Training Goal

Gain proficiency in the HERS testing and verifications protocols related to the air conditioning distribution system.

Training Sections

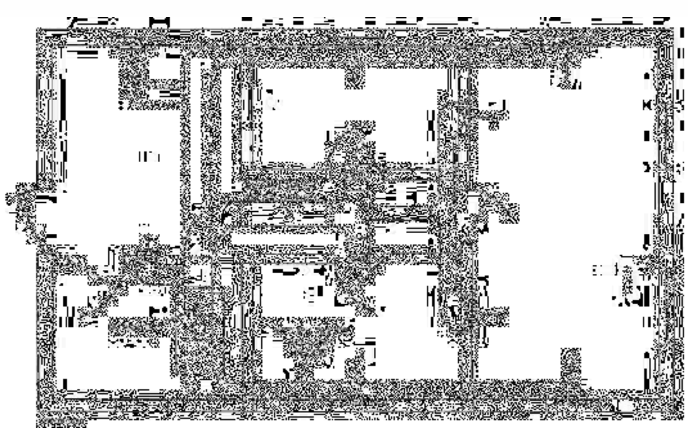
Section 1- Procedures

- Verified duct design
  - ✓ Supply Duct Surface Area Reduction
  - ✓ Buried ducts
  - ✓ Deeply buried ducts
- Ducts in conditioned space
  - ✓ Low Leakage Ducts Located in Conditioned Space
  - ✓ Low Leakage air Handling Unit (LLHU)
- 12 Linear Feet or Less of Duct Located Outside Of Conditioned Space
- Return Duct Design
- Air filter device design
- Verification of Prescriptive Bypass Duct Requirements

Section 2- Forms

Air Distribution System 5

Procedures – Verified Duct Design

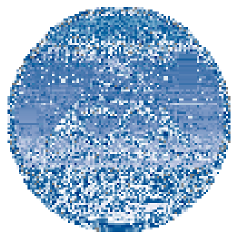


Air Distribution System 6

Procedures – Verified Duct Design

Compliance criteria

- The duct system design shall be based on an industry standard design methodology such as ACCA Manual D or an equivalent.



Procedures – Verified Duct Design

Requirements

- Shall be field verified by a HERS Rater;
- Duct design layout shall meets all applicable duct design and documentation requirements;
- The duct design layout shall be approved by the enforcement agency.

Procedures – Verified Duct Design

Duct Design Layout

- Shall include:
  - ✓A scaled layout drawing;
  - ✓Location of the space conditioning equipment;
  - ✓Location of all supply and return registers/grilles;
  - ✓Diameter, length, R-value, allowed bends, and location of each duct segment;
  - ✓All other supply duct details reported on the registered Certificate of Compliance.

Procedures – Verified Duct Design

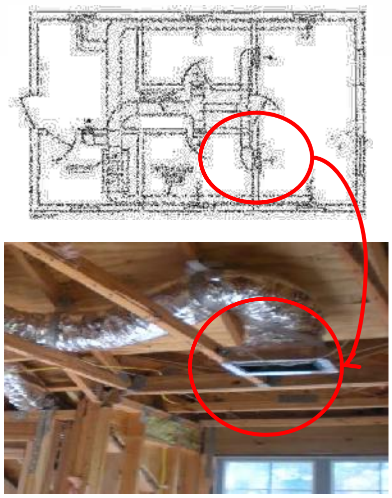
Duct Design Layout (Cont.)

- Approval
  - ✓The layout shall be included with the building design plans and the registered Certificate of Compliance submitted to the enforcement agency in conjunction with the application for the building permit;
  - ✓It shall be made available to the enforcement agency, installing contractor, and HERS rater for use during the installation work and for all applicable inspections.

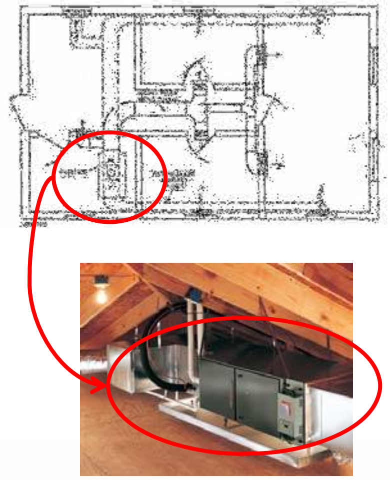
Procedures – Verified Duct Design

Field Verification

- The HERS Rater shall verify
  - ✓ The location of all supply and return registers by inspection of the interior of the dwelling unit.



Procedures – Verified Duct Design



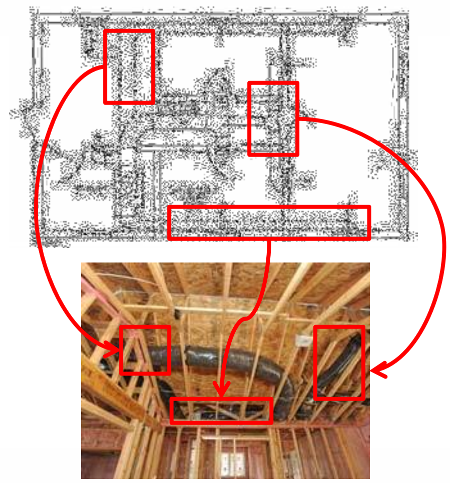
Field Verification (Cont.)

- The HERS Rater shall verify (Cont.)
  - ✓ The location of the space conditioning equipment.

Procedures – Verified Duct Design

Field Verification (Cont.)

- The HERS Rater shall verify (Cont.)
  - ✓The diameter, length, R-value, allowed bends, and location of each duct segment by observation in the spaces where they are located.

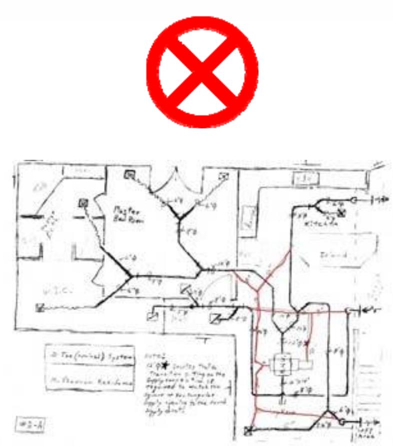


Air Distribution System 13

Procedures – Verified Duct Design

Field Verification (Cont.)

- The HERS Rater shall verify (Cont.)
  - ✓Deviations from the approved Duct Design Layout;
    - **Deviations are not allowed** without a revised a Duct Design Layout approved by the enforcement agency.



Air Distribution System 14

Procedures – Verified Duct Design

There are credits that have a Verified Duct Design as a prerequisite:

- Supply Duct Surface Area Reduction;
- Buried Ducts;
- Deeply Buried Ducts.

Procedures – Verified Duct Design

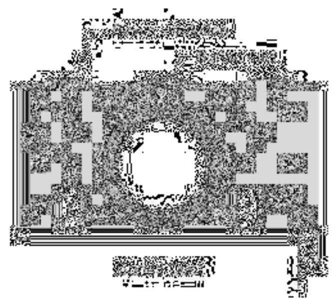
Supply Duct Surface Area Reduction

- Field Verification
  - ✓A verified duct design is a prerequisite for compliance with the Supply Duct Surface Area Reduction compliance credit;
  - ✓A visual inspection shall confirm the installed duct system layout conforms to the Duct Design Layout as previously described.

Procedures – Verified Duct Design

Buried Ducts

- Field Verification
  - ✓ A verified duct design and QII are prerequisites for compliance with the Buried Ducts compliance credit;
  - ✓ This procedure shall be carried out prior to covering the ducts with insulation.



Air Distribution System 17

Procedures – Verified Duct Design

Buried Ducts (Cont.)

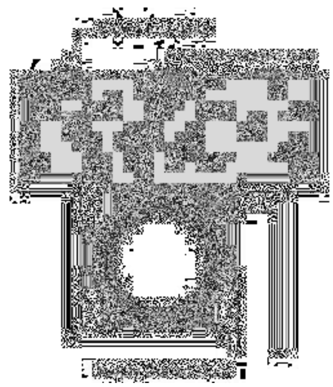
- Field Verification (Cont.)
  - ✓ Ducts designed to be buried shall be insulated to R6 or greater;
  - ✓ Ducts designed to be in contact with the ceiling shall be not more than 3.5 inches from the ceiling drywall;
  - ✓ A sign shall be hung near the attic access that displays a warning: “Caution: Buried Ducts. Markers indicate location of buried ducts;”
  - ✓ All ducts that will be completely buried shall have vertical markers that are visible after insulation installation, placed at least every 8 feet of duct length and at the beginning and end of each duct run.

Air Distribution System 18

Procedures – Verified Duct Design

Deeply Buried Ducts

- Field Verification
  - ✓A verified duct design and QII are prerequisites for compliance with the Deeply Buried Ducts compliance credit;
  - ✓This procedure shall be carried out prior to covering the ducts with insulation.



Air Distribution System 19

Procedures – Verified Duct Design

Deeply Buried Ducts (Cont.)

- Field Verification (Cont.)
  - ✓Ducts designed to be buried shall be insulated to R6 or greater;
  - ✓Ducts designed to be in contact with the ceiling shall be not more than 3.5 inches from the ceiling drywall;
  - ✓A sign shall be hung near the attic access that displays a warning: "Caution: Buried Ducts. Markers indicate location of buried ducts;"
  - ✓All ducts that will be completely buried shall have vertical markers that are visible after insulation installation, placed at least every 8 feet of duct length and at the beginning and end of each duct run.

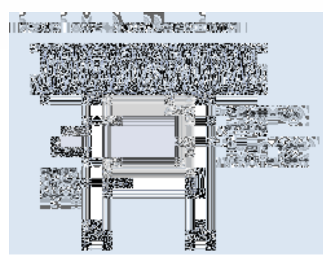
Air Distribution System 20

Procedures – Ducts in Conditioned Space

Procedures – Ducts in Conditioned Space

Ducts in Conditioned Space

- Field Verification
  - ✓ Verify that space conditioning systems are located entirely in conditioned space;
  - ✓ If **any part** of the space conditioning duct system is outside of conditioned space, the system does not pass.



Procedures – Ducts in Conditioned Space

There are credits that have Ducts in Conditioned Space as a prerequisite:

- Low Leakage Ducts Located in Conditioned Space;
- Low Leakage Air Handling Unit (LLAHU.)

Procedures – Ducts in Conditioned Space

Low Leakage Ducts Located in Conditioned Space

- Field Verification
  - ✓ Ducts in conditioned space are a prerequisite for this credit;
  - ✓ Conduct a duct leakage to outside test;
    - If the leakage is $\leq$ 25CFM, the system passes.

Procedures – Ducts in Conditioned Space

Low Leakage Air Handling Unit (LLAHU)

- Field Verification
  - ✓ Low leakage ducts are a prerequisite for this credit;
  - ✓ The air handler shall be included in the list of low leakage air handling units published by the Energy Commission.

Procedures – 12 Linear Feet or Less of Duct Located Outside Of Conditioned Space

Procedures – 12 Linear Feet or Less of Duct Located Outside Of Conditioned Space

Field Verification

- Verify that space conditioning systems with air handlers located outside the conditioned space have 12 linear feet or less of duct located outside the conditioned space, including air handler and plenum;
- If the space conditioning system has more than 12 feet of duct outside of conditioned space, the system does not pass.

Procedures – Verification of Return Duct Design

Procedures – Verification of Return Duct Design

Field Verification

- In lieu of the Fan Watt Draw and Cooling Coil Airflow **for non-zoned systems**, the verification of return duct design (return ducts and grilles size) is allowed;
- Verification shall consist of a visual inspection to confirm that the duct design conforms to the criteria given in
  - ✓ Table 4-10- Single Return Systems
  - ✓ Table 4-11- Multiple Return Systems

Procedures – Verification of Return Duct Design

Field Verification (Cont.)

- Table 4-10- Single Return Systems

Return Duct Sizing for Single Return Duct Systems		
System Total Nominal Cooling Capacity (ton)	Minimum Return Duct Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	16	500
2.0	18	600
2.5	20	800

*Not applicable to systems with nominal capacity greater than 2.5 tons or less than 1.5 ton

Procedures – Verification of Return Duct Design

Field Verification (Cont.)

- Table 4-11- Multiple Return Systems

Return Duct Sizing for Multiple Return Duct Systems			
System Total Nominal Cooling Capacity (ton)	Minimum Return Duct 1 Diameter (inches)	Minimum Return Duct 2 Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4.0	18	18	1200
5.0	20	20	1500

*Not applicable to systems with nominal capacity greater than 5.0 tons or less than 1.5 ton

Procedures – Verification of Return Duct Design

Procedures – Verification of Return Duct Design

Air Filtration

- Except for evaporative coolers, any mechanical forced air heating and/or cooling system with more than 10 feet of duct must meet four sets of criteria:
  1. System Design Criteria;
  2. Air Filter Media Efficiency Criteria;
  3. Air Filter Media Pressure Drop Criteria;
  4. Air Filter Media Labeling Criteria.

Procedures – Verification of Return Duct Design

Air Filtration (Cont.)

- Air System Design Criteria
  - ✓ All recirculated and outdoor air passing through the heating/cooling device must first pass through the filter;
  - ✓ The design airflow and the design pressure drop through the filter must be determined by the designer;
  - ✓ The design pressure drop will determine the size and depth of the filter media required for the device.

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Procedures – Verification of Return Duct Design

Air Filtration (Cont.)

- Air System Design Criteria (Cont.)
  - ✓ If the system design elects compliance utilizing the Return Duct Design alternative specified in Tables 4-10 and 4-11, then the designer must assume a design filter pressure drop of 0.05 IWC at the applicable design airflow rate.

Return Duct Sizing for Single Return Duct Systems

System Total Nominal Cooling Capacity (ton)	Minimum Return Duct Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	16	500
2.0	18	600
2.5	20	800

*Not applicable to systems with nominal capacity greater than 2.5 tons or less than 1.5 ton

Return Duct Sizing for Multiple Return Duct Systems

System Total Nominal Cooling Capacity (ton)	Minimum Return Duct 1 Diameter (inches)	Minimum Return Duct 2 Diameter (inches)	Minimum Total Return Filter Grill Gross Area
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4.0	18	18	1200
5.0	20	20	1500

*Not applicable to systems with nominal capacity greater than 5.0 tons or less than 1.5 ton

CHEERS

Procedures – Verification of Return Duct Design

Air Filtration (Cont.)

- Air System Design Criteria (Cont.)
  - ✓ Replacing the filters when they become dirty brings their resistance to airflow back to the design condition. Therefore, the filters must be located to allow access for regular service by the occupants.

Procedures – Verification of Return Duct Design

Air Filtration (Cont.)

- Air System Design Criteria (Cont.)
  - ✓ A clearly legible label, such as shown shall be permanently placed in a location visible to a person changing the filter.;
  - ✓ The filter media pressure drop specifications at the design airflow rates that fall between the 400 cfm increments must be determined by interpolation of the Standard 680 rating values, or by lookup methods made available by the filter media vendor or manufacturer.

Procedures – Verification of Return Duct Design

Air Filtration (Cont.)

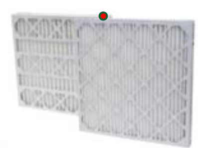
- Air Filter Media Efficiency Criteria
  - ✓ The filter media shall be MERV 6 or better to provide protection to the equipment and to potentially provide health benefits;
  - ✓ Filter media that provide at least 50% particle efficiency in the 3.0–10 µm range in AHRI 680 are considered to meet the MERV 6 criterion.

Procedures – Verification of Return Duct Design

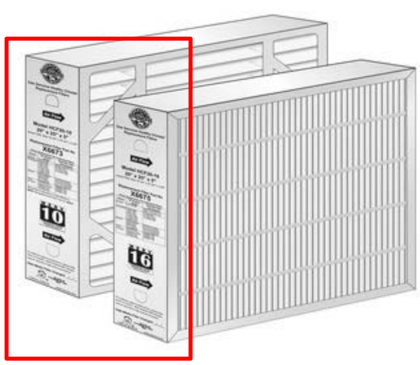
Air Filtration (Cont.)

- Air Filter Media Pressure Drop Criteria
  - ✓ To ensure airflow for efficient heating and cooling equipment operation, the installed filter media must conform to the design pressure drop specification shown in the Filter Location Label previously described.

VS



Procedures – Verification of Return Duct Design



Air Filtration (Cont.)

- Air Filter Media Labeling Criteria
  - ✓ The filter media product has been labeled by the manufacturer to disclose performance ratings that meet both the Efficiency and Pressure drop criteria previously described, as shown in the Filter Location Label.

Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems

Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems

What is a bypass duct?

- A bypass duct is a short duct placed between the supply plenum and the return air plenum;
- The purpose of the bypass duct is to allow the excess pressure from the supply plenum to escape into the return air plenum.

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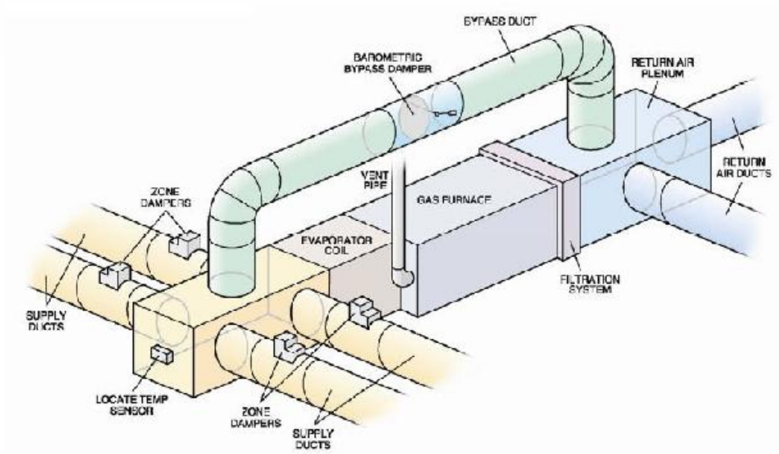
Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems

What is a bypass duct? (Cont.)

- Excess pressure can occur in the supply plenum when less than all the zone dampers are open;
- Excess pressure escaping through the bypass damper is taken back into the return air system and re-circulated through the equipment.

CHEERS

Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems



CHEERS

Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems

Field Verification

1. A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used;

OR

2. If the Certificate of Compliance indicates an allowance for use of a bypass duct, the bypass duct shall conform to the specifications given on the Certificate of Compliance.

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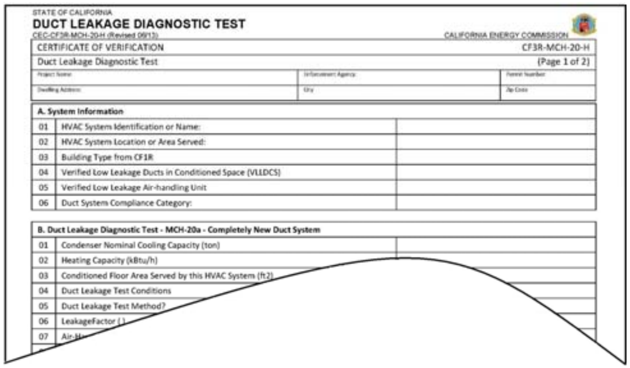
Procedures – Verification of Prescriptive Bypass Duct Requirements for Zonally Controlled Forced Air Systems

Field Verification (Cont.)

- If the zonally controlled system meets one of two previously described criteria, the system complies.

CHEERS

Forms



STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-CF3R-MCH-20-H (Revised 09/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor ( )	
07	Air-H	

CHEERS

Forms

STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST

CF3R-MCH-20-H

- MCH-20B
- Low Leakage Ducts in Conditioned Spaces
- 2 Pages

CHEERS

Forms

CF3R-MCH-20-H

- MCH-20C
- Low Leakage Air Handling unit (LLAHU)
- 3 Pages


DUCT LEAKAGE DIAGNOSTIC TEST

CHEERS

Forms


DUCT LOCATION

CF3R-MCH-21-H

- Duct Location
- 2 Pages

CHEERS

Forms

CF3R-MCH-28-H

- Return Duct Design and Air Filter Device Sizing
- 3 Pages


RETURN DUCT DESIGN AND AIR FILTER DEVICE SIZING ACCORDING TO TABLES 150.0-C OR D

CHEERS

Forms


DUCT SURFACE AREA REDUCTION; R-VALUE; BURIED DUCTS COMPLIANCE CREDIT

CF3R-MCH-29-H

- Duct Surface Area Reduction; R-Value; Buried Ducts Compliance Credit
- 3 Pages

Training Sections

Section 1- Procedures

- Verified duct design
  - ✓ Supply Duct Surface Area Reduction
  - ✓ Buried ducts
  - ✓ Deeply buried ducts
- Ducts in conditioned space
  - ✓ Low Leakage Ducts Located in Conditioned Space
  - ✓ Low Leakage air Handling Unit (LLHU)
- 12 Linear Feet or Less of Duct Located Outside Of Conditioned Space
- Return Duct Design
- Air filter device design
- Verification of Prescriptive Bypass Duct Requirements

Section 2- Forms

Overall Training Goal

Gain proficiency in the HERS testing and verifications protocols related to the air conditioning distribution system.

CHEERS

QUESTIONS

C|H|E|E|R|S

Unmatched Service with Integrity

MECHANICAL VENTILATION

CHEERS

Unmatched Service with Integrity

2013 HERS I Training

Whole Building Mechanical Ventilation Systems

RA3.7- Residential Appendices

CHEERS

References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.7
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Mechanical Ventilation Systems

- The purpose of this diagnostic is to measure the airflow in mechanical ventilation systems to confirm compliance with the requirements of ASHRAE 62.2;
- These procedures are applicable to continuous and intermittent mechanical ventilation systems in low-rise residential buildings.

Overall Training Goal

Familiarize yourself with Mechanical Ventilation Testing Equipment, Protocols and Forms.

Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- Continuous Operation
- Intermittent Operation

Section 3- Forms

Equipment Specifications

Equipment Specifications

Pressure Measurements

- Shall be measured with equipment having an accuracy equal to or better than ± 1% of pressure reading or ± 0.2 Pa., whichever is greater.
- All pressure measurements within the duct system shall be made with static pressure probes such as Dwyer A303 or equivalent.

Dwyer A-303 Static Pressure Probe

Equipment Specifications

Airflow Rate Measurements

- Shall be made with an airflow rate measurement apparatus (i.e., sensor plus data acquisition system) having an accuracy equal to or better than ± 10% of reading.

Equipment Specifications

Calibration

- All instrumentation used for mechanical ventilation system airflow rate diagnostic measurements shall be calibrated according to the manufacturer's calibration procedure.

Equipment Specifications

Authorized Diagnostic Equipment

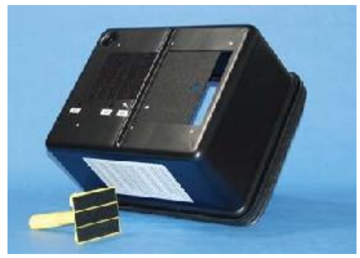
- Ventilation system airflow rate shall be measured using one of following type of apparatuses:
  - ✓Residential Mechanical Exhaust Airflow Measurement Device;
  - ✓Powered Flow Capture Hood Airflow Measurement Device;
  - ✓Traditional Flow Capture Hood.

CHEERS

Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Residential Mechanical Exhaust Airflow Measurement Device
  - ✓ A flowmeter that meets the applicable instrument accuracy specifications as previously described can be used to measure the mechanical exhaust airflow.



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Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Powered Flow Capture Hood Airflow Measurement Device
  - ✓ A device that that has the capability to balance the flow capture static pressure difference between the room and the flow capture hood enclosure, and meets the applicable instrumentation specifications as previously described;
  - ✓ May be used to verify the ventilation airflow , as long as it has a flow capture area at least as large as the ventilation system register/grille in all dimensions;
  - ✓ The fan adjustment needed to balance the flow capture static pressure difference shall be provided by either an automatic or manual control.

Equipment Specifications

Authorized Diagnostic Equipment (Cont.)

- Traditional Flow Capture Hood
  - ✓ Shall meet the applicable instrumentation specifications as previously described;
  - ✓ May be used to verify the ventilation system airflow rate if it has a capture area at least as large as the ventilation system register/grille in all dimensions.

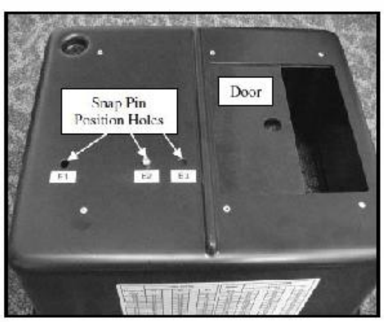
Procedures

Procedures

Equipment Setup

- Exhaust Fan Flow Meter
  - ✓ Connect the metering box to a pressure gauge.

Procedures



Door Position	Flow Range (CFM)
E1	44 -124
E2	21 - 59
E3	10 - 28

Equipment Setup (Cont.)

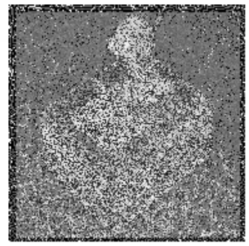
- Exhaust Fan Flow Meter (Cont.)
  - ✓ Select the door position on the metering box.

CHEERS

Procedures

Equipment Setup (Cont.)

- Exhaust Fan Flow Meter (Cont.)
  - ✓ Attach the handle to the metering box.



Whole Building Mechanical Ventilation 17

CHEERS

Procedures

Equipment Setup (Cont.)

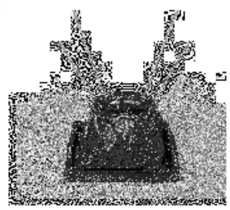
- Exhaust Fan Flow Meter (Cont.)

Whole Building Mechanical Ventilation 18

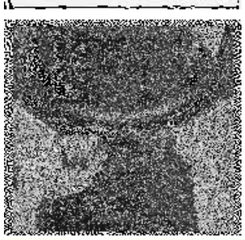
Procedures

Equipment Setup (Cont.)

- Powered Flow Hood
  - ✓ Assembling the capture hood.



Procedures



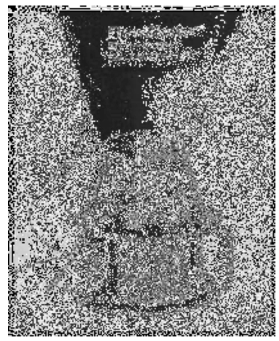
Equipment Setup (Cont.)

- Powered Flow Hood (Cont.)
  - ✓ Attach the fan to the capture hood.

Procedures

Equipment Setup (Cont.)

- Powered Flow Hood (Cont.)
  - ✓Setup the pressure gauge.



Procedures

Equipment Setup (Cont.)

- Exhaust Flow Hood (Cont.)

Procedures

Equipment Setup (Cont.)

- Traditional Flow Capture Hood
  - ✓ Assembling the hood.

Procedures

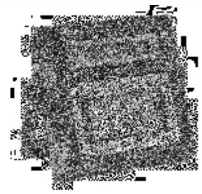
Equipment Setup (Cont.)

- Traditional Flow Capture Hood (Cont.)
  - ✓ Attach the handle
    - On some models the handles might be permanently attached.

Procedures

Equipment Setup (Cont.)

- Traditional Flow Capture Hood (Cont.)
  - ✓ Setup the gauge.



Shortridge

Alnor/ TSI

Procedures

Equipment Setup (Cont.)

- Traditional Flow Capture Hood (Cont.)

Procedures

Field Verification

- Acquiring Target Values:
  - ✓Prescriptively, the targets will be calculated and transferred on the appropriate CF3R-MCH-27;
  - ✓Using the performance approach, the value will be found on the Certificate of Compliance.

Procedures

Field Verification

- There are separate procedures for:
  - ✓Continuous Operation;
  - ✓Intermittent Operation.

Procedures

Field Verification (Cont.)

- Continuous Operation
  - ✓ Exhaust Ventilation Systems
    - Using one of the previously described apparatuses, if the measured airflow is equal to or greater than the value for whole-building ventilation airflow rate required by Section 4 of ASHRAE Standard 62.2, and listed on the CF1R, the mechanical ventilation system complies with the requirement for whole-building mechanical ventilation airflow;
    - If the measured airflow is less than the required whole-building ventilation airflow rate, the mechanical ventilation system does not comply, and corrective action shall be taken.

Procedures

Field Verification (Cont.)

- Continuous Operation (Cont.)
  - ✓Supply Only Systems
    - Approved systems, devices, or controls, and field verification and diagnostic test protocols for Supply Ventilation Systems are listed in directories published by the Energy Commission;
    - This is subject to a manufacturer providing sufficient evidence to the Executive director that the installed mechanical ventilation systems, devices, or controls will provide at least the minimum whole building ventilation airflow required by ASHRAE Standard 62.2, and subject to consideration of the manufacturer's proposed field verification and diagnostic test protocol for these ventilation system(s).

Procedures

Field Verification (Cont.)

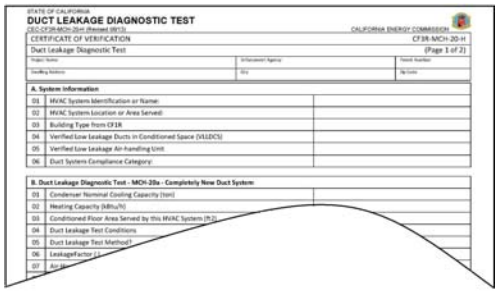
- Continuous Operation (Cont.)
  - ✓Combination Systems
    - When a combination ventilation system is installed, the ventilation rate is considered the larger of either total supply airflow or the total exhaust airflow. The airflow rates of the supply and exhaust fans may NOT be added together.

Procedures

Field Verification (Cont.)

- Intermittent Operation
  - Approved systems, devices, or controls, and field verification and diagnostic test protocols for Supply Ventilation Systems are listed in directories published by the Energy Commission;
  - This is subject to a manufacturer providing sufficient evidence to that the installed mechanical ventilation systems, devices, or controls will provide at least the minimum whole building ventilation airflow required by ASHRAE Standard 62.2, and subject to consideration of the manufacturer's proposed field verification and diagnostic test protocol for these ventilation system(s).

Forms



STATE OF CALIFORNIA

DUCT LEAKAGE DIAGNOSTIC TEST

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor (	
07	Air	

Forms

CF3R-MCH-27a-H

- Continuous Ventilation Airflow- Fan Vent Rate Method
- 5 Pages

STATE OF CALIFORNIA

INDOOR AIR QUALITY AND MECHANICAL VENTILATION

CERTIFICATE OF VERIFICATION

Indoor Air Quality and Mechanical Ventilation

For information only. Not valid until registered with a HERS provider

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Forms

INDOOR AIR QUALITY AND MECHANICAL VENTILATION

CF3R-MCH-27b-H

- Continuous Ventilation Airflow- Total Ventilation Rate Method
- 5 Pages

CHEERS

Forms

CF3R-MCH-27c-H

- Intermittent Ventilation Airflow- Fan Vent Rate Method
- 5 Pages

INDOOR AIR QUALITY AND MECHANICAL VENTILATION

CHEERS

Forms


INDOOR AIR QUALITY AND MECHANICAL VENTILATION

CF3R-MCH-27d-H

- Intermittent Ventilation Airflow- Total Vent Rate Method
- 5 Pages

CHEERS

Forms

CF3R-MCH-30-H

- Central Fan Ventilation Cooling System (VCS)
- 2 Pages


Central Fan Ventilation Cooling Systems (VCS)

Training Sections

Section 1- Equipment Specifications

Section 2- Procedures

- Continuous Operation
- Intermittent Operation

Section 3- Forms

Overall Training Goal

Familiarize yourself with Mechanical Ventilation Testing Equipment, Protocols and Forms.

QUESTIONS

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WATER HEATING SYSTEMS

2013 HERS I Training

Water Heating Systems

RA3.6- Residential Appendices

References

- Residential Reference Appendices- May 2012 w/June ‘14 Errata
- RA 3.6
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Water Heating Systems

- HERS field verification offers credits for improved performance in terms of “quality” pipe insulation installation, for the installation of field-verified hot water distribution systems that are more compact and therefore perform better than typical hot water distribution systems and for the installation of specific circulation strategies.

Overall Training Goal

Familiarize yourself with Water Heating Systems Verification Protocols, and Forms.

Training Sections

Section 1- HERS Pipe Insulation Requirements

Section 2- Procedures

- Pipe Insulation Credit (PIC-H)
- Central Parallel Piping (PP-H) or Homerun
- Compact Hot Water Distribution System (CHWDS-H)
- Point of Use (POU-H)
- Demand Recirculation; Manual Control (R-DRmc-H)
- Demand Recirculation; Sensor Control (R-DRsc-H)
- Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units

Section 3- Forms

HERS Pipe Insulation Mandatory Requirements

HERS Pipe Insulation Mandatory Requirements

Required for all hot water distribution systems

- Shall fit tightly to the pipe and all elbows and tees shall be fully insulated.

HERS Pipe Insulation Mandatory Requirements

Required for all hot water distribution systems (Cont.)

- No piping should be visible due to insulation voids with the exception of the last segment of piping that penetrates walls and delivers hot water to the sink, appliance, etc.

HERS Pipe Insulation Mandatory Requirements

Required for all hot water distribution systems (Cont.)

- Needs to be present on the first five feet of hot and cold water piping from storage water heaters.

HERS Pipe Insulation Mandatory Requirements

Required for all hot water distribution systems (Cont.)

- All piping from the water heater to kitchen sinks and dishwashers;
- All non-recirculating hot water piping of 3/4" diameter or greater.

HERS Pipe Insulation Mandatory Requirements

Required for all hot water distribution systems

- All hot water piping below grade;
- All piping below grade must be installed in a waterproof and non-crushable casing or sleeve that allows for installation, removal and replacement of the enclosed pipe and insulation;
- Piping below grade that serves any island sinks or other island fixtures or appliances may be insulated with 1/2 inch wall thickness insulation.

HERS Pipe Insulation Mandatory Requirements

EXCEPTIONS

- Pipe insulation may be omitted where hot water distribution piping is:
  - ✓In attics:
    - Completely surrounded with at least 1 inch of insulation ;
    - Piping must be elevated from framing;
    - Piping is completely covered with at least 4 inches of insulation further away from the conditioned space;
  - ✓In walls:
    - Completely surrounded with at least 1 inch of insulation.

CHEERS

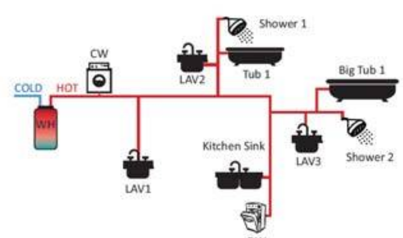
Procedures

CHEERS

Procedures

Pipe Insulation Credit (PIC-H)

- The visual inspection shall verify that all hot water piping is insulated;
- This credit can only be taken for trunk and branch hot water distribution systems.



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Procedures

Pipe Insulation Credit (PIC-H) (Cont.)

- Hot water piping from the water heater(s) to all fixtures and appliances shall be insulated based TABLE 120.3-A, usually 1 inch of insulation, typically equivalent to R-4;
- The HERS rater shall verify that all hot water piping is insulated in accordance with mandatory requirements previously described.

CHEERS

Procedures

Pipe Insulation Credit (PIC-H) (Cont.)

- Table 120.3-A

TABLE 120.3-A PIPE INSULATION THICKNESS

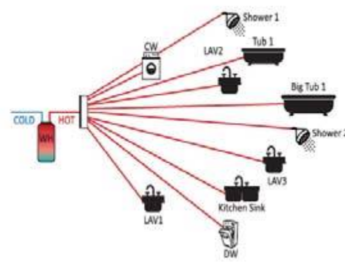
FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			< 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.31	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5

CHEERS

Procedures

Central Parallel Piping (PP-H)- or Home Run

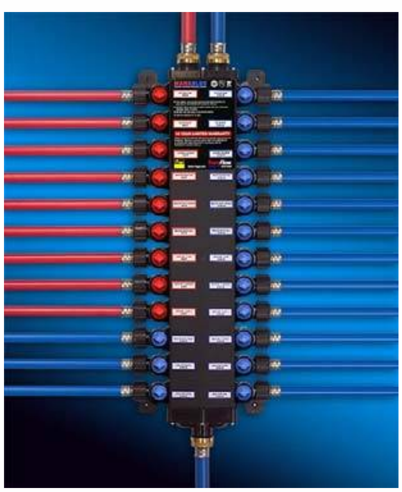
- This measure expands on the requirements for parallel piping systems that use one or more central manifolds with individual runs from the manifold to each point of use;
- Visual inspection shall verify that all supply lines of the parallel piping system meet the following requirements.



Water Heating Systems 17

CHEERS

Procedures



Central Parallel Piping (PP-H) (Cont.)

- The maximum measured length of pipe from the water heater to each central manifold shall not exceed 5 feet (measured to the nearest half foot).

Water Heating Systems 18

Procedures

Central Parallel Piping (PP-H) (Cont.)

- The hot water distribution system piping from the manifold to the fixtures and appliances must take the most direct path;
  - ✓For example, in a house with more than 1-story and the water heater in the garage, this requirement would exclude running hot water supply piping from the manifold to the attic, and then running the line back down to a first floor point of use.

Procedures

Central Parallel Piping (PP-H) (Cont.)

- The hot water distribution piping must be separated by at least two inches from any other hot water supply piping AND at least six inches from any cold water supply piping;

OR

- The hot water supply piping must be insulated based on the conductivity range in TABLE 120.3-A, usually 1 inch of insulation, typically equivalent to R-4.

Procedures

Central Parallel Piping (PP-H) (Cont.)

- The HERS rater shall verify that all hot water piping is insulated in accordance with mandatory requirements previously described.

Procedures

Compact Hot Water Distribution System (CHWDS-H)

- The HERS Rater shall verify that the longest measured pipe run length between a hot water use point and the water heater serving that use be no more than the distance specified in Table 3.6.4.
- Measurements shall be made to the nearest half foot.

Procedures

Compact Hot Water Distribution System (CHWDS-H) (Cont.)

- Table 3.6.4 specifies the maximum pipe length as a function of Floor Area Served, where Floor Area Served is defined as the conditioned floor area divided by the number of installed water heaters.

Floor Area Served (ft2)	Maximum Measured Water Heater To Use Point Distance (Ft)
< 1000	28’
1001-1600	43’
1601-2200	53’
2201-2800	62’
>2800	68’

Procedures

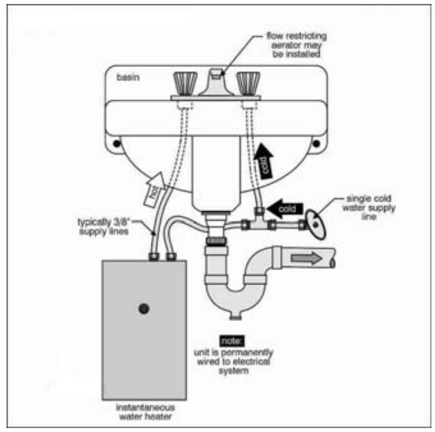
Compact Hot Water Distribution System (CHWDS-H) (Cont.)

- The floor area of the building has to match the CFA used in the compliance documentation;
- Ensure the hot water distribution system piping from the water heater to the fixtures and appliances take the most direct path;
- Verify that all hot water piping is insulated in accordance with the mandatory requirements previously described.

Procedures

Point of Use (POU-H)

- This measure requires that all hot water fixtures in the dwelling unit, with the exception of a stand alone tub, must use pipe length per run no more than defined in table 2.6.6;
- To meet this requirement most houses will require multiple water heaters.



Procedures

Size Nominal, Inch	Length of Pipe (ft.)
3/8"	15
1/2"	10
3/4"	5

Point of Use (POU-H) (Cont.)

- Measurements shall be made to the nearest half foot;
- If a combination of piping is used in a single run then one half the allowed length of each size shall be the maximum installed length.

Procedures

Point of Use (POU-H) (Cont.)

- Ensure the hot water distribution system piping from the water heater to the fixtures and appliances take the most direct path;
- The HERS rater shall verify that all hot water piping is insulated in accordance with the mandatory requirements previously described.

Procedures

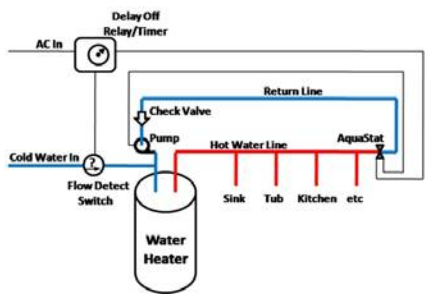
Recirculation Systems

- Not eligible for the Pipe Insulation Credit (PIC-H) but HERS verification of pipe insulation is a mandatory requirement;
- For systems serving a single dwelling unit, the recirculating loop within a dwelling unit must be laid out to pass within 8 feet of each hot water fixture served by the loop.
- These inspections may require two visits; at rough, and after all equipment is set and operational.

Procedures

Demand Recirculation-Manual Control (R-DRmc-H)

- Demand controlled recirculation systems shall operate “on-demand”, meaning that pump operation shall be initiated shortly prior to the hot water draw;
- The controls shall operate on the principal of shutting off the pump with a sensed rise in pipe temperature (Delta-T);
- For this HERS verification process, a manual switch is required.



Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- More than one circulation loop may be installed;
  - ✓ Each loop shall have its own pump and controls;
- Verify that the pump, demand controls and thermo-sensor are present.

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Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Manual switches shall be located in the kitchen, all bathrooms, and any hot water use location that is at least 20 feet (measured along the hot water piping) from the water heater.

Water Heating Systems 31

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Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Manual controlled systems may be activated by wired or wireless button mechanisms;
- Verify that manual controls have standby power of 1 watt or less.

Water Heating Systems 32

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that manual controls initiate pump operation by pressing one of the manual controls and observing that the pump turns on and then shuts off in accordance with one of the two methods listed.
  1. After the pump has been activated, the controls shall allow the pump to operate until the water temperature at the thermo-sensor rises not more than 10ºF (5.6 º C) above the initial temperature of the water in the pipe;

     OR

  2. The controls shall not allow the pump to operate when the temperature in the pipe exceeds 102ºF (38.9 ºC).

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that the controls have a feature that limits pump operation to a maximum of 5 minutes following any activation. This is provided in the event that the normal means of shutting off the pump have failed.

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- The manufacturer(s) of the recirculation pump and the controls shall provide installation and operation instructions that provide details of the operation of the pump and controls and such instructions shall be available at the jobsite for inspection.

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that pump and control placement for the demand recirculation meets one of the following criteria:
    1. When a dedicated return line has been installed at the pump, controls and thermo-sensor are installed at the end of the supply portion of the recirculation loop (typically under a sink,)

OR

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that pump and control placement for the demand recirculation meets one of the following criteria (Cont.):
  2. The pump and controls are installed on the return line near the water heater and the thermo-sensor is installed in an accessible location as close to the end of the supply portion of the recirculation loop as possible (typically under a sink,)

OR

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that pump and control placement for the demand recirculation meets one of the following criteria (Cont.):
  3. When the cold water line is used as the return, the pump, demand controls and thermo-sensor shall be installed in an accessible location at the end of supply portion of the hot water distribution line (typically under a sink.)

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- Verify that a check valve is installed in the recirculation loop to prevent unintentional circulation of the water (thermo-siphoning) and back flow when the system is not operating. This check valve may be included with the pump.

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- The hot water distribution system piping from the water heater to the fixtures and appliances must take the most direct path;
  - ✓For example, in a house with more than 1-story and the water heater in the garage, this requirement would exclude running hot water supply piping from the manifold to the attic, and then running the line back down to a first floor point of use.

Procedures

Demand Recirculation-Manual Control (R-DRmc-H) (Cont.)

- The HERS rater shall verify that the supply portion of each circulation loop is insulated based on TABLE 120.3-A, usually 1 inch of insulation, typically equivalent to R-4;
- Insulation is not required on the cold water line when it is used as the return;
- All other hot water piping is insulated in accordance with the mandatory requirements previously described.

Procedures

Demand Recirculation-Sensor Control (R-DRsc-H)

- The requirements for this credit are the same as the ones previously described for manual controls;
- A sensor control, such as motion sensors, door, and floor switches are used to activate the pump rather than a manual control.

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Procedures

HERS-Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units

- The visual inspection shall verify that a central DHW system serving a building with more than eight dwelling units has at least two recirculation loops, each serving roughly the same number of dwelling;
- Unique building sections may have additional recirculation loops;
- These recirculation loops may be connected to the same water heating equipment or be connected to independent water heating equipment;
- Ideally each loop will have its own pump and controls.

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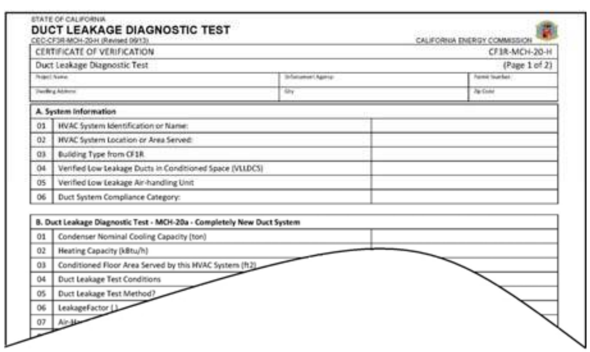
Forms


STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-CF3R-MCH-20-H (Revised 09/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor (.)	
07	Air-H	

Forms

CF3R-PLB-22-H

- Single Dwelling Unit Water System Distribution
- 4 Pages

SINGLE DWELLING UNIT HOT WATER SYSTEM DISTRIBUTION

Forms

MULTIFAMILY CENTRAL HOT WATER SYSTEM DISTRIBUTION

CF3R-PLB-21-H

- Multifamily Central Hot Water System Distribution
- 2 Pages

Training Sections

Section 1- HERS Pipe Insulation Requirements

Section 2- Procedures

- Pipe Insulation Credit (PIC-H)
- Central Parallel Piping (PP-H) or Homerun
- Compact Hot Water Distribution System (CHWDS-H)
- Point of Use (POU-H)
- Demand Recirculation; Manual Control (R-DRmc-H)
- Demand Recirculation; Sensor Control (R-DRsc-H)
- Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units

Section 3- Forms

Overall Training Goal

Familiarize yourself with Water Heating Systems Verification Protocols, and Forms.

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QUESTIONS

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Unmatched Service with Integrity

QUALITY INSULATION INSTALLATION

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Unmatched Service with Integrity

2013 HERS I Training

Quality Insulation Installation

RA3.5- Residential Appendices

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References

- Residential Reference Appendices- May 2012 w/June '14 Errata
- RA 3.5
- Found at: http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV3.pdf

Introduction

Quality Insulation Installation

- A procedure applicable to wood and metal construction of framed and non-framed envelope assemblies;
- Used for verifying the quality of insulation installation and air leakage control used in low-rise residential buildings.

Overall Training Goal

Familiarize yourself with Quality Insulation Installation, Protocols, Equipment and Forms.

Training Sections

Section 1- Equipment Specifications

Section 2- Definitions

Section 3- Procedures

- Walls
- Ceiling & Roofs
- Floors
- Spray Foam Insulation
- Multi-Family

Section 4- Forms

Equipment Specifications

CHEERS

Equipment Specifications

Coring Tool

- Used to measure pounds per square foot of blown-in insulation;
- At least 18 Inches in length or longer than the thickest insulation sample;
- A 13.54 inch inside diameter equals 1 Ft2 area.

CHEERS

Equipment Specifications

Postal Scale

- Used to measure pounds per square foot of blown-in insulation;
- Needs to be accurate within ± 2g , or ± 0.004 Lbs.

CHEERS

Equipment Specifications

Spray Insulation Probe

- Used to measure the thickness of spray foam insulation;
- Shall be accurate to within ±1/8 inch;
- Shall be designed and used in a manner to cause minimal damage to the insulation.

CHEERS

Definitions

Definitions

Continuous Air Barrier

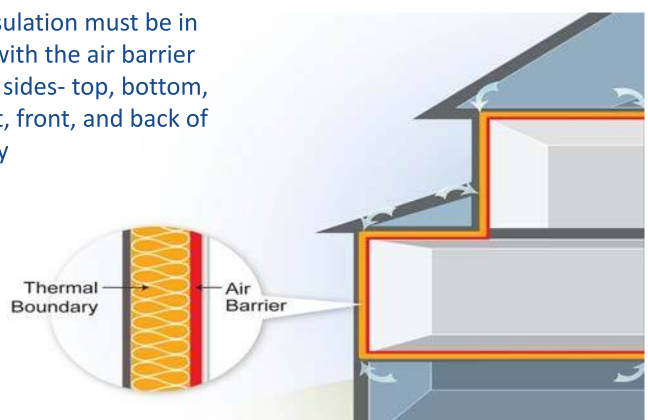
- A combination of interconnected materials and assemblies joined and sealed together to provide a continuous barrier to air leakage through the building envelope separating conditioned from unconditioned space, or adjoining conditioned spaces of different occupancies or uses.

Quality Insulation Installation 11

Definitions

Continuous Air Barrier (Cont.)

Note: Insulation must be in contact with the air barrier on all six sides- top, bottom, left, right, front, and back of the cavity



Quality Insulation Installation 12

CHEERS

Definitions

Continuous Air Barrier (Cont.)

- Examples of
  - ✓ Plywood – minimum 3/8 inch;
  - ✓ Oriented strand board – minimum. 3/8 inches;
  - ✓ Extruded polystyrene insulation board – minimum. ½ inch.

CHEERS

Definitions

Continuous Air Barrier (Cont.)

- Examples of
  - ✓ Foil-back polyisocyanurate insulation board – minimum. ½ inch;
  - ✓ Foil backed urethane foam insulation (1 inch).

Definitions

Continuous Air Barrier (Cont.)

- Examples of (Cont.)
  - ✓ Closed cell spray polyurethane foam with a minimum density of 2.0 pcf and a minimum thickness of 1½ inches;
  - ✓ Open cell spray polyurethane foam with a minimum density of 0.4 to1.5 pcf and a minimum thickness of 5½ inches.

Definitions

Continuous Air Barrier (Cont.)

- Examples of (Cont.)
  - ✓ Exterior or interior gypsum board - minimum 1/2 inch;
  - ✓ Cement board - minimum 1/2 inch.

Definitions

Continuous Air Barrier (Cont.)

- Examples of (Cont.)
  - ✓Built up roofing membrane;
  - ✓Modified bituminous roof membrane;
  - ✓Fully adhered single-ply roof membrane.

Definitions

Continuous Air Barrier (Cont.)

- Examples of (Cont.)
  - ✓Particleboard-minimum1/2 inch;
  - ✓Portland cement/sand parge ,or gypsum plaster minimum 5/8 inch.

CHEERS

Definitions

Continuous Air Barrier (Cont.)

- Examples of (Cont.)
  - ✓ Cast-in-place and precast concrete;
  - ✓ Fully grouted un-insulated and insulated concrete block masonry;
  - ✓ Sheet steel or aluminum.

CHEERS

Definitions

Air-tight

- Limiting the passage of air either in or out of the building envelope;
- For these procedures, air-tight shall be defined as an assembly or air barrier with all openings caulked, or sealed with minimally expansive foam, or taping/sealing of adjoining surfaces of air barrier materials and assemblies.

Definitions

Compression

- Compacting of insulation in an assembly that results in elimination of the air pockets trapped in the material that gives the insulation its R-value per inch.

Definitions

Gaps

- Un-insulated areas at the edge of insulation where insulation is not in contact with framing members or other materials at the edge of the insulation;
- Gaps occur when insulation length and width is too short for the cavity.

CHEERS

Definitions

Voids & Air Spaces

- An un-insulated space within an enclosed building assembly created where the assembly has been insulated by partial filling of the framed cavity;
- The partial fill results in an air space (void) between the insulation surface and the assembly’s exterior or interior layers which form the assembly’s air barrier;
- Result of Compression and Gaps.

CHEERS

Definitions

Delaminated

- Separation of the insulation's full thickness to facilitate it's installation around or between obstructions.

Definitions

Hard Covers

- Building materials, such as plywood or gypsum board, which become part of the ceiling air barrier, and are air tight.

Definitions

Draft Stops

- A material, device or construction installed to prevent the movement of air within open spaces of concealed areas of building components, such as crawl spaces, floor/ceiling assemblies, wall assemblies, roof/ceiling assemblies and attics.

Definitions

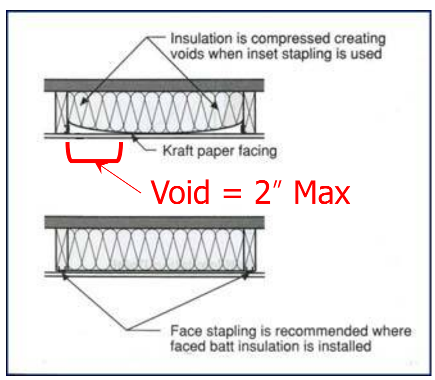
Friction Fit

- A means of attaching insulation within the framed cavity without the use of mechanical fasteners such that the material's full thickness in all directions is sufficient to maintain its installation integrity.

Definitions

Inset Stapling

- A method of attaching faced batt or blanket insulation to wood framing;
- The flange of the insulation facing is pushed inside the face of the framing member and stapled.



Definitions

CHEERS

Minimally Expansive Foam Sealing Material (Polyseal)

- A single-component polyurethane foam system typically formulated in a handheld can or portable container to seal and fill construction gaps and crevasses, holes, and cracks without distorting adjacent framing.
- These materials are not used for insulation purposes, rather as agents for air sealing of gaps and crevasses that are too small to be insulated.
- Manufacturer specifies approved use (around windows, door, etc.)

Definitions

CHEERS

Net Free Area

- The net free area of a vent cover is equal to the total vent opening less the interference to air flow caused by a screen or louver used for ventilation;
- Screened or louvered vent opening covers are typically marked by the manufacturer with the "net free area."

CHEERS

Definitions

Insulation Types-Framed assemblies

- **Batt & Blanket**: made of mineral fiber and mineral wool;
- Used to insulate below floors, above ceilings, below roofs, and within walls.

CHEERS

Definitions

Insulation Types- Framed assemblies (Cont.)

- **Loose-fill insulation**: loose fibers or fiber pellets that are blown into building cavities or attics using special equipment;
- Installed in walls, floors, attics and below roofs using a dry-pack process or a moist-spray technique, and may include a netting material.

CHEERS

Definitions

Insulation Types- Framed assemblies (Cont.)

- **Rigid Board**: made from fiberglass, expanded polystyrene (EPS), extruded polystyrene (XPS), polyisocyanurate, or polyurethane;
- Used for above roof decks, exterior walls, cathedral ceilings, basement walls, as perimeter insulation at concrete slab edges.

Quality Insulation Installation 33

CHEERS

Definitions

Insulation Types- Framed assemblies (Cont.)

- **Spray Polyurethane Insulation (SFP)**: a two-component reactive system mixed at a spray gun or a single-component system that cures by exposure to humidity. The liquid is sprayed through a nozzle into wall, roof/ceiling, and floor cavities.

Quality Insulation Installation 34

Definitions

Insulation Types- Non-Framed assemblies

- **Structurally Insulated Panel (SIP)**: a composite building material consisting of an insulating layer of rigid polymer foam sandwiched between two layers of structural board;
- They can be used for many different applications, such as exterior walls, roofs, floors, and foundation systems.

Definitions

Insulation Types- Non-Framed assemblies (Cont.)

- **Insulated Concrete Form (ICF):** interlocking modular units that can be dry-stacked (without mortar) and filled with concrete as a single concrete masonry unit;
- They lock together externally and have internal metal or plastic ties to hold the outer layer(s) of insulation to create a concrete form for the structural walls, roof/ceilings, or floors of a building.

Procedures

Procedures

The QII inspection is divided into three stages:

1. Air Sealing- Framing Stage
2. Air Sealing- Ceiling/ Roof Deck
3. Insulation Stage

Each stage has its own compliance form;

This diagnostic inspection will require multiple trips to the jobsite.

Procedures

CHEERS

R-value Measurement

- The HERS raters shall verify the installed thickness of insulation in all assemblies and locations on walls, roof/ceilings, and floors, and to ensure that insulation levels and installation integrity meet the R-value specified on the Certificate of Compliance (CF1R), and all other required compliance documentation;
- All insulation must be installed to the manufacturer insulation installation instructions.

Procedures

CHEERS

R-value Measurement (Cont.)

- For loose fill and SPF, the HERS rater shall measure the installed thickness and density of insulation in at least 6 random per opaque surface type: wall, roof/ceiling or floor;
- For walls, measurement areas shall include low and high areas of the insulated assembly and the HERS rater shall verify density measurements are consistent with the manufacturer's coverage chart.
- Label, specifications data sheets, and/or coverage charts will be attached to the CF2R-ENV-03 for each insulating material and also permanently posted in the house.

Procedures

Additional Verifications

- The HERS Raters will have to visually verify multiple items, in addition to the R-Value, in the:
  - ✓Walls
  - ✓Ceiling
  - ✓Roof
  - ✓Floor

Procedures- Walls

Procedures- Walls

Air Sealing

- Wall stud cavities shall be caulked or foamed to provide a substantially air-tight envelope to the outdoors, attic, garage, and crawl space;
- This includes but is not limited to all gaps around doors and windows, plumbing and wiring penetrations through the top and bottom plates and electrical boxes that penetrate the sheathing.

Procedures- Walls

Air Sealing (Cont.)

- Bottom plates of framed and non-framed assemblies shall be sealed to the ground subfloor or slab, and above ground subfloor.
- Top and bottom plates are sealed to the drywall.
- Exterior wall air barrier is sealed to the top and bottom plate in each stud bay.

Procedures- Walls

Air Sealing (Cont.)

- Rigid board insulation shall uniformly fit across the plane of the wall and taping and/or caulking of all joints and seams of the insulation shall be maintained to be considered as the air barrier.

Procedures- Walls

Air Sealing (Cont.)

- Connections of wall panels shall be sealed, caulked, foamed, or taped (i.e., SIP tape) to provide a substantially air-tight envelope to the outdoors, attic, garage and crawl space;
- Bottom connections of wall panels shall be sealed to the ground subfloor or slab, and above ground subfloor;
- All plumbing and wiring penetrations through the top and bottom of panels, and electrical boxes that penetrate the SIP sheathing shall be sealed.
- All top plates need to be sealed to the drywall.

Procedures- Walls

Air Sealing (Cont.)

- Taping (i.e., SIPs tape), caulking or sealing of all joints and seams of panel joints (i.e., spline connections) shall be maintained to be considered as the air barrier;
- Connections of ICF walls shall be grouted and sealed meeting manufacturer's specifications;
- All plumbing and wiring penetrations through the top and bottom of the ICF, and electrical boxes that penetrate the plane of the ICF shall be sealed;
- All top plates need to be sealed to the drywall.

Procedures- Walls

Air Sealing (Cont.)

- All gaps between interconnecting envelope assemblies of different materials shall have air barrier caulked, or sealed with minimally expansive foam or taped;
- Bottom connections of ICFs shall be sealed to the ground subfloor or slab, and above ground subfloor;
- Insulation shall uniformly fit across the plane of the wall and taping, caulking or sealing of all joints and seams of the ICF shall be maintained to be considered as the air barrier.

Procedures- Walls

Chimney/ Flue Baffles

- Insulation shall be kept away from combustion appliance flues and chimneys with sheet metal flashing in accordance with flue manufacturer's installation instructions or labels on the flue.
- The flashing shall be sealed to the surrounding framing.
- Sealing will be done with fire rated caulk.

Procedures- Walls

Gaps & Voids

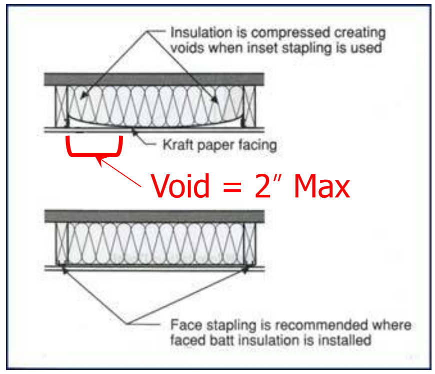
- Insulation shall uniformly fill the cavity side-to-side, top-to-bottom, and front-to-back;
- Insulation shall be installed to fill the cavity and be in contact with the sheathing on the back and the wallboard on the front - no gaps or voids;
- Batt insulation shall fill the cavity by friction fitting, inset or face stapling of flanges of faced batts, or by other support methods as necessary.

CHEERS

Procedures- Walls

Compression

- Batts with flanges that are inset stapled to the side of the stud must be flush with the face of the cavity (or protrude beyond) except for the portion that is less than two inches from the edge of the stud.



Quality Insulation Installation 51

CHEERS

Procedures- Walls

Compression (Cont.)

- Batt insulation shall be cut to butt-fit around wiring and plumbing, or be delaminated so that one layer can fit behind the wiring or plumbing, and one layer fit in front.

Quality Insulation Installation 52

Procedures- Walls

Compression (Cont.)

- Loose fill wall insulation shall be installed to fit around wiring, plumbing, and other obstructions.

Procedures- Walls

Narrow Framed Wall Cavities

- Non-standard width cavities shall be filled with insulation to snuggly fit into the space, or with minimally expansive foam sealing material.

Procedures- Walls

Narrow Framed Wall Cavities (Cont.)

- Narrow spaces less than 1 inch in width at windows and door jambs, shall be filled with minimally expansive foam sealing if allowed by manufacturer;
- Stuffing batt insulation is not allowed.

Procedures- Walls

Narrow Framed Wall Cavities (Cont.)

- Narrow spaces less than 2 inches in width, such as between studs at building corners, and at the intersection of interior partition walls to exterior walls, shall be filled with insulation snuggly fitted in the space, or with minimally expansive foam sealing.

Procedures- Walls

Special Situations- Installation Prior to Exterior Sheathing or Lath

- Hard to access wall stud cavities, such as corner channels, wall intersections, and behind tub/shower enclosures shall be insulated to the proper R-value;
- In most cases this can only be completed prior to the installation of the tub/shower enclosure, the exterior sheathing, or the exterior stucco lath.

Procedures- Walls

Special Situations- Installation Prior to Exterior Sheathing or Lath (Cont.)

Procedures- Walls

Special Situations- Installation Prior to Exterior Sheathing or Lath (Cont.)

- An air barrier shall be installed on the inside of the exterior wall(s) directly adjacent to the tub/shower enclosure.

Procedures- Walls

Special Situations- Installation Prior to Exterior Sheathing or Lath (Cont.)

Procedures- Walls

Special Situations- Obstructions

- In cold climates, where water pipes may freeze (Climate Zones 14 and 16) pipes shall have at least 2/3 of the insulation between the water pipe and towards the outside surface of the exterior wall;
- If the pipe is near the exterior finish assembly layers, as much insulation as possible shall be placed between the pipe and the outside (without excessive compression), and remaining insulation shall be placed between the pipe and the interior assembly material.

Procedures- Walls

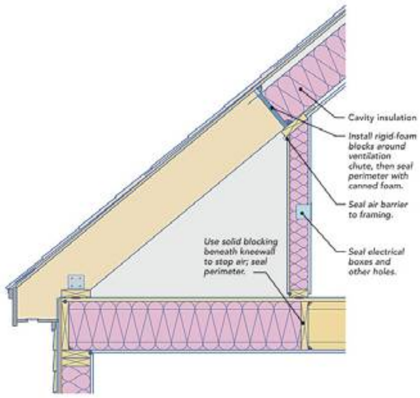
Special Situations- Rim Joists

- All band/rim-joists shall be airtight, and insulated to the same R-value as the adjacent walls.

Procedures- Walls

Special Situations- Knee walls, Skylight Shafts, and Gable Ends

- Framing for knee walls, skylight shafts and gable ends that separate conditioned from unconditioned space shall be air sealed and insulated to meet or exceed the wall R-value specified on the Certificate of Compliance, and all other required compliance documentation.



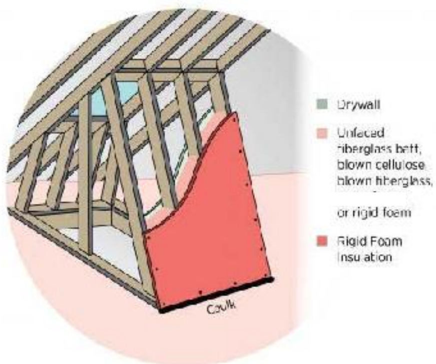
Procedures- Walls

Special Situations- Knee walls, Skylight Shafts, and Gable Ends (Cont.)

- For steel-framed knee walls, skylight shafts, and gable ends, external surfaces of steel studs shall be covered with insulation unless otherwise specified on the Certificate of Compliance using correct U-factors from Joint Appendix JA4, Table 4.3.4 (or U-factors approved by the Commission Executive Director).

CHEERS

Procedures- Walls



Special Situations- Knee walls, Skylight Shafts, and Gable Ends (Cont.)

- The backside of air permeable insulation (not SPF) exposed to the unconditioned attic space shall be completely covered with rigid board insulation or an air barrier;
- The house side of the insulation shall be in contact with the drywall or other wall finish.

CHEERS

Procedures- Walls

Special Situations- Knee walls, Skylight Shafts, and Gable Ends (Cont.)

- Insulation for all knee wall and skylight shafts shall be completely enclosed by, and in full contact with, sealed vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.

Procedures- Walls

Special Situations- HVAC/ Plumbing Closets

- Walls of interior closets for HVAC and/or water heating equipment, which require combustion air venting, shall be insulated to the same R-value as the exterior walls as specified in compliance documentation.

Procedures- Walls

Special Situations- Double Walls and Framed Bump-Outs

- Insulation shall fill the entire cavity; or, an additional air barrier shall be installed inside the double wall or bump-out and in contact with the insulation on all six sides, unless SPF is used;
- Entire double walls and framed bump-outs shall be air-tight on all unconditioned sides (attic, subfloors, etc.).

CHEERS

Procedures- Walls

Special Situations- Structural Bracing, Tie-downs, Steel Structural Framing

- Insulation shall be installed in a manner that restricts thermal bridging through the structural framing assembly;
- Insulation shall be applied to fully enclose and/or adhere to all sides and ends of structural assembly framing that separate conditioned from unconditioned space;
- The structural portions of assemblies shall be air-tight.

Quality Insulation Installation 69

CHEERS

Procedures- Walls

Special Situations- Window and Door Headers

- All window and door headers shall be insulated to a minimum of R-2 between the exterior face of the header and inside surface of the finish wall material.

Quality Insulation Installation 70

Procedures- Walls

Special Situations-
Electrical Panels

- When located in exterior insulated wall, the panel is airtight and insulation is installed behind the panel;
- Mainly an issue in 2x6 walls.

Quality Insulation Installation 71

Procedures- Walls

Special Situations- Fan
Exhaust Ducts

- Any fan exhaust ducts that run between conditioned floors to exterior walls have to include a damper at the exterior wall.

Quality Insulation Installation 72

CHEERS

Procedures- Walls

CHEERS

Procedures- Walls

CHEERS

Procedures- Walls

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Procedures- Walls

Procedures- Walls

Procedures- Walls

CHEERS

Procedures- Walls

Quality Insulation Installation 79

CHEERS

Procedures- Walls

Quality Insulation Installation 80

Procedures- Ceiling & Roof

Procedures- Ceiling & Roof

Air Sealing

- Hard covers or draft stops shall be placed at ceiling level over all drop ceiling areas, interior wall cavities (chases) and double walls (bump outs) to keep insulation in place and stop air movement to and from unconditioned space.
- If hard covers or draft stops are missing or incomplete, they shall be completed before insulation is installed.

CHEERS

Procedures- Ceiling & Roof

Air Sealing (Cont.)

- Any penetration cut into the ceiling are sealed to the surrounding drywall;
- Includes but is not limited to electrical boxes, fire alarm boxes, fire sprinklers, HVAC boots and exhaust fan housing including all holes and seams in the housing itself.

CHEERS

Procedures- Ceiling & Roof

Air Sealing (Cont.)

- In unvented attics there is a continuous air barrier at the roof deck and gable ends.
- All penetrations must be sealed.

CHEERS

Procedures- Ceiling & Roof

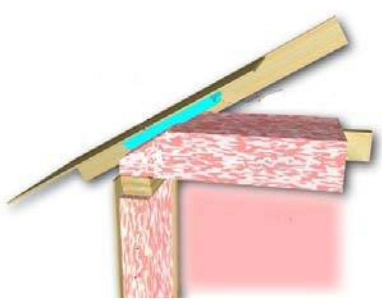
Voids & Gaps

- Insulation shall be correctly sized to fit snugly at the sides and ends.
- Insulation shall be installed to be in contact with the air barrier (ceiling or hard covers).

Quality Insulation Installation 85

CHEERS

Procedures- Ceiling & Roof



Voids & Gaps (Cont.)

- Insulation shall be applied all the way to the outer edge of the wall top plate, and flush against any ventilation dams/baffles.
- Rigid board insulation installed above the roof deck shall be applied to the outer edge of the plane of the wall top plate.

Quality Insulation Installation 86

Procedures- Ceiling & Roof

Voids & Gaps (Cont.)

- Batt and blanket insulation that is thicker than truss depth, shall be installed so that the insulation expands to touch adjoining cavity over each truss member.

Procedures- Ceiling & Roof

Compression

- Where necessary, batt and blanket insulation shall be cut to fit properly - there shall be no gaps, nor shall the insulation be doubled-over or compressed;
- When batt and blanket insulation are cut to fit a non-standard cavity, they shall be snuggly fitted to fill the cavity without compression.

Procedures- Ceiling & Roof

Compression (Cont.)

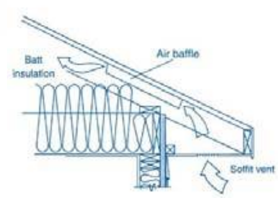
- Batt and blanket insulation shall be cut to butt-fit around wiring and plumbing, or delaminated, so that one layer can fit behind the wiring or plumbing, and one layer fit in front.

Quality Insulation Installation 89

Procedures- Ceiling & Roof

Baffling

- Baffles shall be placed at all eaves or soffit vents of vented attics to keep insulation from blocking eave ventilation and prevent air movement under the insulation.
- The required net free-ventilation shall be maintained.



Quality Insulation Installation 90

CHEERS

Procedures- Ceiling & Roof

Recessed Lights

- Recessed light fixtures shall be rated as Insulation Contact (IC) and Air Tight (AT);
- They shall be sealed with a gasket or caulk between the light's housing and the ceiling;
- Insulation shall cover all recessed lighting fixtures to the same value as the ceiling;
- If not, an area weighted calculation is required.

Quality Insulation Installation 91

CHEERS

Procedures- Ceiling & Roof

Chimney/ Flue Baffles

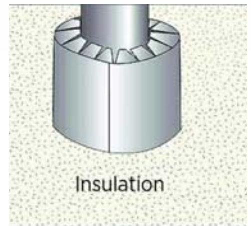
- Insulation shall be kept away from combustion appliance flues and chimneys with sheet metal flashing
- 1" distance for double wall flues, 6" for single wall, or in accordance with flue manufacturer's installation instructions or labels on the flue.
- The flashing shall be sealed to the surrounding framing with fire rated caulk.

Quality Insulation Installation 92

Procedures- Ceiling & Roof

Chimney/ Flue Baffles (Cont.)

- Insulation will be in full contact with the flashing.
- The collar must be at least as tall as the depth of the insulation.



Procedures- Ceiling & Roof

Attic Rulers for loose fill/blown in insulation

- Attic rulers appropriate to the material shall be installed and evenly distributed throughout the attic to verify depth;
- 1 ruler for every 250 square feet and clearly readable from the attic access;
- Attic rulers shall be scaled to read inches of insulation and the R-value installed.

CHEERS

Procedures- Ceiling & Roof

Blown- in Insulation

- Insulation shall be blown to a uniform thickness throughout the attic with all areas meeting or exceeding the insulation manufacturer's minimum requirements for depth and weight-per-square-foot.

CHEERS

Procedures- Ceiling & Roof

Measuring Blown-In thickness

- The HERS rater shall verify that the manufacturer’s minimum insulation thickness has been installed;
- For cellulose insulation, this verification shall take into account the time that has elapsed since the insulation was installed;
- At the time of installation, the insulation shall be greater than or equal to the manufacturer’s minimum initial insulation thickness.

Procedures- Ceiling & Roof

Measuring Blown-In thickness (Cont.)

- If the HERS rater does not verify the insulation thickness at the time of installation, and if the insulation has been in place less than seven days, the insulation thickness shall be greater than the manufacturer's minimum required thickness to achieve the given R-value at the time of installation, less 1/2 inch to account for settling;
- If the insulation has been in place for seven days or more, the insulation thickness shall be greater than or equal to the manufacturer's minimum required settled thickness to achieve the given R-value.

Procedures- Ceiling & Roof

Measuring Blown-In Weight-per-square-foot

- The HERS rater shall verify that the manufacturer's minimum weight-per-square-foot requirement has been met for attics insulated with loose-fill insulation;
- Verification shall be determined using the methods of the Insulation Contractor's Association of America (ICAA) Technical Bulletin #17 or #33;
- Only one sample shall be taken in the area that appears to have the least amount of insulation;
- The rater shall record the weight-per-square-foot of the sample on the Certificate of Verification.

Procedures- Ceiling & Roof

CHEERS

Measuring Blown-In Weight-per-square-foot (Cont.)

- Press the coring tool, also called a cookie cutter into the insulation to its full depth;
- Avoid electrical wiring, plumbing, framing and other obstructions.

Procedures- Ceiling & Roof

CHEERS

Measuring Blown-In Weight-per-square-foot (Cont.)

- Remove the insulation within the sampling tool and place it in a separate container

Procedures- Ceiling & Roof

Measuring Blown-In Weight-per-square-foot (Cont.)

- Tare the scale with the empty sample container on it;
- Weigh the sample of insulation;
- Divide the weight of the sample, by the area of the coring tool in square feet.

Procedures- Ceiling & Roof

Installation Specifications

OPEN ATTIC APPLICATION - BAG WEIGHT: 35 LBS

To Obtain An R-Value* Of:	Minimum Bags/1,000 net ft.²	Maximum Coverage/ Bag (ft.²)	Minimum Weight/ Sq. Ft. (Lbs.)	Minimum Thickness (inches)	Minimum Settled Thickness (inches)
13	6.6	152.5	0.230	4.75	4.75
19	9.7	103.4	0.338	7.00	7.00
22	11.0	90.5	0.387	8.00	8.00
26	13.1	76.2	0.459	9.50	9.50
30	15.9	63.0	0.556	11.50	11.50
38	21.8	46.0	0.761	15.75	15.75
44	25.9	38.6	0.906	18.75	18.75
49	29.3	34.1	1.027	21.25	21.25
60	36.9	27.1	1.293	26.75	26.75

[1] Use of this product results in minimal settling (less than 1%). There is no loss of insulating power (R-value) over time.

R-Values are determined in accordance with ASTM C 518 and ASTM C 687.

Note: *this label is for example only. Each product will be unique in its specifications.*

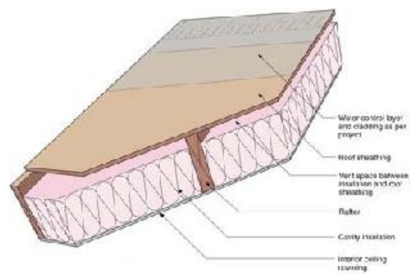
Measuring Blown-In Weight-per-square-foot (Cont.)

- The measured weight per square foot, or density, must be greater than the manufacturer's specifications required to achieve the target R-Value on the CF1R

Procedures- Ceiling & Roof

Special Situations- Enclosed Rafter Ceilings

- An air space shall be maintained between the insulation and roof sheathing per California Building Code, Sections 1203.2 and R8065.23, or as specified by the local building department.



Procedures- Ceiling & Roof

Special Situations- Attics & Cathedral Ceilings

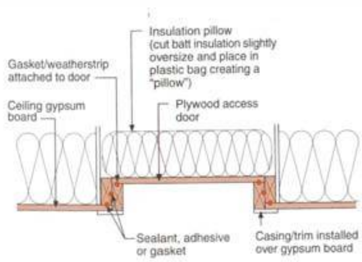
- In unvented attics, where insulation is applied directly to the underside of the roof deck, all gable ends shall be insulated to the same R-value as the exterior walls as specified in the compliance documentation;
- In unvented attics, where SIPs are the insulated roof structure, all gable ends shall be insulated to the same R-value as the exterior walls as specified in the compliance documentation.

Procedures- Ceiling & Roof

Special Situations- HVAC Platform

- Insulation shall be placed below any platform or cat-walk for HVAC equipment installation and access, to the same value as the ceiling insulation.
- Insulation shall be installed so that they will be in contact with the air barrier.
- If not, an area weighted calculation is completed and turned in with the CF3R-ENV-23

Procedures- Ceiling & Roof



Special Situations- Attic Access

- Permanently attach rigid board insulation, batt, or blanket insulation with the same R-Value as the ceiling to the access door using adhesive or mechanical fastener;
- The bottom of the attic access shall be gasketed to prevent air leakage of conditioned air to the unconditioned attic.
- Vertical access requires mechanical compression, such as screws, latches, or doors.

Procedures- Ceiling & Roof

Special Situations- Attic Access (Cont.)

- The attic access must be surrounded with a dam at least the same depth as the insulation to prevent loss of ceiling insulation, when the access is opened.

Procedures- Ceiling & Roof

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Procedures- Ceiling & Roof

CHEERS

Procedures- Ceiling & Roof

Procedures- Ceiling & Roof

Quality Insulation Installation 111

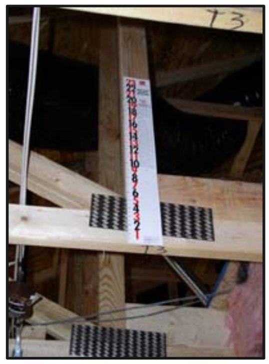
Procedures- Ceiling & Roof

Quality Insulation Installation 112

Procedures- Ceiling & Roof

Procedures- Ceiling & Roof

ELO 3- Procedures- Ceiling & Roof



Procedures- Ceiling & Roof

Procedures- Floors

Procedures- Floors

Air sealing

- Subfloor sheathing is glued or sealed to all exterior panel edges to create a continuous air tight subfloor.

Procedures- Floors

Compression, Voids & Gaps

- Batt and blanket insulation shall be correctly sized to fit snugly at the sides and ends;
- Batt and blanket insulation shall be cut to fit properly without gaps. Insulation shall not be doubled-over or compressed.

Procedures- Floors

Loose Fill

- Loose-fill insulation shall completely fill around wiring and plumbing;
- Loose-fill insulation shall be properly supported where necessary to avoid sagging, gaps, voids, and compression.

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Procedures- Floors

Air Barrier Alignment

- Insulation shall be in contact with the air barrier - usually the subfloor.

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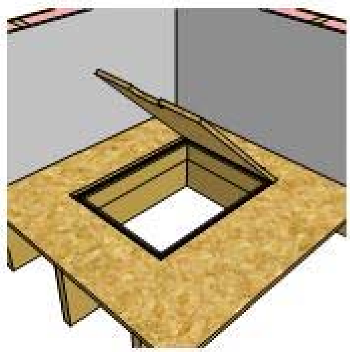
Procedures- Floors

Hangers and supports

- Hangers must be spaced at 18 inches or less and cannot compress the insulation;
- Netting or mesh can be used if the cavity is filled and in contact with the subfloor

Procedures- Floors



Crawlspace/Basement Access

- If access to the crawlspace or basement is from the conditioned area of the house, the access has to be airtight and insulated to the same value as the floor.

Procedures- Floors

Cantilevers

- Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever;
- Exterior sheathing is installed at the bottom so that there is a continuous air and weather barrier for the cantilever.
- The cantilever joist must be insulated to the same R-value as the subfloor prior to closing.
- Can lights in the cantilever are IC and AT Rated and properly sealed to sheathing.

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Procedures- Floors

SIPs & ICF

- SIPs air barrier shall be maintain through use of SIPs tape, or sealing and caulking between panels and at all spline joints;
- The outer and inner face, and all joints of the ICF air barrier, shall be maintain through use of tape, or sealing and caulking as needed.

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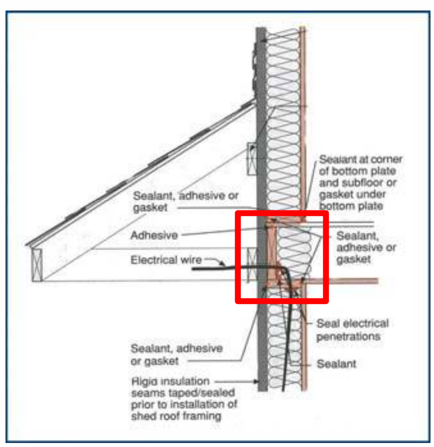
Procedures- Floors

Homes with Floors Over Garage

- On floors that are over garages, or where there is an air space between the insulation and the subfloor, the rim joist shall be insulated.



Procedures- Floors

Homes with Floors Over Garage (Cont.)

- The garage and the adjacent conditioned space (house) shall be insulated up to the subfloor;
- All rim and band joists adjoining conditioned space shall be air tight and insulated.

Procedures- Floors

Homes with No Conditioned Space Over The Garage (Cont.)

- The band joist where the garage transitions to an attic above conditioned space shall have an air barrier installed in contact with the edge of the attic insulation.

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Procedures- Floors

Quality Insulation Installation 129

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Procedures- Floors

Quality Insulation Installation 130

CHEERS

Procedures- Floors

CHEERS

Procedures- Floors

Procedures- Floors

Procedures- Floors

Procedures- Spray Foam Insulation

Procedures- Spray Foam Insulation

When dealing with SPF insulation, all of the previously described installation considerations still apply, with some additional requirements.

Procedures- Spray Foam Insulation

ccSPF insulation is not required to fill the cavities of framed assemblies:

- If the installed thickness of insulation conforms to compliance documentation;

AND

- If all framing is sprayed to completely fill the cavity adjacent to and in contact with the framing to a distance of 2.0 inches away from the framing for ocSPF insulation, or filled to the thickness meeting ASTM testing as an air barrier.

Quality Insulation Installation 137

Procedures- Spray Foam Insulation

ccSPF insulation is not required to fill the cavities of framed assemblies (Cont.)

Quality Insulation Installation 138

Procedures- Spray Foam Insulation

ocSPF insulation

- Will completely fill cavities of 2x4 inch framing or less;

AND

- Will fill cavities greater than 2x4 inch framing dimensions to the thickness that meets the required R-value used for compliance provided that all framing is sprayed to completely fill the cavity adjacent to and in contact with the framing to a distance of 5.5 inches away from the framing for ocSPF insulation, or filled to the thickness meeting ASTM testing as an air barrier.

Quality Insulation Installation 139

Procedures- Spray Foam Insulation

ocSPF insulation (Cont.)

Quality Insulation Installation 140

CHEERS

Procedures- Spray Foam Insulation

ocSPF insulation (Cont.)

- Depression in the foam insulation surface are not greater than 1 inch of the required thickness provided these depressions do not exceed 10% of the surface area being insulated

Quality Insulation Installation 141

CHEERS

Procedures- Spray Foam Insulation

SPF as an Air Barrier

- ccSPF installed as an air barrier shall be 2.0 inches in thickness;
- ocSPF installed as an air barrier shall be a minimum of 5.5 inches in thickness;
- Alternatively, ccSPF and ocSPF insulation shall be installed at a thickness that meets an air permeance no greater than 0.02 L/s-m2 at 75 Pa pressure differential when tested in accordance to ASTM E2178 or ASTM E283.

Quality Insulation Installation 142

Procedures- Spray Foam Insulation

SPF as an Air Barrier (Cont.)

- SPF insulation shall be applied to provide an air-tight envelope to the outdoors and between adjoining cavity surfaces of conditioned and unconditioned space, such as the: attic, garage, and crawl space.

Procedures- Spray Foam Insulation

Quality of Installation

- Shall be spray-applied to fully adhere to assembly framing of wall, floor, ceiling, the joists, and other surfaces within the construction cavity;
- Shall fully adhere on and around plumbing, electrical and any obstructions within the construction cavities;
- When multiple layers of SPF material are applied, each foam lift (i.e. spray application) shall have adhesion at substrate and foam interfaces.

Procedures- Spray Foam Insulation

Quality of Installation (Cont.)

- Shall be installed in conformance with the manufacturer's specifications, recommendations and temperature/humidity limitations;
- Substrates to which SPF insulation is applied shall be secure and free of surface moisture, frost, grease, oils, dirt, dust or other contaminants that would adversely affect adhesion.
- If values other than R-5.8 per inch for ccSPF and R-3.6 per inch for ocSPF are used, the ICC Evaluation Service Report (ESR) number (e.g. ESR-XXXX) will be documented on the CF2R-ENV-03.

Procedures- Spray Foam Insulation

Quality of Installation (Cont.)

- Shall not exhibit areas that:
  1. Have voids or gaps in the uniformity of the insulation
  2. Are extremely soft or spongy
  3. Show the presence of liquid
  4. Have blistering between lifts
  5. Show differences in coloration of adjacent foam layers
  6. Indicate the presence of other materials between lifts

Procedures- Spray Foam Insulation

Recessed Can Lights

- SPF Shall not be applied directly to recessed lighting fixtures and left exposed.

Procedures- Spray Foam Insulation

Recessed Can Lights (Cont.)

- Recessed light fixtures insulated with SPF insulation shall be protected from ignition by a combination of one or more of the following methods:
  - ✓ Be covered with a minimum of 1.5 inches of mineral fiber insulation;
  - ✓ Be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8inch hard board or gypsum board.

Procedures- Spray Foam Insulation

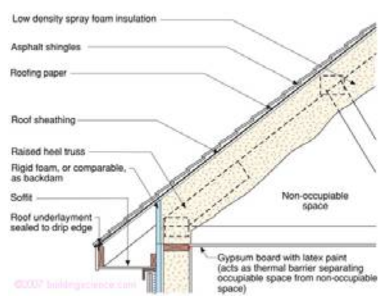
Roof

- SPF insulation shall be applied to fully adhere to the substrate of the ceiling or roof deck;
- SPF insulation shall be applied to fully adhere to the joist and other framing faces to form a complete air seal within the construction cavity.

Procedures- Spray Foam Insulation

Roof (Cont.)

- In unvented attics, if the SPF insulation is located on the underside of the roof deck, it shall extend to the outer edge to the top plate.



Procedures- Spray Foam Insulation

Gable Ends

- In unvented attics where SPF is applied directly to the underside of the roof deck, all gable end areas shall be insulated to the same R-value as the walls and as specified on compliance documentation;
- It is not necessary to place hard covers over drop ceilings and interior wall cavities in this situation.

Quality Insulation Installation 151

Procedures- Spray Foam Insulation

HVAC Platform

- A minimum of 3 inches of ccSPF insulation or 5.3 inches of ocSPF shall be placed below any platform or cat-walk access ways installed in vented attics for HVAC equipment or other needs;
- The overall assembly R-value shall meet the required R-values specified in the compliance documentation.

Quality Insulation Installation 152

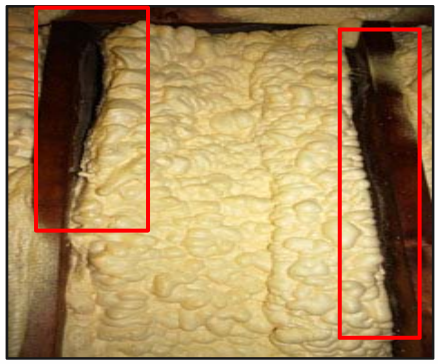
Procedures- Spray Foam Insulation

Attic Access

- A minimum of 3 inches of ccSPF or 5.3 inches of ocSPF insulation shall be applied to the access door assuring good adhesion to the door surface;
- Alternatively, permanently attach rigid foam or batt insulation with adhesive or mechanical fastener;
- The overall assembly R-value shall meet the required values specified in the compliance documentation.

Procedures- Spray Foam Insulation

Procedures- Spray Foam Insulation



Procedures- Spray Foam Insulation

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Procedures- Spray Foam Insulation

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Procedures- Spray Foam Insulation

Procedures- Spray Foam Insulation

Procedures- Multi-Family

Procedures- Multi-Family

Air Sealing

- Multifamily buildings must meet all air sealing requirements for single family buildings, as previously described;
- Each dwelling unit must be air sealed to stop air movement from one unit to another.

Procedures- Multi-Family

Access to outdoors

- Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatches, and plumbing stacks are all sealed to reduce air transfer from attached spaces.

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Procedures- Multi-Family

Garbage Shute and Elevator Shafts

- Vertical chases for garbage chutes, elevator shafts, HVAC ducting, and any other penetration must be sealed to the floor and ceiling of each unit to stop air movement thru it and to surrounding spaces.

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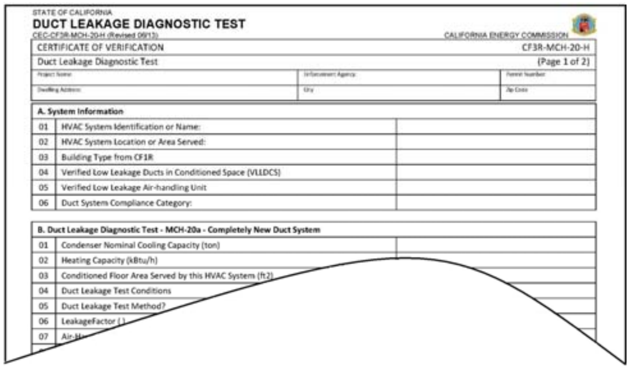
Procedures- Multi-Family

Common Hallways

- Penetrations between dwelling units and common hallways are sealed, including doors to dwelling units which shall be gasketed or made substantially airtight

Forms



STATE OF CALIFORNIA
DUCT LEAKAGE DIAGNOSTIC TEST
CEC-CF3R-MCH-20-H (Revised 09/13)
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION			CF3R-MCH-20-H
Duct Leakage Diagnostic Test			(Page 1 of 2)
Project Name:		Enforcement Agency:	Permit Number:
Dwelling Address:		City:	Zip Code:

A. System Information		
01	HVAC System Identification or Name:	
02	HVAC System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category:	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor ( )	
07	Air-H	

Forms

- CF3R-ENV-21-H
  - Air Infiltration Sealing – Framing Stage for Batt, Loose Fill, and SPF
  - 4 pages

STATE OF CALIFORNIA
AIR INFILTRATION SEALING – FRAMING STAGE FOR BATT, LOOSE FILL, AND SPF

Forms

- CF3R-ENV-21-H
  - Air Infiltration Sealing – Framing Stage for SIP and ICF
  - 3 pages

Forms

- CF3R-ENV-22-H
  - Air Infiltration Sealing – Ceiling, Roof/ Deck
  - 4 pages

Forms

CF3R-ENV-23-H

- Insulation Stage
- 4 pages

Training Sections

Section 1- Equipment Specifications

Section 2- Definitions

Section 3- Procedures

- Walls
- Ceiling & Roofs
- Floors
- Spray Foam Insulation

Section 4- Forms

Overall Training Goal

Familiarize yourself with Quality Insulation Installation, Protocols, Equipment and Forms.

QUESTIONS

C|H|E|E|R|S

Unmatched Service with Integrity

ADDITIONS & ALTERATIONS

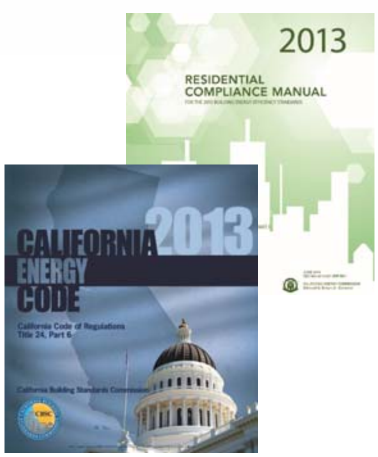
C|H|E|E|R|S

Unmatched Service with Integrity

2013 HERS I Training

Additions & Alterations

References



- California 2013 Residential Compliance Manual
  - Chapter 9
  - Found at: http://www.energy.ca.gov/title24/2013standards/residential_manual.html
- California Building Standards Code Part 6
  - Subchapter 9
  - Found at: http://www.ecodes.biz/ecodes_support/Free_Resources/2013California/13Energy/13Energy_main.html

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Introduction

Additions & Alterations

- This section covers key aspects of how the Standards apply to construction of residential additions, alterations to an existing residential building, or both;
- These standards do not apply to repairs;
- All HERS inspections procedures are conducted as previously described.

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Overall Training Goal

Gain an understanding of T24 requirements specifically applicable to Additions & Alterations.

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Training Sections

Section 1- Definitions

Section 2- Methods of Compliance

Section 3- Mandatory Requirements

Section 4- Additions

Section 5- Alterations

Section 6- Sampling

Section 7- HERS Verifications of Existing Features

Section 8- Forms

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Definitions

Definitions

- **Additions**: An addition is any change to an existing building that increases conditioned floor area and conditioned volume;
- **Alterations**: An alteration is any change to a building's water-heating system, space-conditioning system, lighting system, or envelope that is not an addition.

Definitions

- **Repairs**:
  - ✓The reconstruction or renewal for the purpose of maintenance of any component, system, or equipment of an existing building;
  - ✓Repairs shall not increase the pre-existing energy consumption of the repaired component, system, or equipment;
  - ✓Replacement of any component, system, or equipment for which there are requirements in the Standards is considered an alteration and not a repair.

***Note:** T24 Standards do not apply to repairs*

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Definitions

- **Accessible**: having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions;
  - ✓Some judgment is required in determining if something is accessible or not;
  - ✓The local code enforcement agency will have the final say when it is not immediately obvious.

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Definitions

- **Existing building components**: building components that remained unchanged by the Alteration or Addition (e.g. insulated exterior walls in the existing portion of the home that will not be touched).

C H E E R S

Definitions

- **Altered building components**: building components that exist prior to the remodel, but are being changed (e.g. attic insulation that will be added, or a furnace that will be replaced).

C H E E R S

Definitions

- **New building components**: building components that do not exist prior to the construction work (e.g. new walls added to create the addition).

Methods of Compliance

Methods of Compliance

Compliance Approaches

- Most alterations & additions will use the prescriptive approach although the performance compliance approach is allowed; larger additions (1000 Ft2 +) often use the performance approach;

- Available paths to compliance depend on the scope of work:
  - ✓Additions
  - ✓Alterations
  - ✓Additions + Alterations

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Methods of Compliance

Compliance Approaches (Cont.)

Project Scope	Prescriptive Approach	Performance Approach[1,2]
1. Addition Only:	Additions ≤400 ft2; or	Addition Alone
	Additions >400 ft2 and ≤700 ft2	Existing + Addition as new Construction
	Additions >700 ft2; or	
2. Alteration Only:	Meet All Applicable Requirements for Prescriptive Alterations	Existing + Alterations Without Third Party Verification of Existing Conditions; or
		Existing + Alterations With Third Party Verification of Existing Conditions; or
		Existing + Alterations as All New Construction
3. Addition and Alteration Combined:	Meet All Applicable Requirements for Prescriptive Alterations and a Prescriptive Addition Approach (see Additions Only above)	Existing + Addition + Alterations Without Third Party Verification of Existing Conditions; or
		Existing + Addition + Alterations With Third Party Verification of Existing Conditions; or
		Existing + Addition + Alterations as All New Construction

1) In the performance method, the building must be modeled with Energy Commission-approved compliance software as explained in Chapter 8 of this Manual.

2) The Existing + Alterations performance approach with or without third party verification may be used only if there are at least two types of altered components in the existing building. This requirement does not apply to the Existing + Addition + Alterations compliance method.

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Methods of Compliance

Compliance Approaches (Cont.)

- Modeling Rules For Existing+ Additions + Alterations

Type of Component or System Modeled	Standard Design Without Third Party Verification of Existing Conditions	Standard Design With Third Party Verification of Existing Conditions
"EXISTING" -- Components or Systems That Remain Unchanged	Model each component or system as "Existing"	Model each component or system as "Existing"
"ALTERED" -- Components or Systems Being Changed/Replaced	Model each altered component or system as "Altered" but do not model the "Existing" conditions	Model each component or system as "Altered" and also model the "Existing" conditions
"NEW" -- Components or Systems Being Added	Model each component or system as "New"	Model each component or system as "New"
"REMOVED" -- Components or Systems Being Removed and Not Replaced	These components and systems are omitted entirely from the model (Note: this is a change from 2008 Standards rules)	These components and systems are omitted entirely from the model (Note: this is a change from 2008 Standards rules)

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Mandatory Requirements

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Mandatory Requirements

Mandatory measures and minimums apply to all added or altered components as they do to new construction, regardless of whether the prescriptive or performance compliance method is used.

Mandatory Requirements

Ceiling & Roof Insulation

- Ceiling: minimum R-30 in all CZs;
- Ceiling without attics: minimum R-19 or equivalent between wood framing members;
- When the space between framing members becomes accessible as a part of a ceiling/roof modification, the ceiling/roof is considered altered and the insulation measure applies;
  - ✓ If the roofing material is replaced but not the roof sheathing, there is no insulation requirement.

Mandatory Requirements

Roofing Products

- Roofing products installed either to meet prescriptive requirements or to take performance compliance credit for reflectance and emittance are referred to as “cool roof”;
- To be considered a cool roof the roofing products manufacturer must have its roofing product tested for solar reflectance and thermal emittance, and be listed in the Cool Roof Rating Councils (CRRC) Rated Product Directory.

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Mandatory Requirements

Wall Insulation

- If R-11 is present in framed walls, it is not required to meet the minimum R-13 or R-19;
- Building has to show it meets compliance with the performance method, modeled with the R-11.

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Mandatory Requirements

Fenestration

- New or replacement (altered) glazing – including skylights -- must meet the maximum U-factor requirement in one of three ways:
  - ✓ Every fenestration product (glazed opening) meets the mandatory maximum U-factor of 0.58; **OR**
  - ✓ All new or replacement fenestration combined meet the mandatory maximum of 0.58 U-factor using an area weighted average calculation; **OR**
  - ✓ The area of new and replacement fenestration up to 10 ft^2 or 0.5% of the conditioned floor area (CFA), whichever is greater, is exempt from the U-factor requirement.

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Mandatory Requirements

Fenestration (Cont.)

- Greenhouse or Garden Windows
  - ✓ Special windows that project from the facade of the building and are typically five sided structures;
  - ✓ An NFRC-rated U-factor for greenhouse windows is typically quite high and may not meet the mandatory requirements for the fenestration U-factor of 0.58;
  - ✓ When using the performance approach, dual glazed greenhouse or garden window installed as part of an alteration complies automatically with the U-factor requirements. However, these windows are not exempt from the SHGC requirements;
  - ✓ All options from new and altered glazing to meet U factor requirements also apply.

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Mandatory Requirements

HVAC & Water Heating Measures

- Same as new construction
  1. Equipment efficiencies
  2. Controls
  3. Pipe insulation
  4. Heating and cooling loads calculations
  5. Duct insulation
  6. Installation standards

Mandatory Requirements

Whole Building Mechanical Ventilation

- Whole building ventilation airflow requirement is only required in additions over 1000 ft^2;
- The requirement applies to the whole house, not only the addition;
- All other mechanical ventilation requirements, including local exhaust, must be met as applicable, in all additions and alterations;
- When whole-building ventilation airflow is required for compliance, HERS field verification and diagnostic testing of airflow performance is required in accordance with the same procedures as new construction.

Additions & Alterations 25

Mandatory Requirements

Lighting

- Only the lighting equipment that is altered needs to comply with the Standards;
- Low efficacy lighting cannot be added to an altered kitchen until at least 50% of the lighting in the finished kitchen becomes high efficacy;
- The newly installed lighting is also required to comply with the switching requirement;
- All other lighting requirements same as new construction.

Additions & Alterations 26

Additions

Additions

Prescriptive requirements for additions depend on the total CFA of the addition;

The total CFA of the addition can be from separate areas under the same permit;

The requirements are divided into three tiers:

- $\leq$ 400 ft^2
- > 400 ft^2 $\leq$ 700 ft^2
- > 700 ft^2

Additions

Additions $\leq$ 400 ft^2

- All prescriptive Package A requirements must be met <u>except</u>:
  - ✓ Total glazing area may be up to 75 ft^2 or 30% of conditioned floor area, whichever is greater;
  - ✓ West-facing glazing area may be up to 60 ft^2;
  - ✓ Required exterior wall insulation:
    - In 2x4 wood frame walls, insulation shall be R-13 or an overall construction assembly U-factor < 0.102, for wood or metal frame walls;
    - In 2x6 or greater wood frame walls, insulation shall be R-19 or an overall construction assembly U-factor < 0.074, for wood or metal frame walls;
  - ✓ No requirement for a whole house fan (WHF) to provide ventilation cooling;
  - ✓ For additions ≤ 300 ft^2 cool roof compliance is not required.

Additions & Alterations 29

Additions

Additions $\geq$ 400 ft^2 and $\leq$ 700 ft^2

- All prescriptive Package A requirements must be met <u>except</u>:
  - ✓ Total glazing area may be up to 120 ft^2 or 25% of conditioned floor area, whichever is greater;
  - ✓ West-facing glazing area may be up to 60 ft^2;
  - ✓ Required exterior wall insulation:
    - In 2x4 wood frame walls, insulation shall be R-13 or an overall construction assembly U-factor < 0.102, for wood or metal frame walls;
    - In 2x6 or greater wood frame walls, insulation shall be R-19 or an overall construction assembly U-factor < 0.074, for wood or metal frame walls;
  - ✓ No requirement for a whole house fan (WHF) to provide ventilation cooling.

Additions & Alterations 30

Additions

Additions $\geq$ 700 ft^2

- All prescriptive Package A requirements must be met <u>except</u>:
  - ✓ Total glazing area may be up to 120 ft^2 or 20% of conditioned floor area, whichever is greater;
  - ✓ West-facing glazing area in CZ 2, 4, and 6-16 may be up to 70 ft^2 or 5% of the CFA, whichever is greater;
  - ✓ If the addition is $\leq$ 1000 ft^2 there is no requirement for a whole house fan (WHF) to provide ventilation cooling.

Additions

Roof/ Ceiling Envelope

Component	Requirements of Additions $\leq$ 400 ft^2	Requirements of Additions > 400 ft^2 and $\leq$ 700 ft^2	Requirements of Additions > 700 ft^2
Roof/Ceiling Insulation:	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031
Roof Products (Cool Roof):	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16
	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75
	Exception: Additions < 300 ft^2 exempt from all cool roof requirements.		
Radiant Barrier Above Attic:	Package A: CZ2-15: Radiant Barrier above Attic Spaces	Package A: CZ2-15: Radiant Barrier above Attic Spaces	Package A: CZ2-15: Radiant Barrier above Attic Spaces

Additions

Glazing

Component	Requirements of Additions $\leq$ 400 ft^2	Requirements of Additions > 400 ft^2 and $\leq$ 700 ft^2	Requirements of Additions > 700 ft^2
Total Glazing Area:	p to 75 ft^2 or 30% of Conditioned Floor Area, whichever is greater	p to 120 ft^2 or 25% of Conditioned Floor Area, whichever is greater	p to 175 ft^2 or 20% of Conditioned Floor Area, whichever is greater
West-Facing Glazing Area: In Climate Zone 2, 4, 6-16	Up to 60 ft^2	Up to 60 ft^2	Up to 70 ft^2 or 5% of Conditioned Floor Area, whichever is greater
Glazing U-Factor & SHGC[1]:	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25
1. See §150.0(q) and §150.1(c)3 for new and replaced window and skylight exceptions .			

Additions

Wall & Floors Envelope

Component	Requirements of Additions $\leq$ 400 ft^2	Requirements of Additions > 400 ft^2 and $\leq$ 700 ft^2	Requirements of Additions > 700 ft^2
Exterior Wall[1] Insulation:	1 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074	Package A: All CZs: U=0.065
Raised Floor[1] Insulation:	Package A: All CZs: R-19 or equivalent U-factor	Package A: All CZs: R-19 or equivalent U-factor	Package A: All CZs: R-19 or equivalent U-factor
Slab Floor[1] Insulation:	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58
1. R-values refer to wood framing and U-factors refer to metal framing.			

Additions

CHEERS

Prescriptive Water Heating Systems

- If an addition increases the number of water heaters serving a dwelling unit, then the addition can comply prescriptively if any one of the following conditions:
  1. The additional water heater is a 50 gallon or less, storage or instantaneous, non-recirculating water heater with an EF (Energy Factor) equal to or greater than the federal minimum standards;
  2. The water heating system is a water-heating system determined by the Executive Director of the Energy Commission to use no more energy than the one specified in item 1 above.

Additions

CHEERS

HVAC & Water Heating

Component	Requirements of Additions < 400 ft2	Requirements of Additions > 400 ft2 and < 700 ft2	Requirements of Additions > 700 ft2
Ventilation Cooling1 (Whole House Fan)	No Requirement.	No Requirement.	Additions < 1,000 ft2: No requirement Additions > 1,000 ft2: Package A Whole House Fan, §150.1(c)12
Adding New Space Conditioning System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.

Additions

HVAC & Water Heating (Cont.)

Component	Requirements of Additions < 400 ft2	Requirements of Additions > 400 ft2 and < 700 ft2	Requirements of Additions > 700 ft2
Replacing Existing Space Conditioning System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.
Adding All New Complete Duct System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.
Extending Existing Duct System(s) by > 40 Feet	All Package A duct insulation requirements; duct system sealing and HERS Verified	All Package A duct insulation requirements; duct system sealing and HERS Verified	All Package A duct insulation requirements; duct system sealing and HERS Verified
1. (Note: also mandatory mechanical ventilation per ASHRAE 62.2 with HERS verification for additions > 1,000 ft^2)			

Alterations

Alterations

Although alterations must meet many of the same prescriptive requirements for new construction and additions, there are several exceptions or special allowances for certain types of alterations.

Alterations

Alterations must comply with all applicable mandatory measures of the Standards as explained in Chapters 3, 4, 5 and 6 of the Residential Manual;

Several prescriptive measures are Climate Zone (CZ) specific as in new construction, but several exceptions or special allowances for certain types of alterations exist;

There are no mandatory measures or prescriptive requirements when altering below-grade or exterior mass walls.

CHEERS

Alterations

Ceiling Envelope

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Adding Ceiling or Roof Insulation to an Existing Roof; or a New Roof on an Existing Building	Ceiling w/ Attic: R-30, U=0.031	CZ 1, 11-16, R-38, U=0.025	N/A	CF1R-ALT
	Roof Rafters: R-19, U=0.056 §150.0(a)	CZ 2-10: R-30, U 0.0.031		
Replacing Roof Sheathing	§110.8(j)	CZ 2 - 15: Radiant Barrier above Attic Spaces	No requirement in CZ1 and CZ16	CF1R-ALT
Replacing > 50% of the Existing Roof Surface	§110.8(i)	Steep Sloped (≥ 2:12), CZ 10 - 15: Reflect.=0.20 and Emittance=0.75, or SRI=16	(a) Air space of 1.0" between roof deck and bottom of roofing product; or, (b) Profile ratio of rise to width of 1:5 for > 50% width of roofing product, or, (c) Existing ducts in attic insulated and sealed per §150.1(c)9, or, (d) Roof has ≥ R-38 ceiling insulation, or, (e) Roof has a radiant barrier per §150.1(c)2, or, (f) There are no ducts in the attic; or, (g) In CZ10-15, ≥R-4.0 insulation above the roof deck.	CF1R-ALT
		Low Sloped < 2:12, CZ13 & 15: Reflect. 0.63 and Emittance=0.75, or SRI 75	(a) There are no ducts in the attic, or (b) Reflectance and Roof Deck Insulation R-value in Table 150.2-A are met.	CF1R-ALT

CHEERS

Alterations

Walls & Floor Envelope

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Adding Exterior Framed Wall Insulation[3] or a New Wall in an Existing Building	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074 Exception: Walls already insulated to R-11 §150.1(c)	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074 (same as Mandatory)	N/A	CF1R-ALT
Adding Raised Floor Insulation	R-19 or equivalent U-factor Exception: Floors over controlled ventilation or unvented crawlspaces per §150.1(d)	R-19 or equivalent U-factor (same as Mandatory)	N/A	CF1R-ALT

Alterations

Fenestration

- Replacement fenestration that is located in the same existing wall or roof in which the same or larger area of existing fenestration is being removed it labeled as "altered”
  - ✓It does not need to be in the same exact openings as the glazing being removed, as long as it is being installed in the same existing wall or roof surface which remains a part of the existing building.
- Any new fenestration area that increases the total net area of fenestration in any existing wall or roof is labeled as "new“.

Alterations

Fenestration (Cont.)

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Adding or Replacing Skylight[3]	Weighted average U-factor = or < 0.58 Exemption: Up to 10 ft^2 or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.1(q)	Must not exceed the 20% Total or 5% West Fenestration Area with a U-factor = 0.32 (all CZs); in CZ2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.A.	Added fenestration up to 75 ft^2 need not meet Total or West-facing fenestration area as per §150.2(b)1A Exception 1. Replacement skylights up to 16 ft^2 with a U=0.55 and SHGC=0.30 and not meet the total fenestration and West-facing area requirements as per §150.2(b)1 A Exception 2.	CF1R-ALT

Alterations

Fenestration (Cont.)

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Replacing Vertical Fenestration[4] (Altered Glazing)	Weighted average U-factor = or < 0.58 <u>Exemption</u>: Up to 10 ft² or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.0(q)	All CZs: U-factor = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.B	Replacement of vertical fenestration up to 75 ft²: U=0.40 (in all CZs) and SHGC=0.35 in CZs 2, 4 & 6-16 as per §150.2(b)1B Exception 1	CF1R-ALT
Adding Vertical Fenestration[4] (New Glazing) and Greenhouse	Weighted average U-factor = or < 0.58 <u>Exemption</u>: Up to 10 ft² or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.0(q)	Must not exceed the 20% Total or 5% West Fenestration Area U-factor = 0.32 (in all CZs), In CZ2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.A	Added fenestration up to 75 ft² need not meet total or west-facing fenestration area requirements as per §150.2(b)1A Exception 1. Added Greenhouse must either meet the maximum U-factor of 0.58 or weighted average U-factor of 0.58 or up to 10ft² or 0.5% of CFA whichever is greater as per §150.0(q)1.	CF1R-ALT

Alterations

HVAC Change outs

- The Standards make a distinction between two types of HVAC "change out" situations:
  1. Entirely New or Complete Replacement Space Conditioning Systems;
  2. Altered Space Conditioning Systems.

***Note:** Refer to the Energy Code Ace Trigger Sheet, downloadable on the LMS, for a quick reference to HVAC requirements based on the type of Alteration.*

Ace Resources

Title 24 Part 6
Residential Triggers Sheet

HVAC Alterations

Split Systems and Packaged Systems	Mandatory Measures					Prescriptive Requirements	
Change this (and nothing else)	Setback Thermostat §110.2(c) §150.2(b)F	Cooling Load Calcs §150.0(h), §150.2(b)1C	Heating Load Calcs §150.0(h), §150.2(b)1C	HERS: Duct Seal and Test §150.0 (m)1-3 & 11 §150.2(b)1C,D, & E	HERS: Cooling Coil Airflow and Fan Watt Draw §150.0(m)12, 13 & 15 §150.2 (b)1C, D	Duct Insulation §150.1(c)9 §150.2(b)1D	HERS: Refrigerant Charge §150.1(c)7 A §150.2(b)1 F
Whole split or packaged system (no ducts added or replaced)	YES	no	no [A]	YES [B]	no	no	YES [C, D]
Evaporator coil (cooling coil), condenser coil, or outdoor condensing unit	YES	no	no [A]	YES [B]	no	no	YES [C, D]
Furnace (air handler)	YES	no	no [A]	YES [B]	no	no	YES [C, D]
Compressor, refrigerant metering device	YES	no	no [A]	no	no	no	YES [C, D]
Some ducts	no	maybe [E]	maybe [A, E]	YES [B]	no	YES [F]	no
"All new" ducts [G]	no	maybe [E]	maybe [A, E]	YES [H]	YES [I]	YES [F]	no
Whole split or packaged system and all new ducts	YES	YES [E]	YES [A, E]	YES [H]	YES [I]	YES [F]	YES [C, D]

NOTE:
- ✦ Replacing the blower wheel fan is considered a repair and does NOT trigger the Standards.
- ✦ All new HVAC equipment must meet minimum federal efficiency requirements
- ✦ Cooling line insulation is triggered if the line set (cooling system, suction line) is replaced or repaired. Line sets ≤1.5" in diameter must have 0.5" thick insulation.

[A] Heating equipment must meet CBC minimum capacity requirements.

[B] Unless exceptions apply, duct systems must be sealed and verified if >40 feet of ducts in unconditioned space. Duct system leakage must be ≤15% in total, or ≤10% to the outside. Or, if unable to meet the sealing requirements, all accessible leaks must be sealed and verified by a HERS rater.

[C] HERS verification of refrigerant charge is required in **climate zones 2 and 8–15 only** when a refrigerant containing component of an air conditioner or heat pump is replaced or installed in an existing building.

[D] Although there are no commercially available HVAC systems with approved Charge Indicator Display (CID) devices at the time of publication (July 2014) the Standards do allow use of a CEC-approved CID should such equipment become available during the 2013 code cycle.

[E] Cooling and heating load calculations are required when ducts are added to **serve new conditioned space**, such as an addition.

[F] When adding or replacing >40 feet of ducts in unconditioned space: CZ 1-10 and 12-13: R-6; CZ 11 and 14-16: R-8. HERS verification is required for insulated ducts in conditioned space. Mandatory duct insulation requirements (R-6) apply to all new or replacement ducts (not existing or unaltered ducts).

[G] The system is considered to have "all new" ducts when 75% or more of the ducts are new material and up to 25% reused parts from the existing duct system (e.g., registers, grilles, boots, air handler, coil, plenums, duct material) if the reused parts are accessible and can be sealed to prevent leakage.

[H] In all climate zones, when new duct systems are installed in unconditioned space, leakage must be ≤6% of the air handler airflow.

[I] When new duct systems are installed, cooling coil airflow must be >350 CFM per ton, and fan watt draw must be ≤0.58W/CFM. Alternatively, the system can meet the requirements in Table 150.0-C or Table 150.0-D (Return Duct Sizing and Filter Sizing).

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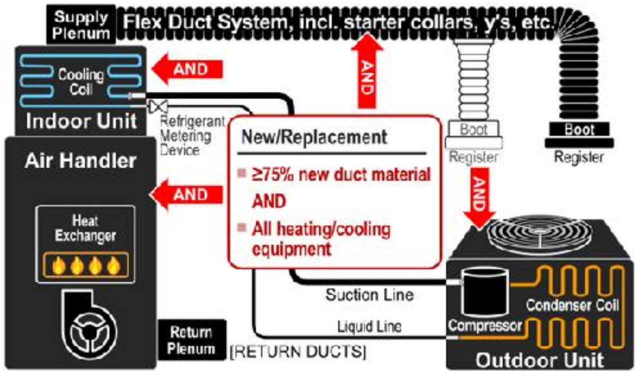
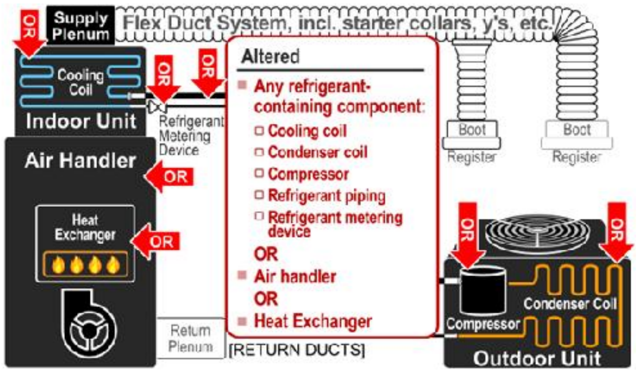
2013 Entirely New or Complete Replacement Space-Conditioning System §150.2(b)1C



A space-conditioning system is considered entirely new or a complete replacement when all of the following are installed or replaced:

- All the system heating/cooling equipment
- ≥75% new duct material G

2013 Altered Space-Conditioning System §150.2(b)1E, F

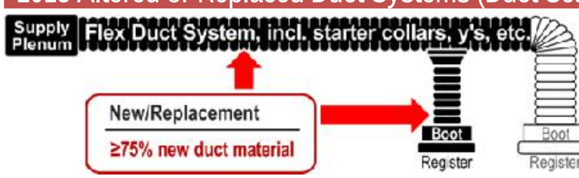


A space-conditioning system is considered altered when it is not a new or replacement system and any of the following components is installed or replaced:

- Any refrigerant-containing component, including:
  - Cooling coil
  - Condenser coil
  - Compressor
  - Refrigerant piping
  - Refrigerant metering device
- Air handler
- Heat exchanger

Replacing other components is considered a repair — not an alteration. For example, replacing the blower wheel fan, but not the heat exchanger or air handler in the furnace, is a repair.

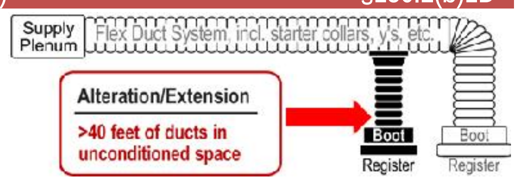
2013 Altered or Replaced Duct Systems (Duct Sealing) §150.2(b)1D



Entirely New or Complete Replacement Ducts

Entirely new or complete replacement duct systems are those that contain at least 75% new duct material. Existing duct system components (up to 25%) may be reused if they are accessible and can be sealed.G

The Duct Sealing and Testing HERS measure must demonstrate a leakage rate less than or equal to 6% of the system air handler airflow. In addition, verification of Cooling Coil Airflow and Fan Watt Draw (HERS measure) is required. The system must have airflow >350 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy ≤0.58 W/CFM.



Alteration or Extension of Existing Ducts

In all climate zones when more than 40 feet of new or replacement system ducts are installed as an extension of an existing duct system, Duct Sealing and Testing (HERS measure) is required, and the measured leakage shall be equal to or less than 15% of system air handler air flow.

(There are alternatives to meeting the maximum 15% leakage. Consult your Building Department or §150.2(b)1Diib in the Standards.)

Required Documentation

For All HVAC Alterations

All HVAC alterations require:

- Permit — for all HVAC changeouts
- CF1R: Certificate of Compliance: Alteration to an HVAC System (CF1R-ALT-02*-E, or CF1R-ALT-03-E or CF1R-ALT-04-E)
  Submitted to the building department by the contractor or the home owner
- CF2R-MCH-01-H: Certificate of Installation for Space Conditioning Systems, Ducts and Fans
  Completed and signed by the installing contractor and made available for final inspection by building department

For HERS Measures

Projects with HERS measures require:

- Registration of the CF1R, via HERS Provider
- CF2R-MCH…H: Certificates of Installation for mechanical system with HERS measures
  Completed and signed by the installing contractor; must be submitted to a HERS Provider Registry after the contractor has signed it, and made available for inspection by the building department
- CF3R-MCH…H: Certificates of Field Verification for mechanical system with HERS measures
  Completed and registered by a HERS Rater for each CF2R-H; the HERS Rater or contractor ensures the relevant CF3Rs are available for final inspection by the building department.
- HERS: Duct Leakage Diagnostic Test
  - CF2R-MCH-20*-H and CF3R-MCH-20*-H
- HERS: Fan Efficacy (Fan Watt Draw)
  - CF2R-MCH-22-H and CF3R-MCH-22-H

  and

  HERS: Space Conditioning System Airflow Rate
  - CF2R-MCH-23*-H and CF3R-MCH-23*-H
- HERS: Refrigerant Charge Verification
  - CF2R-MCH-25*-H and CF3R-MCH-25*-H

  or
  - CF2R-MCH-25f-E (for packaged systems with refrigerant charge certified by manufacturer)

* *Correct version (e.g., “a” or “b” or “c”) varies depending upon the project scope and approach used to demonstrate compliance*

For Projects with New or Replacement Duct Systems using Duct and Filter Sizing

Projects that use Duct and Filter Sizing instead of the Cooling Coil Airflow and Fan Watt Draw HERS Measure require:

- CF2R-MCH-28-H and CF3R-MCH-28-H

Alterations

HVAC Change outs (Cont.)

1. Entirely New or Complete Replacement Space Conditioning Systems
   - ✓ **ALL** heating and cooling equipment is new;
   - ✓ The duct system meets the definition of an Entirely New or Complete Replacement Duct System, including systems with less than 40 ft in length.
     - At least 75% of the duct material is new;

       AND
     - Any remaining components from the previous system are accessible and can be sealed.

Alterations

HVAC Change outs (Cont.)

1. Entirely New or Complete Replacement Space Conditioning Systems (Cont.)
   - ✓ Must meet the mandatory and prescriptive requirements of all new systems, and tested as previously described in the Duct Leakage section.

Alterations

HVAC Change outs (Cont.)

2. Altered Space Conditioning Systems

✓Any of the following is considered an altered system and shall be tested as previously described in the Duct Leakage Section:

- An air handler, outdoor condensing unit of a split system air conditioner, or heat pump is installed or replaced;
- A cooling or heating coil is installed or replaced;
- More than 40 feet of new or replacement ducts are installed in unconditioned space.

Alterations

HVAC Change outs (Cont.)

2. Altered Space Conditioning Systems (Cont.)

✓Required HERS Inspections

- Duct Sealing (all CZ)
  - As previously described in the Duct Leakage section
- Refrigerant Charge or CID (CZ 2, 8-15)
  - As previously described in the Refrigerant Charge section
  - Only required when components of the AC system have been altered (coils, TXV, refrigerant lines)

Alterations

HVAC Change outs (Cont.)

2. Altered Space Conditioning Systems (Cont.)

✓Required HERS Inspections

- **EXCEPTIONS:** Duct Sealing is not required when any of the following conditions apply:
  - The system is not ducted;
  - There are less than 40 feet of ducts total in unconditioned space including plenums and FAU;
  - The ducts are sealed or insulated with asbestos;
  - The system was previously tested and certified by a HERS Rater and it can be documented thru a CF3R or 4R. This exception does not apply if more than 40 ft. were added or replaced since the original verification.

Alterations

HVAC Change outs (Cont.)

2. Altered Space Conditioning Systems (Cont.)

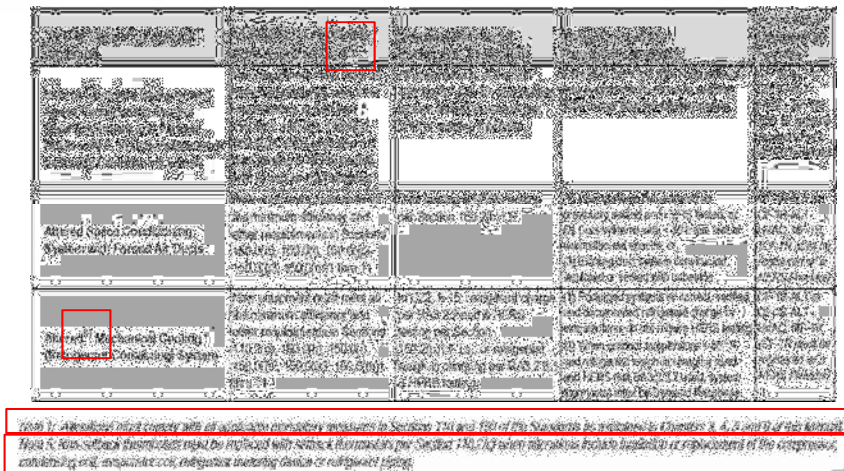
✓Required HERS Inspections

- **EXCEPTIONS:** Refrigerant Charge is not required when any of the following conditions apply:
  - The system does not have air conditioning installed;
  - The AC system is determined to be non-op by the local jurisdiction;
  - The system is a new package with factory certification of charge. The Rater will still have to access the AHRI database in order to obtain the certification number associated with the unit and document it in the CF3R-MCH-25;
  - The system has an approved and verified CID as previously described in the HVAC Components and Devices section.

CHEERS

Alterations

HVAC Change outs (Cont.)



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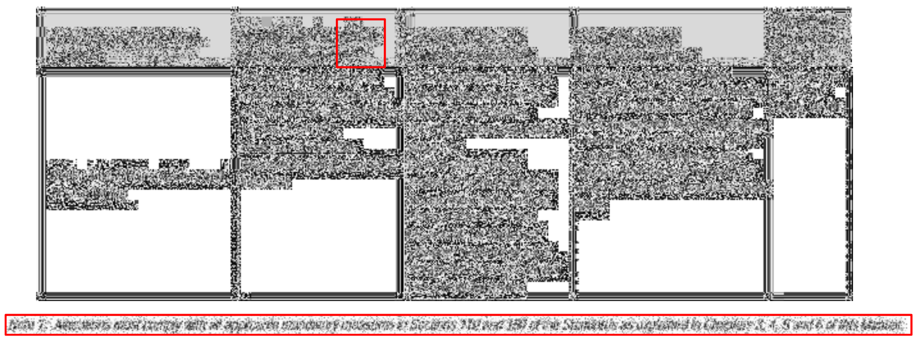
Alterations

HVAC Change outs (Cont.)

CHEERS

Alterations

Water Heating



CHEERS

Alterations

Fuel Switching

- New electric resistance heating systems are prohibited in alterations unless the system being replaced is an electric resistance heating system;
- Changing from a gas, propane, or LPG space heating system to an electric heat pump is allowed as long as the heat pump efficiency meets minimum efficiency standards, and the heat pump installed size is shown to result in no more TDV energy use than the standard design heat pump using the performance method.

Alterations

Fuel Switching (Cont.)

Existing Heating System Fuel Source	Acceptable Replacement Heating System Fuel Source(s)
Electric	Electric, natural gas, or equipment with efficiency equal to or better than existing system*
Natural gas	Natural gas, or equipment with efficiency equal to or better than existing system* or a heat pump with equal or lower TDV energy use than a standard design system.
LPG	Liquefied petroleum gas, natural gas, or equipment/ system with efficiency equal to or better than existing system* or a heat pump with equal or lower TDV energy use than a standard design system.

*Proof that equipment has an efficiency that is equal to or better than the existing system can be demonstrated by an approved compliance program or other approved alternative calculation method to compare the TDV energy use of the existing system to the proposed system.

Sampling

Sampling

Sampling HERS Measures for Additions & Alterations:

- Sampling works the same way as new construction with the exception that you only use the closed method.

Procedure	Closed
Sampling Rate	1 tested home in a group of up to 7 homes
Required Before Testing	ALL CF-1Rs and CF-2Rs for homes in sampling group
Group is Closed	when HERS inspections begin

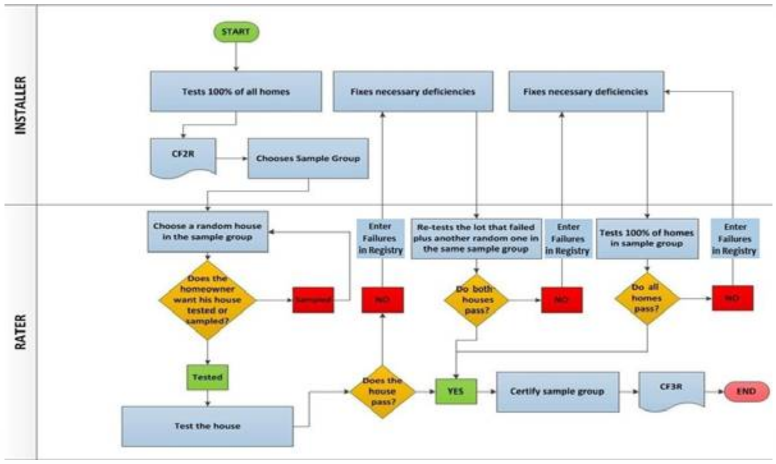
Sampling

Sampling HERS Measures: **Additions & Alterations** (Cont.)

- No model testing required
- Allowed when the following apply:
  - ✓All homes in the group have the same installing subcontractor
  - ✓All homes in the group have the same associated HERS measures
- The building owner may choose for the field verification and diagnostic testing to be completed for the dwelling unit individually; or alternatively, as part of a designated sample group of dwelling units
- If homes cannot meet sampling requirements, the HERS Raters will have to test 100% of the homes in the sampling group.

Sampling

Sampling HERS Measures: **Additions & Alterations** (Cont.)



HERS Verification of the Existing Features

HERS Verification of the Existing Features

Introduction

- When adding to or altering an existing home, compliance credit can be taken for upgrading existing features by using the performance approach when the existing features are verified by a qualified HERS rater prior to registration of the certificate of compliance.

HERS Verification of the Existing Features

Introduction (Cont.)

- Third-party verification of the features prior to the construction is required to receive this compliance credit.
- The credit level depends on whether defaults are used or actual values (that are less efficient than defaults) collected by the HERS Rater are used.

HERS Verification of the Existing Features

The HERS Inspection Process

- The HERS rater can verify the existing conditions before or after the compliance run is completed;

HOWEVER

- The HERS rater must visit the home to verify the assumptions of the existing conditions in the building, ***prior*** to registration of the certificate of compliance;
- The Data Registry will generate a CF3R-EXC-20-H compliance document based upon the output from the Performance Compliance Software.

HERS Verification of the Existing Features

The HERS Inspection Process (Cont.)

- If conducting the inspections prior to the compliance run being run, the rater will be informed of what building components will be updated.
- The rater or builder then determines what products are installed in those areas and informs the energy consultant of their findings.
- After the energy consultant inputs the correct values on the CF1R, the rater verifies the conditions on a CF3R-EXC-20-H.
- Then the certificate of compliance can be registered.

HERS Verification of the Existing Features

The HERS Inspection Process (Cont.)

- The generated CF3R-EXC-20-H will list the features of the existing conditions that must be field verified by the HERS rater.
- A registered CF3R-EXC-20-H that agrees with the existing conditions input for the proposed building for the performance compliance calculation, will be required by the HERS Registry as a prerequisite to completion of the registration of the CF1R for the project.

HERS Verification of the Existing Features

The HERS Inspection Protocols

- HERS raters are to follow the protocols for a Whole House Home Energy Rating (WHHER/HERS II) when verifying existing conditions.
- The requirement of following WHHER protocols does not mean being Whole House Rater Certified.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

- The following are the potential pre-existing components that will have to verified by HERS Raters:
  1. Building Envelope (Wall, floor and ceiling construction)
  2. Fenestration
  3. Water heating systems
  4. Space Heating/Cooling equipment
  5. Air distribution systems

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HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determine Framing Type:
   - ✓ 2x4, 2x6
   - ✓ Wood
   - ✓ Steel
   - ✓ SIP
   - ✓ ICF
   - ✓ Log
   - ✓ Other

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HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Insulation R-Value:
   - ✓ Use the following values per inch
     - R-3.85 for fiberglass blankets or batts
     - R-3.41 for loose-fill cellulose
     - R-2.13 for vermiculite
     - R-3.85 for expanded polystyrene (EPS) rigid boards
     - R-11 for 3.75-5 inches of mineral fiber (rock, slag or glass),
     - R-19 for 6.5 to 8.75 inches of mineral fiber
     - R-22 for 7.5 to 10 inches of mineral fiber
     - R-30 for 10.25 inches or greater of mineral fiber

Note: *if batt insulation is installed and you can read the R-Value of it, do so.*

Additions & Alterations 71

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Insulation R-Value (Cont.):
   - ✓ If unable to verify R-Value of any building component, vintage table R3-50 from Appendix B of the Residential Compliance Manual must be used.

Additions & Alterations 72

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Insulation R-Value (Cont.):

Table R3-50

	Default Assumptions for Year Built (Vintage)								
Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 - 2000	2001-2003	2004-2005	2006 and 2012	2013 and Later
INSULATION U-FACTOR									
Roof/Ceiling	0.079	0.049	0.049	0.049	0.049	0.049	0.049	0.049	
Wall	0.356	0.110	0.110	0.102	0.102	0.102	0.102	0.102	
Raised Floor –Crawl Space	0.099	0.099	0.099	0.046	0.046	0.046	0.046	0.046	
Cool Roof	0.10	0.10	0.10	0.10	0.10	0.10	0.10	Pres Pkg.	
Radiant Barrier	None	None	None	None	None	None	Pres Pkg.	Pres Pkg.	
Raised Floor-No Crawl Space	0.238	0.238	0.238	0.064	0.064	0.064	0.064	0.064	
Slab Edge F-factor	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Insulation R-Value (Cont.):
   - ✓ You'll need to convert the U-Factors to R-Values, as described in the Basics of Building Science section;

R-Value= 1 / U-Factor

-U-Factor= 0.356

-R-Value= 1 / 0.356

-R-Value= 2.8

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

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

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Wall Insulation R-Value (Cont.):
   - ✓ **For foam core walls (SIPs)**, the value is chosen based on the insulation level of the core. Values are presented for both EPS (expanded polystyrene panels) and polyiso (polyisocyanurate) panels.
   - ✓ Assume an insulation R-value per inch of 3.85 for EPS.
   - ✓ For polyiso core panels, insulation R-values of R-26 and R-40 are present for 4.5" and 6.5" panels, respectively.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Wall Insulation R-Value (Cont.):
   - ✓ **For log walls,** select a U-Factor based on the log thickness from Table 4.3.11 of Reference Appendix JA4 and convert it to R-Value as previously described.

Log Diameter		U-factor	Heat Capacity (HC)
		A	
6"	1	0.133	4.04
8"	2	0.102	6.06
10"	3	0.083	6.73
12"	4	0.070	8.08
14"	5	0.060	9.42
16"	6	0.053	10.77

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Wall Insulation R-Value (Cont.):
   - ✓ 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.
   - ✓ Determine the thickness of the sheathing and resulting R-value.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Wall Insulation R-Value (Cont.):
   - ✓ The rim joist is installed around the perimeter of the floor joists over a basement or crawl space, or between 2 stories of a house.
   - ✓ 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.

Additions & Alterations 79

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Wall Insulation R-Value (Cont.):
   - ✓ Look for access to the rim joist area between stories 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.
   - ✓ Otherwise, assume no rim joist insulation exists.

Additions & Alterations 80

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Walls Orientation:
   - ✓ Use a set of plans or a compass to determine:
     - Azimuth
     - Orientation

Additions & Alterations 81

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Floor Insulation R-Value:
   - ✓ For loose fill applications, multiply the thickness of the insulation (in inches) by the R-value per inch based on the insulation type in order to calculate the total existing floor insulation R-value.
   - ✓ Also note if any exterior sheathing insulation exists.
   - ✓ Determine if slab insulation is present.

Additions & Alterations 82

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Ceiling Insulation R-Value:
   - ✓Determine the type of ceiling insulation present (may be a combination of more than one type);
   - ✓Measure the depth of the insulation in four places and take the average; if the depth in one section of the attic is different by 2 inches or more than other areas, measure the depth for the areas separately or use the least depth for the whole attic;
   - ✓Multiply the R-value per inch of the material by the depth of the insulation;

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Roof Rise:
   - ✓Using a set of plans or a digital level, determine the roof rise:
     - 2:12 or less= Low Slope
     - More than 2:12 = High Slope

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Determining Roofing Products:
   - ✓ Identify the type of roofing surface.
   - ✓ Choose from:
     - Concrete or clay tile;
     - Metal tile or wood shakes;
     - Other high slope roofing types (including asphalt and composite shingles and tapered cedar shingles);
     - Low slope membranes (a rise to run ratio of 2:12 or less);
   - ✓ Determine emittance and reflectance of material type.

Additions & Alterations 85

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

1. Radiant Barrier:
   - ✓ Verify installation of the radiant barrier in accordance with the standards
     - Below the roof deck and all gable end walls

Additions & Alterations 86

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration:
   - ✓ **Area:**
     - Measure the area of the openings using width times height to the nearest inch.
     - Estimate the width and height to represent the rough frame opening.
     - Typically this will be the outside dimensions of the frame plus an approximate ½ in. perimeter band.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **Orientation:**
     - Use a compass (adjusting for magnetic deviation) to determine orientation of all fenestration.
     - If a parcel map or site plan is available, orientations may be determined from the plans.
     - Also specify the tilt for windows that are not vertical.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):

✓ **Frame Type:**

- Examine each frame in order to determine the type of material used (metal, wood, vinyl)
- Ask the customer for documentation if you can't tell.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):

✓ **Glazing characteristics:**

- Check all windows in the house for number of panes (single, double, or glass block) and existence of tint.
- Determine window type (operable, fixed, greenhouse/garden)

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **SHGC:**
     - Check for labels
     - Check product information and consult NFRC guide.
     - If NFRC product information is not available, select a representative SHGC from Table 110.6-B of the Title 24 Standards based on the number of panes and the existence of a tint/film.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **SHGC (Cont.):**

TABLE 110.6-B DEFAULT SOLAR HEAT GAIN COEFFICIENT (SHGC)

FRAME TYPE	PRODUCT	GLAZING	FENESTRATION PRODUCT SHGC		
			Single Pane[2,3] SHGC	Double Pane[2,3] SHGC	Glass Block[1,2] SHGC
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.

1 Translucent or transparent panels shall use glass block values when not rated by NFRC 200.

2. Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.

3. Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table

Table 110.6-B

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **U-Factor:**
     - Check for labels
     - Check product information and consult NFRC guide.
     - If NFRC product information is not available, select a representative U-Factor from Table 110.6-A of the Title 24 Standards based on the number of panes and frame type.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **U-Factor (Cont.):**

TABLE 110.6-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME	PRODUCT TYPE	SINGLE PANE [3,4] U-FACTOR	DOUBLE PANE [1,3,4] U-FACTOR	GLASS BLOCK [2,3] U-FACTOR
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/garden window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/garden window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Doors	0.99	0.53	N.A.
	Greenhouse/garden windows	1.94	1.06	N.A.
	Skylight	1.47	0.84	N.A.

1. For all dual-glazed fenestration products, adjust the listed U-factors as follows:
   a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.
   b. Add 0.05 to any product with true divided lite (dividers through the panes).
2. Translucent or transparent panels shall use glass block values when not rated by NFRC 100.
3. Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.
4. Windows with window film applied that is not rated by NFRC 100 shall use the default values from this table.

Table 110.6-A

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **Area of skylights:**
     - For skylights with a curb, measure the length and width of the skylight to the outside dimensions of the curb.
     - For skylights without a curb, estimate the dimensions of the rough frame opening.

Additions & Alterations 95

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):
   - ✓ **Orientation of skylights:**
     - Determine the orientation of the lower edge of the skylight.
     - Use the outward horizontal direction perpendicular to the lower edge of the skylight as the orientation of the skylight.

Additions & Alterations 96

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):

   ✓ **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 or assume the same tilt as the pitch of the roof where the skylight is installed.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

2. Determining Fenestration (Cont.):

   ✓ **Exterior Shading:**

   - Verify any exterior shading device permanently fixed to the house present
   - Measure the dimensions of overhangs and fins

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):

✓ **Storage Water Heaters:**

- Determine the tank volume (gal), exterior insulation, BTU input rating, and Energy Factor (EF) by examining the water heater's nameplate and product literature.
- If the EF cannot be determined in this manner use the model number to find the EF from CEC appliance directories or manufacturer trade association directories.

Additions & Alterations 99

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):

✓ **Storage Water Heaters (Cont.):**

- EF cannot be determined from the FTC label or from the model number and manufacturer's information use the equations below to determine the EF.

Gas Water Heaters EF = 0.62 – (0.0019 x V)

Electric Water Heaters EF = 0.93 – (0.00132 x V)

V= Volume of Water Heater in Gallons

- For older water heaters (manufactured before 2004), which are wrapped with R-12 insulation or better, add 0.05 to the EF.

Additions & Alterations 100

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):
   - ✓ **Storage Water Heaters (Cont.):**
     - For large storage gas water heaters not covered by NAECA (greater than 75,000 Btu/hr input), look for an efficiency rating on the water heater, and the Tank R-value (hr-ft2-F/Btu), the total thermal resistance of the internally-insulated tank and the R-value of any external insulation wrap.
     - The standby loss is taken from the Energy Commission database.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):
   - ✓ **Combined Hydronic Heating Systems:**
     - For combined hydronic heating systems, determine the heat input in kBtu/h for gas (or kW for electric) and the recovery efficiency (%).
     - For large storage gas or indirect gas water heaters in a combined hydronic heating system, determine the pump input in Watts.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):

✓ **Instantaneous Water Heaters:**

- For large instantaneous water heaters (>10 gal), determine the unit's Thermal Efficiency (TE) from the nameplate or by using the model number and CEC or manufacturer's directories. For gas models, determine if there is a standing pilot light.
- Determine the pilot light energy consumption (Btu/hr) from the Energy Commission's database. Also record the standby loss in Btu/h and note the R-value of any external insulation wrap.
- For small instantaneous water heaters, determine the EF of the water heater.

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HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):

✓ In unable to find the EF you may use vintage table R3-50 from Appendix B of the Residential Compliance Manual

Default Assumptions for Year Built (Vintage)

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 - 2000	2001-2003	2004-2005	2006 and 2012	2013 and Later
WATER HEATING									
Energy Factor	0.525	0.525	0.525	0.525	0.575	0.575	0.575	0.575	

Additions & Alterations 104

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

3. Determining Water Heating System Efficiency Values(Cont.):
   - ✓ **Distribution System:**
     - Determine water heating distribution system type used, as previously described in the Water Heating section.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values:
   - ✓ **Heating:**
     - Identify the type and model number from the nameplate, and review CEC appliance directories or historical GAMA product directories to determine the efficiency.
     - If the efficiency cannot be found, use the default value from Table R3-50 of Appendix B of the Residential Compliance Manual based on the estimated age of the equipment.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values:
   - ✓ **Heating (Cont.):**

Table R3-50

Default Assumptions for Year Built (Vintage)

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 - 2000	2001-2003	2004-2005	2006 and 2012	2013 and Later
SPACE HEATING EFFICIENCY									
Gas Furnace (Central) AFUE	0.75	0.78	0.78	0.78	0.78	0.78	0.78	0.78	
Gas Heater (Room) AFUE	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	
Hydronic/Comb Hydronic	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	
Heat Pump HSPF	5.6	5.6	6.6	6.6	6.8	6.8	6.8	7.4	
Electric Resistance HSPF	3.413	3.413	3.413	3.413	3.413	3.413	3.413	3.413	
Electric Resistance Radiant HSPF	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values (Cont.):
   - ✓ **Heating (Cont.):**
     - AFUE is used to measure the efficiency of furnaces and boilers.
     - HSPF is used to measure the heating performance of heat pumps.
     - If a HSPF rating is not available, look for a COP rating and use Equation R3-32 in the Residential ACM Manual to convert to HSPF.

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values (Cont.):
   - ✓ **Heating (Cont.):**
     - Equation R3-32

HSPF= (3.2 x COP) – 2.4

-COP= 4
-HSPF= (3.2 x 4) – 2.4
-HSPF= 12.8- 2.4
-HSPF= 10.4

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CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values (Cont.):
   - ✓ **Cooling:**
     - Check nameplate for the type and model number, and use this number to determine the efficiency from CEC appliance directories or ARI directories.
     - EER Verification protocols are the same as previously described in the new construction section.
     - If the efficiency cannot be determined, use the default value from Table R3-50 of Appendix B of the Residential Compliance Manual based on the estimated age of the equipment.

Additions & Alterations 110

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

4. Determining Heating/Cooling Efficiency Values:
   - ✓ **Cooling (Cont.):**

Table R3-50

Default Assumptions for Year Built (Vintage)

Conservation Measure		Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 - 2000	2001-2003	2004-2005	2006 and 2012	2013 and Later
SPACE COOLING EFFICIENCY										
All Types,	SEER	8.0	8.0	8.9	9.7	9.7	9.7	9.7	13.0	

Additions & Alterations 111

CHEERS

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

5. Determining Air Distribution System (Cont.):
   - ✓ **Duct 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.

Additions & Alterations 112

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

5. Determining Air Distribution System (Cont.):

✓ **Duct Insulation (Cont.):**

- For ducts buried in attic insulation, effective insulation R-values shall be taken from Table R3-38 of the Residential ACM Manual.
- The portions of duct runs directly on or within 3.5 inches of the ceiling gypsum board and surrounded with blown attic insulation of R-30 or greater may take credit for increased effective duct insulation as shown in Table R3-38.

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

5. Determining Air Distribution System (Cont.):

✓ **Duct Insulation (Cont.):**

	Nominal Round Duct Diameter								
Attic Insulation	4"	5"	6"	7"	8"	10"	12"	14"	16"
	Effective Duct Insulation R-value for Blown Fiberglass Insulation								
R-30	R-13	R-13	R-13	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-38	R-25	R-25	R-25	R-13	R-13	R-9	R-9	R-4.2	R-4.2
R-40	R-25	R-25	R-25	R-25	R-13	R-13	R-9	R-9	R-4.2
R-43	R-25	R-25	R-25	R-25	R-25	R-13	R-9	R-9	R-4.2
R-49	R-25	R-25	R-25	R-25	R-25	R-25	R-13	R-13	R-9
R-60	R-25	R-25	R-25	R-25	R-25	R-25	R-25	R-25	R-13
	Effective Duct Insulation R-value for Blown Cellulose Insulation								
R-30	R-9	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-38	R-15	R-15	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2	R-4.2
R-40	R-15	R-15	R-15	R-9	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-43	R-15	R-15	R-15	R-15	R-9	R-4.2	R-4.2	R-4.2	R-4.2
R-49	R-31	R-31	R-15	R-15	R-15	R-9	R-9	R-4.2	R-4.2
R-60	R-31	R-31	R-31	R-31	R-31	R-15	R-15	R-9	R-9

Table R3-38

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

5. Determining Air Distribution System (Cont.):

✓ **Duct Insulation (Cont.):**

- Ducts partly or completely buried in blown attic insulation in dwelling units meeting the requirements for High Insulation Quality (Residential Appendix RA3-2013, section 3.5) and Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems (Residential Appendix RA3-2013, section 3.1) may take credit for increased effective duct insulation.
- For each duct segment buried in attic insulation, indicate the duct diameter, attic insulation value and insulation type (fiberglass or cellulose).

Additions & Alterations 115

HERS Verification of the Existing Features

The HERS Inspection Protocols (Cont.)

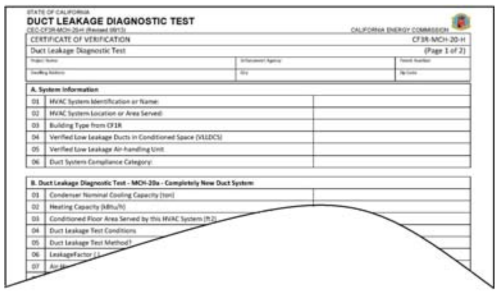
5. Determining Air Distribution System (Cont.):

✓ **Duct Insulation (Cont.):**

- Deeply buried ducts may take credit for an effective R-25 for fiberglass and R-31 for cellulose insulation when Residential ACM requirements are met.

Additions & Alterations 116

Forms



STATE OF CALIFORNIA

DUCT LEAKAGE DIAGNOSTIC TEST

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION	CF3R-MCH-20-H
Duct Leakage Diagnostic Test	(Page 1 of 2)

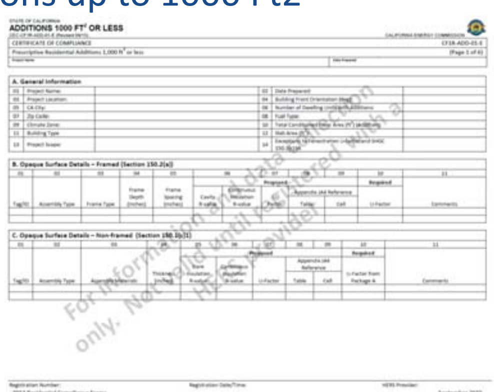
A. System Information		
01	HVAC System Identification or Name	
02	HVAC System Location or Area Served	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS)	
05	Verified Low Leakage Air-handling Unit	
06	Duct System Compliance Category	

B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor (...)	
07	Air ...	

Forms

CF1R-ADD-01-E

- Prescriptive Additions up to 1000 Ft2
- 6 pages



STATE OF CALIFORNIA

ADDITIONS 1000 FT² OR LESS

CERTIFICATE OF COMPLIANCE

A. General Information

B. Opaque Surface Details – Framed (Section 150.2(a))

C. Opaque Surface Details – Non-framed (Section 150.2(a))

CHEERS

Forms

CF1R-NCB-01-E (same as new construction)

- Prescriptive Additions over 1000 Ft2
- 7 pages

Additions & Alterations 119

CHEERS

Forms

CF1R-ALT-01-E

- Prescriptive Alterations
- 6 pages

Additions & Alterations 120

CHEERS

Forms

CF1R-ALT-02-E

- Prescriptive Alterations to HVAC Only
- 6 pages


ALTERATIONS TO SPACE CONDITIONING SYSTEMS

CHEERS

Forms

CF3R-EXC-20-H

- Existing Conditions for Residential Application
- 4 pages


EXISTING CONDITIONS FOR RESIDENTIAL ALTERATIONS

Training Sections

Section 1- Definitions

Section 2- Methods of Compliance

Section 3- Mandatory Requirements

Section 4- Additions

Section 5- Alterations

Section 6- Sampling

Section 7- HERS Verifications of Existing Features

Section 8- Forms

Additions & Alterations 123

Overall Training Goal

Gain an understanding of T24 requirements specifically applicable to Additions & Alterations.

Additions & Alterations 124

QUESTIONS

CHEERS
Unmatched Service with Integrity

MANOMETER REFERENCE GUIDES

Quick Guide DB-PR700

One-Point 25 Pascal Total Leakage Duct Pressurization Test (blowing air into the duct system)
Using the Minneapolis Duct Blaster® and DG-700 Digital Gauge

1. **Connect the Duct Blaster fan to the duct system.**
   a) Choose a location to install the Duct Blaster fan. In single, double or triple returned systems, the largest and closest return to the air handler is usually the best choice. **Note:** In multi-return systems (a return in every room), installing at the air handler cabinet is often best.
   b) Remove any remote filters from the chosen return and then connect the black square transition piece to the return using temporary tape. Completely seal the remaining open area of the return with tape.
   c) Pull the Duct Blaster fan and flex duct out of the carrying case. Connect the flex duct to the ***exhaust side*** of the fan (i.e. the side with the metal guard) using the round transition piece and connect trim. Connect the open end of the flex duct to the square transition piece using the velcro strap on the flex duct.
   d) Connect the fan speed controller to the fan and plug it into a grounded power outlet.
   e) Install the Flow Ring which you think best matches the needed fan flow.
   f) If your DG-700 gauge and fan speed controller are compatible with Cruise Control, install the fan control cable into the 3.5 mm communication jacks located on top of the DG-700 and on the side of the speed controller (otherwise skip this step). **

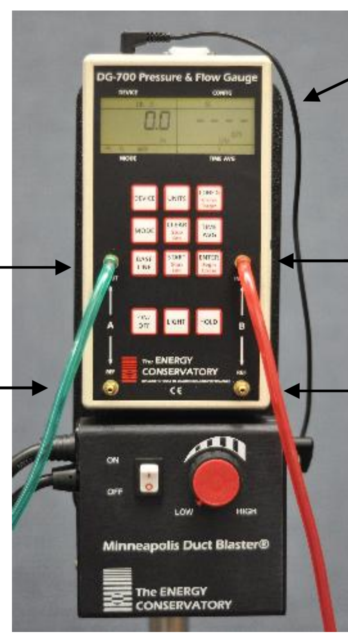
Fan Configuration	Flow Range (cfm) For Series B Duct Blaster
Open (no Flow Ring)	1,500 - 600
Ring 1	800 – 225
Ring 2	300 – 90
Ring 3	125 – 10

2. **Prepare the duct system and house for the Test.**
   a) Adjust the HVAC system controls so that the air handler does not turn on during the Test.
   b) Temporarily seal off all remaining supply and return registers, and combustion or ventilation air inlets which are connected to the duct system. Use ***Duct Mask™*** temporary register sealing material provided with your Duct Blaster, or use painters tape and paper.
   c) Turn off any exhaust fans, vented dryers, and room air conditioners.
   d) Remove all central filters (i.e. in air handler or return plenum).
   e) Open a door or window between the building and outside to prevent changes in building pressure when the Duct Blaster is running.
   f) If the Duct Blaster is installed in an attic, garage or crawlspace - open vents or access panels or doors from these spaces to the outside.

3. **Connect tubing to the DG-700 Pressure Gauge.**
   a) Select a location to measure duct pressure. The best location for measuring duct pressure is often in the supply trunkline or plenum. Drill a small hole (1/4" to 3/8" OD) into the duct to allow a static pressure probe to be installed. Install the static pressure probe with the end of the probe pointing into the air flow that will be coming from the Duct Blaster fan. If the duct system is reasonably airtight (e.g. less than 200 cfm25 of leakage), duct pressures can be measured at any supply register by inserting a piece of tubing through the temporary register seal.
   b) Connect tubing to the DG-700 as shown in the illustration to the right.

Connect the Green (or Clear) tubing to the Chan A Input tap. The other end of the Green tubing should be connected to the duct system (by either inserting into a sealed register, or connecting to the end of the installed static pressure probe).

Connect Chan A Ref tap to inside of building (if gauge is located in the building, leave this tap open). Be sure window is open.



Optional fan control cable (for Cruise Control).

Connect the Red tubing to the Chan B Input tap. The other end of the Red tubing should be connected to the brass tap in the middle of the DB fan housing.

Connect Chan B Ref tap to space where the fan is installed (if fan and gauge are in the same space, leave this tap open).

** Your DG-700 gauge is compatible with Cruise Control if the CONFIG, CLEAR, START and ENTER keys have additional red lettering below the main black script. Cruise Control also requires a Duct Blaster speed controller with a 3.5 mm communication jack installed on the side of the controller box, and a fan control cable.

4. Conducting the Test.

a) Turn on the gauge by pressing the **ON/OFF** button.
b) Press the **MODE** button three times to put the gauge into the **PR/ FL @25** Mode. In this Mode, **Channel A** is used to measure duct system pressure while **Channel B** is used to display estimated total duct leakage at a test pressure of 25 Pascals. (The leakage estimate shown on **Channel B** is determined by mathematically adjusting the actual air flow from the Duct Blaster fan using the **Channel A** duct system pressure reading and a Can't Reach Pressure factor.)
c) Check (and adjust if necessary) the selected test Device (i.e. fan) and Configuration (i.e. Flow Ring) shown in the upper part of the gauge display to match the fan and Flow Ring being used in the test. For example, the Device icon for the Series B Duct Blaster fan is **DB B**, and the Configuration icon for Ring 2 is **B2**. Press the **DEVICE** button to change the selected fan. Press the **CONFIG** button to change the selected Flow Ring.

d) Turn on the Duct Blaster fan.

If Using Cruise Control:

Turn the Duct Blaster speed controller to the "just on" position (i.e. turn the controller knob all the way down counter-clockwise and flip the on/off switch to "ON" – the fan will not be turning). Now press the **Begin Cruise (Enter)** button. The **Channel A** display will now show the number 25 (your target Cruise pressure). Press the **Start Fan (Start)** button. The Duct Blaster fan will now slowly increase speed until the duct pressurization displayed on Channel A is approximately 25 Pascals.

If Manually Controlling Fan:

Turn on the Duct Blaster fan controller and slowly turn the fan controller knob clockwise. As the fan speed increases, the duct pressurization displayed on **Channel A** should also increase. Continue to increase the fan speed until the duct pressurization shown on **Channel A** is between 20 and 30 Pascals. Do not waste time adjusting and re-adjusting the fan speed control to achieve a test pressure of exactly 25 Pascals.

e) **Channel B** will now display the One-Point 25 Pascal Total Duct Leakage estimate. Record this number. If the leakage estimate is fluctuating more than desired, try changing the Time Averaging setting on the gauge by pressing the **TIME AVG** button and choosing the ***5*** or ***10*** second or ***Long-term*** averaging period. (If "**------**" or "**LO**" appear on **Channel B**, see #5 below).
f) Turn off the Duct Blaster fan. If you are using Cruise Control, this is done by pressing the **Stop Fan (Clear)** button.

5. "-----" or "LO" appearing on Channel B

Whenever "**-----**" or "**LO**" appears on **Channel B** in the **PR/ FL @ 25** Mode, the DG-700 can not calculate a reliable leakage estimate. The messages "**-----**" and "**LO**" appear on **Channel B** under the following three conditions:

a) "**-----**" is continuously displayed when the duct test pressure from **Channel A** is below a minimum value of 5 Pascals. Estimating duct leakage results when the test pressure is below this value may result in large errors. If possible, install a larger Flow Ring or remove the Flow Rings to generate more fan flow.
b) "**LO**" is continuously displayed when there is negligible air flow through the test device.
c) "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a Flow Ring or a smaller Flow Ring).

Note: If you change the Flow Ring on the fan, be sure to change the Configuration setting on the gauge to match the installed Ring.

Quick Guide DB-PR700 (Outside)

One-Point 25 Pascal Leakage to Outside Pressurization Test (blowing air <u>into</u> the duct system)

Using the Minneapolis Duct Blaster®, DG-700 Digital Gauge and Minneapolis Blower Door™

1. Connect the Duct Blaster fan to the duct system.

a) Choose a location to install the Duct Blaster fan. In single, double or triple returned systems, the largest and closest return to the air handler is usually the best choice. **Note:** In multi-return systems (a return in every room), installing at the air handler cabinet is often best.

b) Remove any remote filters from the chosen return and then connect the black square transition piece to the return using temporary tape. Completely seal the remaining open area of the return with tape.

c) Pull the Duct Blaster fan and flex duct out of the carrying case. Connect the flex duct to the ***exhaust side*** of the fan (i.e. the side with the metal guard) using the round transition piece and connect trim. Connect the open end of the flex duct to the square transition piece using the velcro strap on the flex duct.

d) Connect the fan speed controller to the fan and plug it into a grounded power outlet.

Fan Configuration	Flow Range (cfm) For Series B Duct Blaster
Open (no Flow Ring)	1,500 - 600
Ring 1	800 – 225
Ring 2	300 – 90
Ring 3	125 – 10

e) Install the Flow Ring which you think best matches the needed fan flow.

f) If your DG-700 gauge and Duct Blaster fan speed controller are compatible with Cruise Control, install the fan control cable into the 3.5 mm communication jacks located on top of the DG-700 and on the side of the speed controller (otherwise skip this step). **

2. Prepare the duct system and house for the Test.

a) Adjust the HVAC system controls so that the air handler does not turn on during the test.

b) Temporarily seal off all remaining supply and return registers, and combustion or ventilation air inlets which are connected to the duct system. Use ***Duct Mask™*** temporary register sealing material provided with your Duct Blaster, or use painters tape and paper.

c) Turn off any exhaust fans, vented dryers, and room air conditioners.

d) Remove all central filters (i.e. in air handler or return plenum).

e) If the Duct Blaster is installed in an attic, garage or crawlspace - open vents or access panels or doors from these spaces to the outside.

f) Install the Blower Door system (including a gauge to measure building pressure with reference to outside) in a centrally located exterior door. Set up the Blower Door fan to pressurize the building (blowing air into the building). If the Blower Door DG-700 gauge and fan speed controller are compatible for Cruise Control, install the fan control cable. We will <u>not</u> be measuring Blower Door fan flow during this test.

g) Prepare the building for a Blower Door test as described in the Blower Door manual.

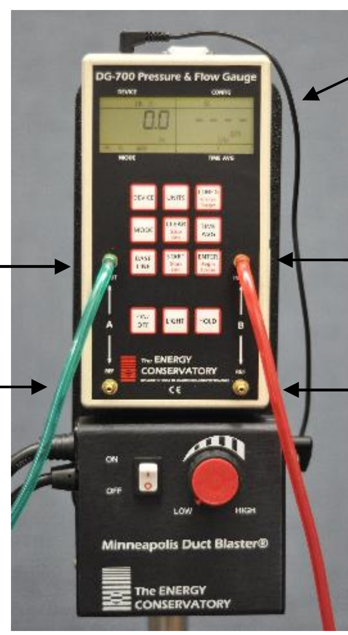
3. Connect tubing to the Duct Blaster Gauge.

a) Select a location to measure duct pressure. The best location for measuring duct pressure is often in the supply trunkline or plenum. Drill a small hole (1/4" to 3/8" OD) into the duct to allow a static pressure probe to be installed. Install the static pressure probe with the end of the probe pointing into the air flow from the Duct Blaster fan. If the duct system is reasonably airtight (e.g. less than 200 cfm25 of leakage), duct pressures can be measured at any supply register by inserting a piece of tubing through the temporary register seal.

b) Connect tubing to the Duct Blaster DG-700 as shown in the illustration to the right.

Connect the <u>Green</u> (or Clear) tubing to the Chan A Input tap. The other end of the <u>Green</u> tubing should be connected to the duct system (by either inserting into a sealed register, or connecting to the end of the installed static pressure probe).

Connect Chan A Ref tap to inside of building (if gauge is located in the building, leave this tap open).



Optional fan control cable (for Cruise Control).

Connect the <u>Red</u> tubing to the Chan B Input tap. The other end of the <u>Red</u> tubing should be connected to the brass tap in the middle of the DB fan housing.

Connect Chan B Ref tap to space where the fan is installed (if fan and gauge are in the same space, leave this tap open).

** Your DG-700 gauge is compatible with Cruise Control if the CONFIG, CLEAR, START and ENTER keys have additional red lettering below the main black script. Cruise Control also requires a Duct Blaster speed controller with a 3.5 mm communication jack installed on the side of the controller box, and a fan control cable.

4. Conducting the Test.

a) Turn on the Blower Door fan and pressurize the house to 25 Pascals. If the Blower Door DG-700 and fan speed controller are compatible with Cruise Control, use the Cruise Control function to maintain the 25 Pa house pressurization.
b) Turn on the Duct Blaster DG-700 gauge by pressing the **ON/OFF** button.
c) Press the **MODE** button once to put the gauge into the **PR/ FL** Mode. In this Mode, **Channel A** is used to measure duct system pressure while **Channel B** is used to display air flow through the Duct Blaster fan.
d) Check (and adjust if necessary) the selected test Device (i.e. fan) and Configuration (i.e. Flow Ring) shown in the upper part of the gauge display to match the fan and Flow Ring being used in the test. For example, the Device icon for the Series B Duct Blaster fan is **DB B**, and the Configuration icon for Ring 2 is **B2**. Press the **DEVICE** button to change the selected fan. Press the **CONFIG** button to change the selected Flow Ring.

e) With the Blower Door fan continuing to run, turn on the Duct Blaster fan.

If Using Cruise Control for the Duct Blaster Fan:

Turn the Duct Blaster speed controller to the "just on" position (i.e. turn the controller knob all the way down counter-clockwise and flip the on/off switch to "ON" – the fan will not be turning). Now press the **Begin Cruise (Enter)** button. The **Channel A** display will now show the number 50 (the default target Cruise pressure). Press the **Cruise Target (Config)** button twice to change the target Cruise pressure to +0. Press the **Start Fan (Start)** button. The Duct Blaster fan will now slowly increase speed until the pressure between the duct system and the house (displayed on **Channel A**) reads zero.

If Manually Controlling the Duct Blaster Fan:

Turn on the Duct Blaster fan controller and slowly turn the fan controller knob clockwise. Increase the fan speed until the pressure between the duct system and the house (displayed on **Channel A**) reads zero.

f) If the Blower Door fan is being controlled by Cruise control, go to section **g)** below. If the Blower Door fan is being manually controlled, you will need to re-check the Blower Door building pressure gauge and if necessary, re-adjust the Blower Door fan speed to maintain a building pressure of 25 Pascals. If you are manually controlling the Duct Blaster fan, also re-check the Duct Blaster DG-700 and if necessary, re-adjust the Duct Blaster fan until **Channel A** reads zero.
g) **Channel B** on the Duct Blaster DG-700 will now display the CFM25 leakage to the outside estimate. Record this number. If the leakage estimate is fluctuating more than desired, try changing the Time Averaging setting on the gauge by pressing the **TIME AVG** button. (If "**LO**" appears on **Channel B**, see #5 below).
h) Turn off both the Duct Blaster and Blower Door fans. If you are using Cruise Control, this is done by pressing the **Stop Fan (Clear)** button(s).

5. "LO" appearing on Channel B

Whenever "**LO**" appears on **Channel B** in the **PR/ FL** Mode, the DG-700 can not display a reliable fan flow reading. The message "**LO**" appears on **Channel B** under the following two conditions:

a) "**LO**" is continuously displayed when there is negligible air flow through the test device.
b) "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a Flow Ring or a smaller Flow Ring).

Note: If you change the Flow Ring on the fan, be sure to change the Configuration setting on the gauge to match the installed Ring.

Quick Guide BD-DEP700-CR

One-Point 50 Pascal Depressurization Test (blowing air <u>out</u> of the building)
Using the Model 3 Minneapolis Blower Door™ and DG-700 Digital Gauge

1. Install the Blower Door System.

a) Install the aluminum frame and nylon panel in an exterior doorway of a large open room.

b) Attach the gauge mounting board and fan speed controller to a door, or to the aluminum frame gauge hanger bar, using the C-clamp on the back of the mounting board.

c) Secure the DG-700 gauge onto the mounting board (using the Velcro strips) and connect tubing to the DG-700 as shown in the illustration to the right.

d) Run approximately 3 - 5 feet of the remaining end of the **Green** tubing outside through one of the patches in the bottom corners of the nylon panel. Be sure the outside end of the tubing is well away from the exhaust flow of the Blower Door fan and is protected from the wind.

e) Install the Blower Door fan, with the Flow Rings and No-Flow Plate attached, into the large hole in the nylon panel. The exhaust side of the fan should be outside, and the inlet side of the fan (the side with the Flow Rings) should be inside the building.

Optional fan control cable (for Cruise Control).

Leave the Channel A Input tap open.

Connect the <u>Red</u> tubing to the Channel B Input tap. The other end of the <u>Red</u> tubing should be connected to the Blower Door fan.

Connect the <u>Green</u> tubing to the Channel A Reference tap. The other end of the <u>Green</u> tubing should be run to the outside.

Leave the Channel B Reference tap open.

f) Insert the female plug from the fan speed controller into the receptacle located on the fan electrical box. The remaining cord (power cord) should be plugged into a power outlet that is compatible with the voltage/frequency of the fan motor and speed controller.

g) If your fan has a fan direction switch, be sure it is set to blow air <u>out</u> of the building.

h) The remaining end of the **Red** tubing should now be connected to the pressure tap on the Blower Door fan electrical box.

i) If your DG-700 gauge and fan speed control are compatible for Cruise Control, install the fan control cable into the 3.5 mm communication jacks located on the top of the DG-700 and on the side of the speed controller (otherwise skip this step). **

2. Prepare the building for the Test.

a) Close all exterior doors and windows, and open all interior doors. Because few house basements can be completely sealed from the house and usually some conditioning of the basement is desirable, they are typically included as conditioned space.

b) Adjust all combustion appliances so that they do not turn on during the test.

c) Be sure all fires are out in fireplaces and woodstoves. Close all fireplace and wood stove doors to prevent scattering of ashes.

d) Turn off any exhaust fans, vented dryers, and room air conditioners.

** Your DG-700 gauge is compatible with Cruise Control if the CONFIG, CLEAR, START and ENTER keys have additional red lettering below the main black script. Cruise Control also requires a Blower Door speed controller with a 3.5 mm communication jack installed on the side of the controller box (standard equipment since September 2004), and a fan control cable.

3. **Conducting the Test.**

a) Turn on the DG-700 gauge by pressing the **ON/OFF** button.

b) Press the **MODE** button twice to put the gauge into the **PR/ FL @50** Mode. In this Mode, **Channel A** is used to measure building pressure while **Channel B** is used to display the estimated building leakage at a test pressure of 50 Pascals. (The leakage estimate shown on **Channel B** is determined by mathematically adjusting the actual air flow from the Blower Door fan using the **Channel A** building pressure reading and a Can't Reach Fifty (CRF) factor).

c) With the fan inlet still covered, press the **BASELINE** button to initiate the building baseline measurement procedure on **Channel A**. Press **START** to begin the baseline measurement. During a baseline measurement, **Channel A** will display a long-term average baseline pressure reading while **Channel B** is used as a timer in seconds to show the elapsed measurement time. When you are satisfied with the baseline measurement, press the **ENTER** key to accept and enter the baseline reading into the gauge. The **Channel A** display will now show an **ADJ** icon to indicate that it is displaying a baseline adjusted building pressure value.

d) Remove the No-Flow Plate from the Blower Door fan and install the Flow Ring which you think best matches the needed fan flow (see Table to the right).

Fan Configuration	Flow Range (cfm) for Model 3 Fan
Open (no Flow Ring)	6,300 - 2,430
Ring A	2,800 - 915
Ring B	1,100 - 300
Ring C	330 - 85

e) Check (and adjust if necessary) the selected test Device (i.e. fan) and Configuration (i.e. Flow Ring) shown in the upper part of the gauge display to match the fan and Flow Ring being used in the test. For example, the Device icon for the Model 3 (110V) Blower Door fan is **BD 3**, and the Configuration icon for Ring A is **A1**. Press the **DEVICE** button to change the selected fan. Press the **CONFIG** button to change the selected Flow Ring.

f) Turn on the Blower Door fan.

If Using Cruise Control:

Turn the Blower Door speed control knob to the "just on" position (i.e. from the off position, turn the controller knob clockwise only until you feel the click and no farther – the fan will not be turning). Now press the **Begin Cruise (Enter)** button. The **Channel A** display will now show the number 50 (your target Cruise pressure). Press the **Start Fan (Start)** button. The Blower Door fan will now slowly increase speed until the building depressurization displayed on Channel A is approximately –50 Pascals.

If Manually Controlling Fan:

Turn on the Blower Door fan by slowly turning the fan controller clockwise. As the fan speed increases, the building depressurization displayed on **Channel A** should also increase. Continue to increase the fan speed until the building depressurization shown on **Channel A** is between –45 and –55 Pascals. Do not waste time adjusting and re-adjusting the fan speed control to achieve a test pressure of exactly –50 Pascals.

g) **Channel B** will now be displaying the One-Point 50 Pascal leakage estimate. Record this number. If the leakage estimate is fluctuating more than desired, try changing the Time Averaging setting on the gauge by pressing the **TIME AVG** button and choosing the ***5*** or ***10*** second or ***Long-term*** averaging period. (If "**------**" or "**LO**" appear on **Channel B**, see #4 below).

h) Turn off the Blower Door fan. If you are using Cruise Control, this is done by pressing the **Stop Fan (Clear)** button.

4. **"-----" or "LO" appearing on Channel B**

Whenever "**-----**" or "**LO**" appears on **Channel B** in the **PR/ FL @ 50** Mode, the DG-700 can not calculate a reliable leakage estimate. The messages "**-----**" and "**LO**" appear on **Channel B** under the following three conditions:

a) "**-----**" is continuously displayed when the building test pressure from **Channel A** is below a minimum value of 10 Pascals. Estimating building leakage results when the test pressure is below this value may result in large errors. If possible, install a larger Flow Ring or remove the Flow Rings to generate more fan flow. Be sure the fan is off when changing Flow Rings.

b) "**LO**" is continuously displayed when there is negligible air flow through the test device.

c) "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a Flow Ring or a smaller Flow Ring). Be sure the fan is off when changing Flow Rings.

Note: If you change the fan Flow Rings, be sure to change the Configuration setting on the DG-700 to match the installed Ring.

QuickGuide

DU200 DucTester

Unpack, connect gauge

Check boxes for each step.

☐ Remove everything from the case.

☐ Press on the gauge, then tap the screen, and check the battery state indicator at the top right:

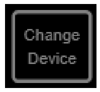
☐ If not green, connect USB to power outlet to charge the gauge.

☐ Connect yellow, green and blue tube to gauge.

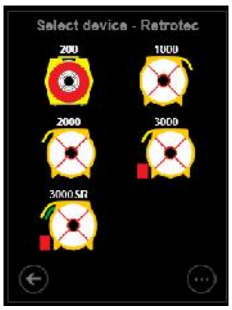
Gauge remains connected like this for all tests.

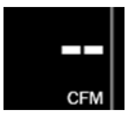
Prepare the gauge

Make sure a DucTester is showing on the **Home** screen with "Mid" Range.

If not, tap the fan picture, then 

Tap the DucTester, then "Mid"





Tap on [**Channel B]** to change the type of result or units. Select based on "Get the results you need" on page 4.

Tap **[Settings]** then **[Time averaging]** and select 5 seconds.

Tap **[Settings]** then 

Make sure the **[Default @ Pressure]** is 25 Pa.
Make sure "n" value is set to 0.60 for Ducts.

Tap to return to the **Home** screen.

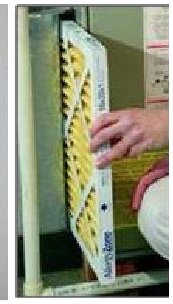
Next, prepare the ducts, house and fan following Steps 1 through 3.

Step 1: Prepare ducts and house

- ☐ Seal all supply and return grills/registers, including any exterior air inlets, with Grill Mask or tape.
- ☐ Open all interior doors leading to rooms containing a supply or return register, and open an exterior door or window.
- ☐ Shut off all HVAC (exhaust fans, dryers, A/C, furnaces).

Step 2: Connect to ducts

- ☐ Turn off air-handler and remove all filters.



- ☐ Tape Flange to main return or air handler cabinet using masking tape.

- ☐ Attach Flex Duct to Flange.

- ☐ Install Mid-Range Ring to start, as most systems can be tested on this Range Configuration.

Remove Range Rings for leakier ducts, add Rings for tighter ducts.

Open

Mid

Low

- ☐ Tap  on gauge and select range to match fan, <u>whenever</u> a Range Ring is changed.

Step 2: Connect to ducts (cont'd)

☐ Connect Flex Duct to fan **inlet** for depressurization.

depressurize

Depressurization is easiest and permitted in all States except CA & WA where it can still be used to evaluate, but not for a final result.

To pressurize, connect the Flex Duct to fan **exhaust**.
All other connections remain the same

pressurize

Step 3: Connect gauge & fan

☐ Connect power cord.

☐ Switch to on: " I ". Green light indicates that power is connected.

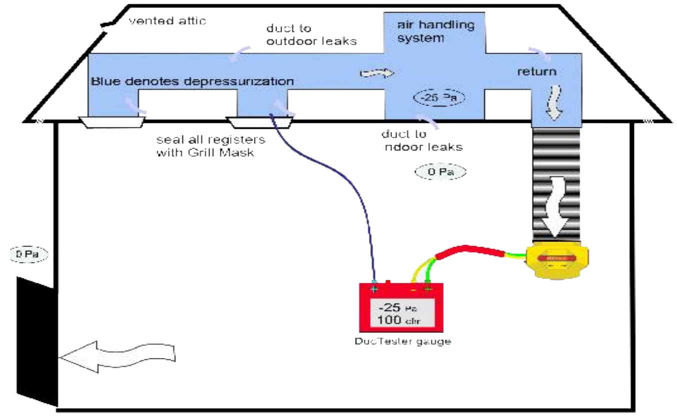
☐ Connect yellow and green tubes to matching color ports on fan. Ethernet style Speed Control Cable will disable the knob. It is connected later in Step 4.

Speed Control Cable

☐ Insert blue tube into the supply register closest to the air handler.

Total Duct Leakage Test: Depressurize

Ready to conduct the test by depressurizing the ducts:



Depressurizing works best because the fan pulls the Grill Mask tight on the registers during the test.

If Pressurizing, see tubing setup on page 7.

Step 4: Conduct test

☐ Go to **Home** screen on gauge.

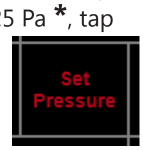
☐ Adjust fan speed knob clockwise until **[Channel A]** reaches test pressure.

☐ If not possible, go to Step 5 for advice on changing setup.

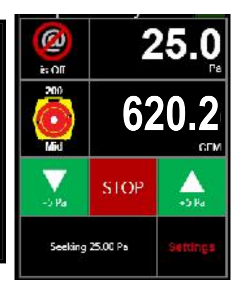
☐ Connect Speed Control Cable to fan.

Solid green Status light indicates gauge is ready to control speed.

☐ For a test pressure of 25 Pa *, tap

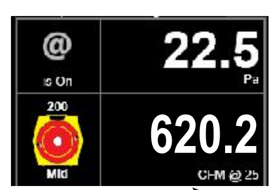


☐ Enter 25, tap **[Set]**



☐ Tap

to display what the result would be at exactly 25 Pa *.



☐ Read results directly from the gauge.

* 50 Pa for Northwest ENERGY STAR.

Get the results you need

☐ Tap the **[Channel B]** key to select a different Result, or tap the **[Result to be displayed]** key on the **[Settings]** menu.

	Flow at the induced pressure is the simplest result. (Also available in metric units).
	Flow per square foot is required in some states such as WA. (Enter an area)
 CT ID MD NY TX DC IL MA NC VT DE IA NH PA GA ME NJ RI	Flow per 100 sq ft is required in many states. (Enter an area)

When a Result is chosen that requires an area or volume,

will be shown on the **Home** screen. Tap to change.

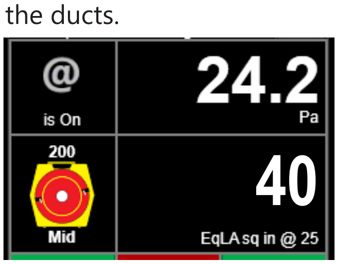
The area and volume can also be changed from the  menu.

Show leakage area Result

Equivalent Leakage Area (EqLA) describes the leakage area in terms of one large hole in a flat surface.

Tap the **[Channel B]** key, then , and select "EqLA: sq in"

[Channel A] shows the duct pressure and **[Channel B]** "EqLA" shows the combined size of all the holes in the ducts.



Leakage area is not a required result, but is a nice way to visualize the size of the hole in the ducts.

Step 5: Desired results not achieved?

Flow reads "--" at test pressure?

If the test pressure has been reached, but "--" appears, the fan is running too slowly to accurately measure flow.

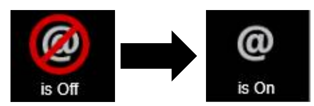
☐ Add the next lower Range
☐ Change **[Range]** to match

☐ Re-adjust fan speed.

Cannot achieve test pressure at full speed?

If fan reaches 100% speed before reaching 25 Pa:

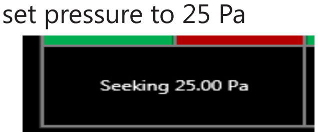
☐ Remove a Range Ring and try again.
☐ Change **[Range]** on the gauge to match.
☐ Check seals on all registers. Look for disconnected ducts or ducts open to outdoors.
☐ Tap **[@ Pressure]** to get the gauge to calculate what the flow would be at exactly 25 Pa.



Jog speed or pressure and Hold display

Tap  **[50] [Set]** to set the fan speed to 50%

Tap  **[25] [Set]** to set pressure to 25 Pa



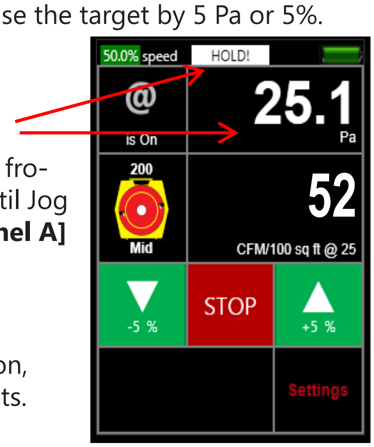
The Jog keys become active on the Home screen.

Use the  keys to decrease or increase the target by 5 Pa or 5%.

Tap **[Channel A]** to "HOLD!" Result.

Result will remain frozen on display until Jog is used or **[Channel A]** is tapped again.

Tap **[Channel B]** when "HOLD!" is on, to see other Results.



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Watch universal training videos including:
- Set up
- Procedures
- Troubleshooting

Leakage: Blower Door
Watch video demonstrations including:
- Blower Door set up
- Common leak locations
- Software
- House preparation

Pressure: Gauge Training
Get help to successfully set up and use digital pressure gauges:
- Gauge set up
- Discover modes & devices
- Perform calibration checks

Optional Test

Duct Leakage to Outdoors: Depressurize

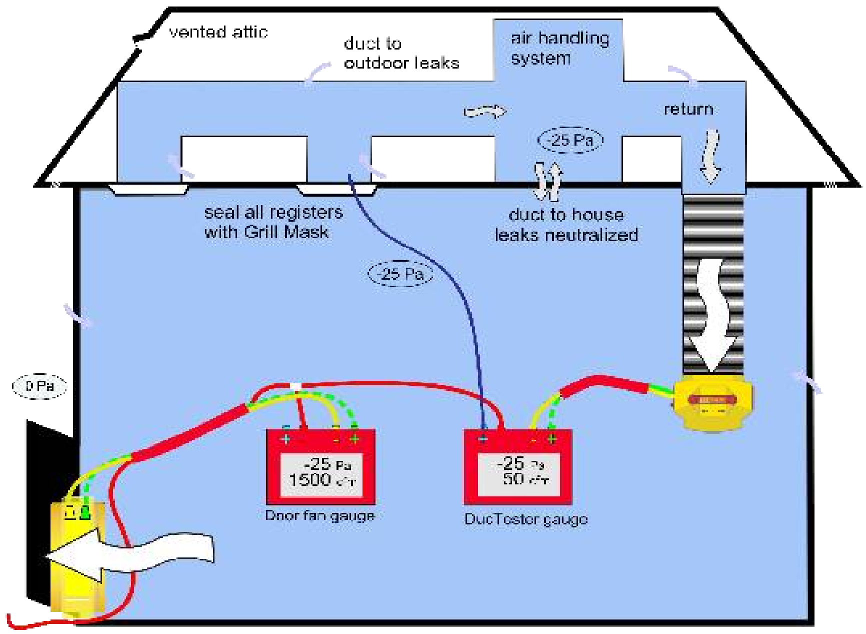
To measure the air leakage from the duct system to outdoors requires both a DucTester and a Blower Door system.

The Door Fan depressurizes the house and the DucTester depressurizes the ducts so leakage from the duct system back into the conditioned space of the home is neutralized.

Method 1 uses the DucTester set up the same was as for the Total Duct Leakage test, and allows use of the **[@ Pressure]** to increase accuracy.

Results are easier to visualize since both the duct and house pressures can be seen.

Method 2 does not require connecting a red tube to the DucTester gauge, but **[@ Pressure]** cannot be used while setting to 0 pressure.

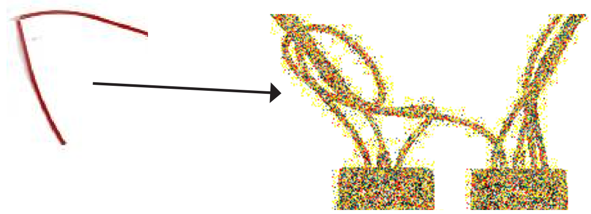


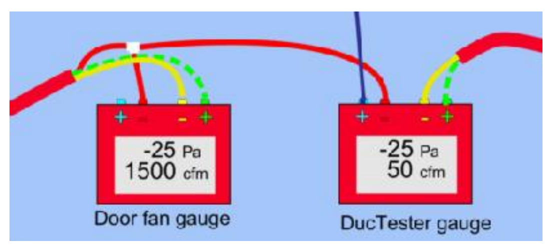
Method# 1

Method #1:

Both gauges at -25 Pa **

- ☐ Connect the red T-connected tubes to red ports and all other tubes per diagram.
- ☐ Tap **[Set Pressure] [25] [Enter]** on DucTester gauge then on Door Fan gauge.
- ☐ Tap **[@ Pressure]** on DucTester gauge to display the results "@25Pa".
- ☐ When "-25 Pa" +/– 1 is achieved on both gauges, record duct leakage to outdoors from the DucTester gauge.

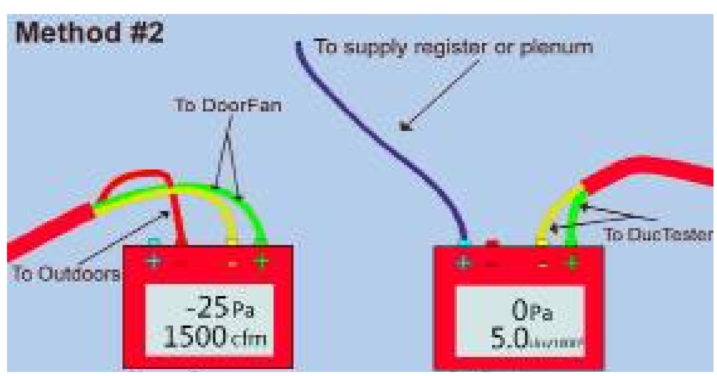




Method #2:

DucTester at 0 Pa, Door Fan at -25 Pa **

- ☐ Connect tubes to gauges per diagram.
- ☐ With DucTester off,
- ☐ Set the Door Fan gauge to -25 Pa by tapping **[Set Pressure] [25] [Enter]**.
- ☐ Set the DucTester to "0 Pa" by tapping **[Set Pressure] [0] [Enter]**.
- ☐ When "0 Pa" +/– 1 is achieved, record duct leakage to outdoors from DucTester gauge.



Door Fan gauge DucTester gauge

** If 50 Pa test pressure required, use 50 in all instructions.

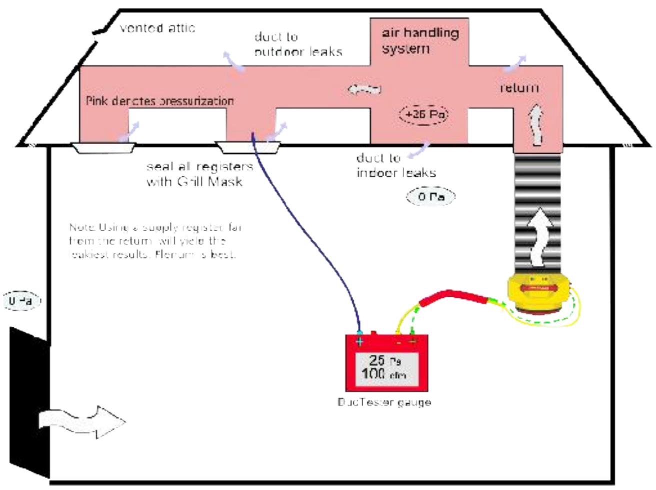
Options

Total Duct Leakage: Pressurize

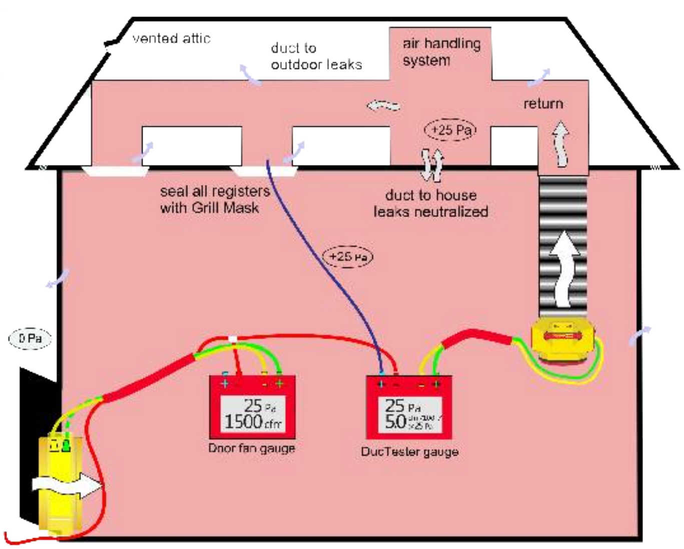
☐ Connect Flex Duct to fan **exhaust**.

☐ Check that tubing is connected the same as for depressurize test (step 3).
☐ Conduct test (step 4).

Pressurizing can blow the Grill Mask off the registers!



Duct Leakage to Outdoors: Pressurize



Follow depressurize test method (page 6) except both fan directions are reversed.

Using the optional Flow Hood

Connect it quickly to ceiling level returns to measure duct leakage or use it with your DucTester as a Powered Flow Hood to accurately measure HVAC system flow rates.

☐ Pass the Flange through the 10 inch hole in the Flow Hood and tape it inside.
☐ Attach the Flex Duct.
☐ Secure the Flow Hood over the register

To measure Duct leakage:

☐ Connect the Flex Duct to the fan and test as usual.

To measure HVAC System Flow:

☐ For measuring supply flows, attach the Flex Duct to the inlet (suction) side of the fan.
☐ For measuring return flows, attach the Flex Duct to the exhaust (discharge) side of the fan.
☐ Connect the Umbilical to the DucTester.
☐ Attach the blue tube to the Flow Hood and gauge.
☐ Tap **[Channel B]** and select "Flow: CFM"

When a definite pressure appears on **[Channel A]**:

☐ Tap **[Set Speed]** and adjust with Jog keys until **[Channel A]** shows close to 0 pressure.
Or
☐ Tap **[Set Pressure] [0]** to have the DucTester automatically achieve a 0 pressure.

☐ Read the HVAC system flow result directly from the gauge

Field check system monthly

Check the DucTester system monthly with a known setup—if flow is outside the acceptable range then system needs full calibration.

- ☐ Tape the optional flow Verification Plate to the Flange and attach the red tube.
- ☐ Attach the Flex Duct to the exhaust side of the fan to pressurize the Flex Duct.
- ☐ Stretch the Flex Duct to it's full length.
- ☐ Set the DM32 to measure "Flow: CFM" @25 Pa.
- ☐ Tap **[Set Speed]**, then adjust with Jog keys until **[Channel A]** reads close to 25 Pa.
- ☐ Read the Verification Plate to determine the acceptable range for flow.

Typically, 100 to 110 CFM is a pass.

Optional DU159 Verification Plate shown.

Field check gauge weekly

Check gauge operation and check for blocked, leaking or pinched tubes weekly, and anytime results are in question.

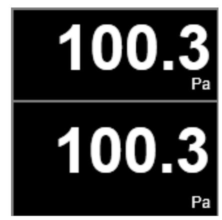
To perform the gauge check, you will need the gauge and Umbilical.

- ☐ Set **[Time Average]** to 5 seconds in **[Settings]**.
- ☐ Tap **[Channel B]** and select"Pressure: Pa".
- ☐ Connect the yellow tube between the red and yellow ports.

If readings on Channel A and Channel B are within 2% and don't drop rapidly, the tube is not blocked or leaking and the gauge is correct.

- ☐ Repeat between different ports with each of the tubes you use for testing.

Checking your gauge and tubes regularly will eliminate a common source of error in readings.



Optional accessories

Flange to connect Flex Duct to register

Part #: DU157

Verification Plate

Part #: DU159

Flow Hood 24 x 24 inches (61 x 61 cm)

Part #: PP105

12.5ft (3.8m) Flex Duct for DucTester

Part #: DU161

Mid-Range Ring & Low-Range Ring

(Mid) Part #: DU154
(Low) Part #: DU155

Tubing Accessory Kit

35 ft (10 m) of blue, red, yellow and green 1/4 inch (12mm) outside diameter tubing. Static Pressure Probe, 4 inch (100 mm) x 1/8 inch (6 mm) outside diameter metal probe, 2 T and 2 male-to-male connectors. Red L for duct leakage to outdoors test.

Part #: TU119

Umbilical for DucTester fans, 7ft (2 m)

Part #: DM240

Grill Mask 12in x 160ft, 12in perfs, Hi-stick Blue, Single Roll

Part #: GR116
Part #: GR117 (for case of 3)

Deluxe Cordura Toolbag with Shoulder Strap

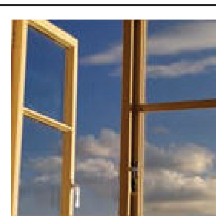
Part #: TL118

Blower Door QuickGuide

Step 1: Prepare the building

- ☐ Close outside doors and windows.
- ☐ Open all interior doors leading to conditioned spaces.
- ☐ Turn gas, hot water, to Pilot.
- ☐ Fireplaces and stoves must be cold with doors closed (cover ashes).
- ☐ Shut off HVAC, combustion appliances, exhaust fans, dryers, A/C and furnaces.

See: *"Residential Pressure & Air Leakage Testing Manual" for additional information.*

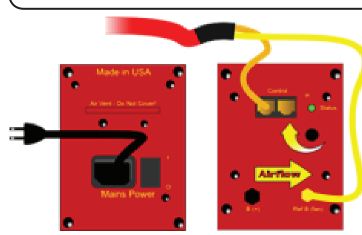
		
Remove or cover ashes.	Turn gas valve to Pilot.	Close all windows and outside doors.

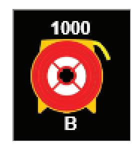
Step 2: Install the system

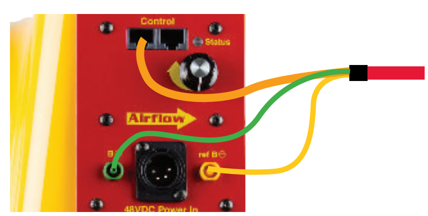
- ☐ Set up the Door Panel.
  See Your Door Panel QuickGuide
- ☐ Connect the yellow tube between yellow ports marked "Ref B" on fan and gauge. If the fan has a green port ("Input B"), connect the green tube.
- ☐ Connect one end of the Speed Control Cable to the fan and another to the gauge.
- ☐ Connect the red tube to the red port on the gauge.
- ☐ Pass the red tube through the Door Panel and toss the end at least 5 feet away from the fan's airstream.

  Water in the tube will result in erroneous readings.

- ☐ Install the fan blowing outdoors. Cover the fan.
- ☐ Connect the fan power plug to a wall outlet.

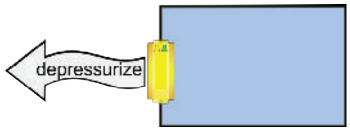




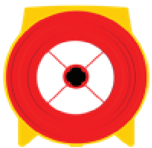


- ☐ Place gauge near fan, or attach gauge to Door Panel.

Step 3: Conduct depressurization test, (CFM@50)



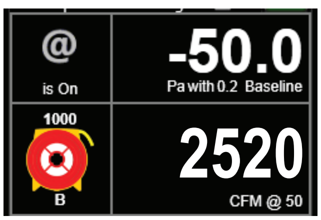
- ☐ Press **[On]** to power up the gauge.
- ☐ Tap **[Settings]** then **[Baseline]**.
- ☐ Tap **[Capture Baseline]** and 20 seconds on a calm day or 60 seconds on a windy day, then tap **[End Capture]** then **[On]** to return to the **Home** screen.
- ☐ Uncover fan. Install Range Ring B (Open for 300 fan).
- ☐ Make sure gauge shows the correct Range on **Home** screen.



Flow Range B

Open

- ☐ Disconnect Speed Control Cable, then adjust Speed Control knob until pressure is about 50 Pa.



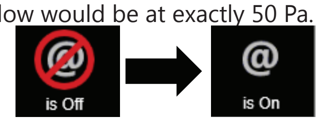
- ☐ Tap **[@ Pressure]** to extrapolate results to exactly 50 Pa.
- ☐ Record results.

Step 4: Desired results not achieved?

Cannot achieve test pressure at full speed?

If fan reaches 100% speed before reaching 50 Pa:

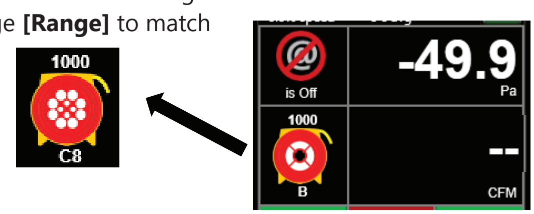
- ☐ Check to see if all doors and windows are closed.
- ☐ Remove a Range Ring and try again.
- ☐ Change **[Range]** on the gauge to match.
- ☐ Re-adjust fan speed.
- ☐ Tap **[@ Pressure]** to get the gauge to calculate what the flow would be at exactly 50 Pa.



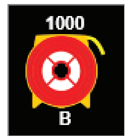
Flow reads "--" at test pressure?

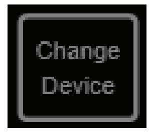
If the test pressure has been reached, but "--" appears, the fan is running too slowly to accurately measure flow.

- ☐ Add the next lower Range
- ☐ Change **[Range]** to match

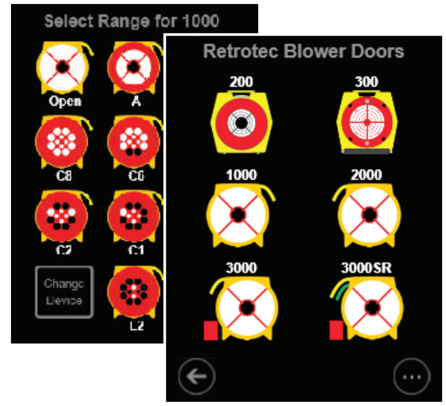


Gauge set up





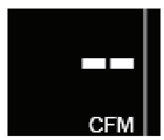
Make sure the device shown on the **Home** screen matches your fan. To change device, tap the fan picture, then the **[Change Device]** key.



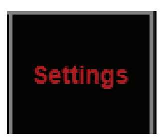
Select your device from the pictures, then choose the Range.

Use Range Ring B for most houses, try "C8" for tighter new houses, or "A" for leakier older houses.

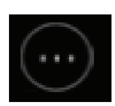
For 300 fans, start with Open Range.

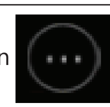


Tap on **[Channel B]** to change the type of result or units. Check the *Door Fan Operation Manual* to see the results required for your region.



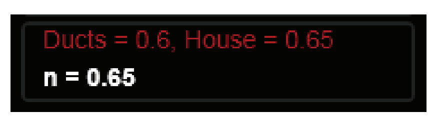
Tap **[Settings]** then **[Time averaging]** to adjust the time averaging. 5 seconds is OK for a calm day. 10 or 30 seconds can be used on windy days.

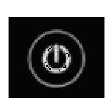


Tap **[Settings]** then 

Make sure the **[Default @ Pressure]** is set to 50 Pa.

Make sure "n" value is set to 0.65 for House.





Tap to return to the **Home** screen.

Different Results

Tap the **[Channel B]** key to view a different Result, or tap **[Result to be displayed]** on the **[Settings]** menu.

Flow: CFM	Required by many states. Also available in metric units.
Flow/Area: CFM/sq ft Flow normalized by area	Normalized leakage area is used in many standards. All common units are available.
ACH: /h Air changes per hour	Air Changes per hour can be shown directly on the gauge.
EfLA4/area: sq in/sq ft Normalized EfLA at 4 Pa	Specialized units such as effective leakage area are also available.

When a Result is chosen that requires an area or volume, **[Area]** or **[Volume]** will be shown on the **Home** screen.

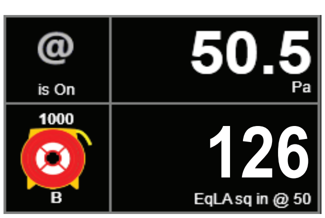
Tap **[Area]** or **[Volume]** to change . The area and volume can also be changed from the **[Settings]** menu.

Show leakage area Result

Equivalent Leakage Area (EqLA) describes the leakage area in terms of one large hole in a flat surface.

Tap the **[Channel B]** key, then  , and select "EqLA: sq in"

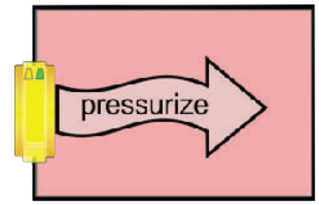
[Channel A] shows the building pressure and **[Channel B]** "EqLA" shows the combined size of all holes in the building.



Leakage area is not a required result, but is a nice way to visualize the size of the hole in the ducts.

Pressurization test

Turn the fan around to blow air into the house.



Tubing configuration stays the same as for the depressurization test.

Adjust fan with gauge

Connect Speed Control Cable to the fan.
Solid green Status light indicates gauge is connected.

Tap **[Set Pressure] [50] [Set]** to get gauge to control to a pressure of 50 Pa.

Any test pressure can be entered. High test pressures over 60 Pa are more likely to disturb building contents and cause damage.

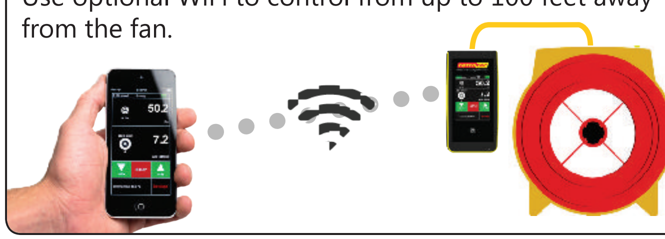
Tap **[Set Speed] [50] [Set]** to set speed to 50%.

When **[Set Speed]** or **[Set Pressure]** is used, the Jog keys become active on the **Home** screen. Use the **[JogUp] [JogDown]** arrow keys to increase or decrease the target by 5 Pa or 5%.

Tap **[Stop]** to turn the fan off.

Adjust fan speed remotely

Use optional WiFi to control from up to 100 feet away from the fan.



Control fan speed with software

Speed control is handled automatically with FanTestic software, for complete automation.

Field check gauge weekly

Check gauge operation and check for blocked, leaking or pinched tubes weekly, and anytime results are in question.

To perform the gauge check, you will need the gauge and Umbilical.

- ☐ Set **[Time Average]** to 5 seconds in **[Settings]**.
- ☐ Tap **[Channel B]** and select“Pressure: Pa”.
- ☐ Connect the red tube between the red and yellow ports.

  If readings on Channel A and Channel B are within 2% and don’t drop rapidly, the tube is not blocked or leaking and the gauge is correct.

- ☐ Repeat between different ports with each of the tubes you use for testing.

Checking your gauge and tubes regularly will eliminate a common source of error in readings.

Field check system monthly

- ☐ Perform a Blower Door test on the building and record the EqLA at 50 Pa.
- ☐ Install cardboard in upper part of doorway with a 20 x 20 inch hole cut in it.
- ☐ Perform a second Blower Door test on the building, record the EqLA at 50 Pa.
- ☐ Subtract the first result from the second result and the value should be 400 sq. in. (+/-10%).

Alternatively, use a Verification Plate in an optional double hole Door Panel, or use the optional Flex Duct with a 400 sq. in. hole in a plate on the end.

QuickGuide

DU200 DucTester

Unpack, connect DM-2 gauge

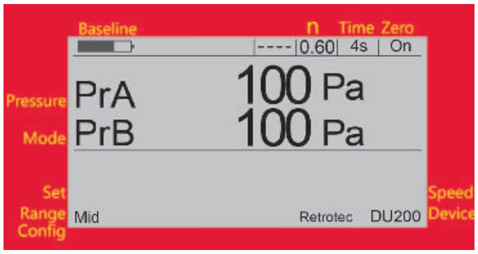
Check boxes for each step.

- ☐ Remove everything from the case.
- ☐ Install 4 NiMH AA batteries.*
- ☐ Plug in the battery charger.
- ☐ Press **[On]**, then **[Exit]**, to display the battery indicator.
- ☐ Charge for 18 hrs.
- ☐ Connect yellow, green and blue tube to gauge.
- ☐ Slide gauge into the clear sleeve and velcro Umbilical to case.

* If changing to non-rechargeable batteries, disable charging in **[Setup]** menu. For steps see: *Quick Guide DM-2 mark II Digital Gauge, page 1*

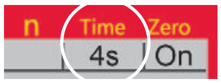
Gauge remains connected like this for all tests.

Prepare the DM-2 gauge



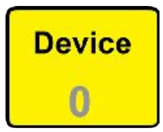
- ☐ Press **[Auto Zero]** until "On" appears - to keep the gauge zeroed and ready to measure.

- ☐ Press **[Time Avg]** until "4s" appears.



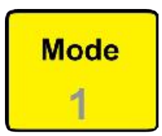
- ☐ Press **[Device]** until "Retrotec DU200" appears.

If desired Device does not appear, see: *QuickGuide DM-2 mark II Digital Gauge,* Add/Remove Devices section



- ☐ Press **[Range Config]** until "Mid" appears.

- ☐ Press **[Mode]** to cycle through results. Select based on "Get the results you need" on page 4.
  If you can't find the required results, see: *QuickGuide DM-2 mark II Digital Gauge*



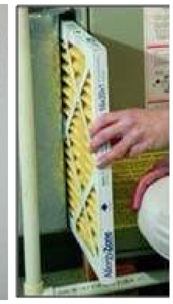
Next, prepare the ducts, house, and fan following Steps 1 through 3.

Step 1: Prepare ducts and house

- ☐ Seal all supply and return grills/registers, including any exterior air inlets, with Grill Mask or tape.
- ☐ Open all interior doors leading to rooms containing a supply or return register, and open an exterior door or window.
- ☐ Shut off all HVAC (exhaust fans, dryers, A/C, furnaces).

Step 2: Connect to ducts

- ☐ Turn off air-handler and remove all filters.

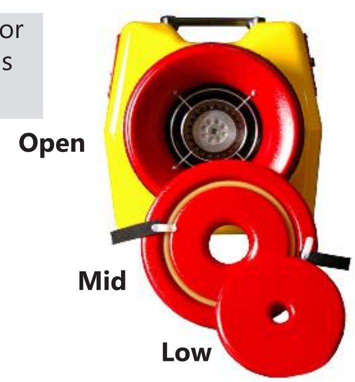


- ☐ Tape Flange to main return or air handler cabinet using masking tape.

- ☐ Attach Flex Duct to Flange.

- ☐ Install Mid-Range Ring to start, as most systems can be tested on this Range Configuration.

Remove Range Rings for leakier ducts, add Rings for tighter ducts.

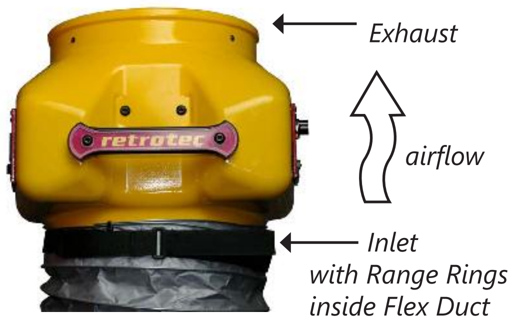


- ☐ Press **[Range Config]** to select range on gauge to match fan, <u>whenever</u> Range Ring is changed.

Step 2: Connect to ducts cont'd

☐ Connect Flex Duct to fan **inlet** for depressurization.

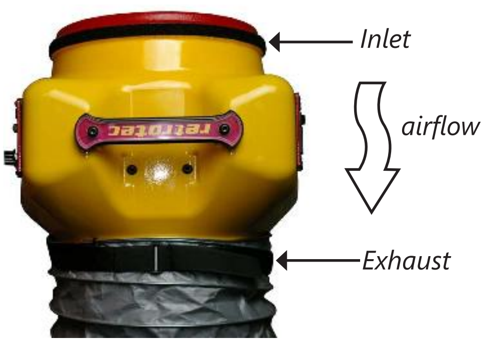
depressurize



Depressurization is easiest and permitted in all States except CA & WA where it can still be used to evaluate, but not for a final result.

To pressurize, connect the Flex Duct to fan **exhaust**.
All other connections remain the same

pressurize



Step 3: Connect DM-2 gauge & fan

☐ Connect power cord.

☐ Switch to on: " I ". Green light indicates that power is connected.

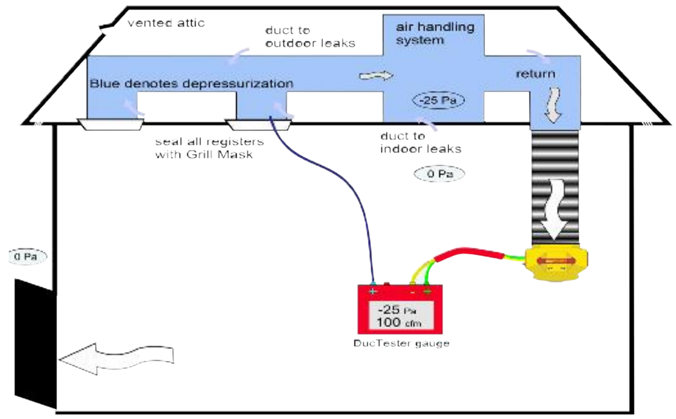
☐ Connect yellow and green tubes to matching color ports on fan. Ethernet style Speed Control Cable will disable the knob. It is connected later in Step 4.

Speed Control Cable

☐ Insert blue tube into the supply register closest to the air handler.

Total Duct Leakage Test: Depressurize

Ready to conduct the test by depressurizing the ducts:



Depressurizing works best because the fan pulls the Grill Mask tight on the registers during the test.

If Pressurizing, see tubing setup on page 7.

Step 4: Conduct test

☐ Press **[On]** twice to get to main screen.

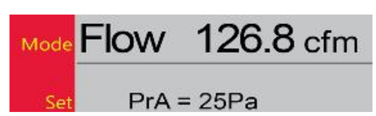
☐ Adjust fan speed knob clockwise until "PrA" reaches test pressure.

☐ If not possible, go to Step 5 for advice on changing setup.

☐ Connect Speed Control Cable to fan.

Solid green Status light indicates DM-2 is ready to control speed.

☐ For a test pressure of 25 Pa *, press **[Set Pressure] [25] [Enter].**



* 50 Pa for Northwest ENERGY STAR.

☐ Press **[@ Pressure]** to display what the result would be at exactly 25 Pa.

☐ Read results directly from the gauge.

Get the results you need

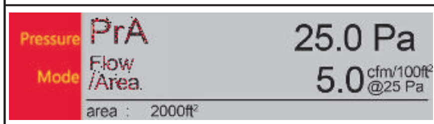
☐ Press **[Mode]** until required results appear

Flow at the induced pressure is the simplest result.

Mode = "Flow"
Units = "CFM"

Flow per ft² (sq ft) is required in some states, such as WA.

Mode = "Flow/Area"
Units = "CFM/ft²"
(enter a value for Area)



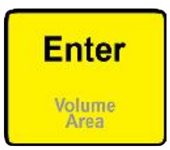
Flow per 100 ft² is required for the following states:

CT	ID	MD	NY	TX
DC	IL	MA	NC	VT
DE	IA	NH	PA	
GA	ME	NJ	RI	

Mode = "Flow/Area"
Units = "CFM/100 ft²"
(enter a value for Area)

☐ Press **[Setup]** for menu to change result units
☐ Press **[▼]** to find "Mode Setup", then **[Enter]**
☐ Press **[▼]** until the Mode you want is highlighted
☐ Press **[Enter]** to change displayed result units
☐ Press **[Exit]** twice to return to main menu

☐ Press **[Enter]** numbers **[Enter]** to input the floor area if CFM/ft² or CFM/100 ft² is used.



*Floor area of 2000 square feet was entered in the above examples.
[Enter] [2000] [Enter]

Show results as leakage area

Equivalent Leakage Area (EqLA) describes the leakage area in terms of one large hole in a flat surface.

☐ Press **[Mode]** until "EqLA" appears.

"PrA" displays the duct pressure and "EqLA" shows the combined size of all the holes in the ducts.

Leakage area is not a required result, but is a nice way to visualize the size of the hole in the ducts.

Step 5: Desired results not achieved?

Flow reads "TOO LOW" or "----" at test pressure?

If the test pressure has been reached, but "TOO LOW" or "----" appears, the fan is running too slowly to measure flow.

☐ Add the next Low-Range Ring.
☐ Change **[Range Config]** on the DM-2 to match.
☐ Re-adjust speed.

Cannot achieve test pressure at full speed?

If fan reaches 100% speed before reaching the target pressure:

☐ Remove a Range Ring and try again.
☐ Change **[Range Config]** on the DM-2 to match.
☐ Check seals on all registers. Look for disconnected ducts or ducts open to outdoors.
☐ Press **[@ Pressure]** to get the gauge to calculate what the flow would be at exactly 25 Pa.

620 CFM is the flow rate that would occur at 25 Pa, even though only 22 Pa was achieved.

Hold display and Jog speed

Use "Jog" to activate arrow keys
[▲] [▼]
then adjust target speed or pressure.

Use "Hold" to freeze results display and hold fan speed.

☐ Press **[Jog/Hold]** until "Hold" appears in top center of display.

The display will be frozen with the current values.

☐ Press **[Jog/Hold]** again to cancel "Hold".

☐ Press **[Jog/Hold]** until "Jog" appears.
☐ The **[▲] [▼]** keys now adjust the speed just like a TV remote. With **[Set Speed]** the % speed changes. With **[Set Pressure]** the pressure changes.

"Jog" is only available when **[Set Pressure]** or **[Set Speed]** have a value entered.

We're here to help!

- Sign up for our monthly gauge setup webinars.

  retrotec.com/residential/SupportCenter/SetupWebinars.aspx

- Bookmark our blog! Everything from new testing techniques to industry updates.

  retrotec.com/blog.aspx

- Our tech support is always ready to field phone-in troubleshoot and testing questions. Give us a call!

  1-855-738-7683

- Access all Retrotec training videos here: **youtube.com/RetrotecTraining**

Free Training Videos

Check out Retrotec's YouTube page, with all the videos you'll need to help you setup, run, or trouble-shoot your equipment!

Retrotec's playlist includes:

Duct Testing
Watch universal training videos including:
- Set up
- Procedures
- Troubleshooting

Leakage: Blower Door
Watch video demonstrations including:
- Blower Door set up
- Common leak locations
- Software
- House preparation

Pressure: Gauge Training
Get help to successfully set up and use digital pressure gauges.
- Gauge set up
- Discover modes & devices
- Perform calibration checks

Optional Test

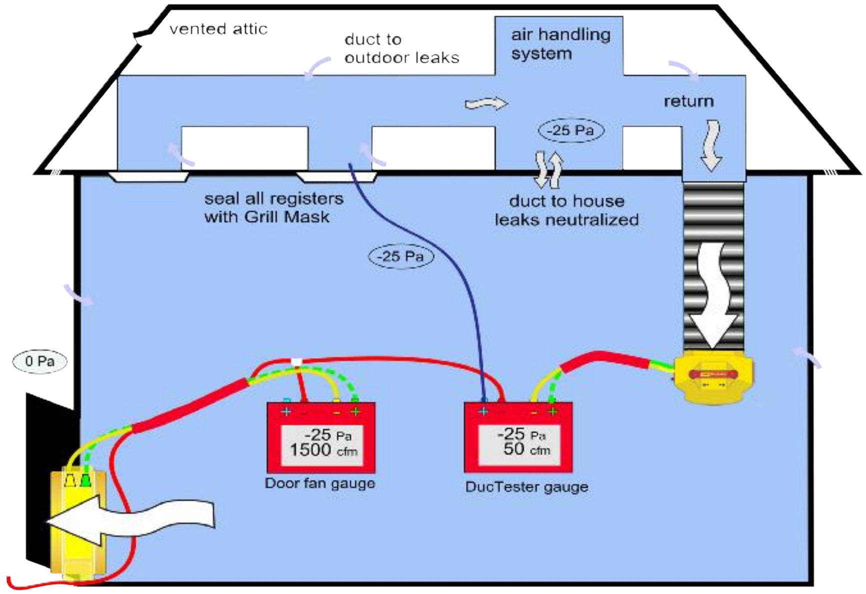
Duct Leakage to Outdoors: Depressurize

To measure the air leakage from the duct system to outdoors requires both a DucTester and a Blower Door system.

The Blower Door depressurizes the house and the DucTester depressurizes the ducts so leakage from the duct system back into the conditioned space of the home is neutralized.

Method 1 uses the DucTester set up the same way as for the Total Duct Leakage test, and allows use of **[@ Pressure]** to increase accuracy.
Results are easier to visualize since both the duct and house pressure can be seen.

Method 2 does not require connecting a red tube to the DucTester gauge but results in large errors if **[@ Pressure]** is turned on.

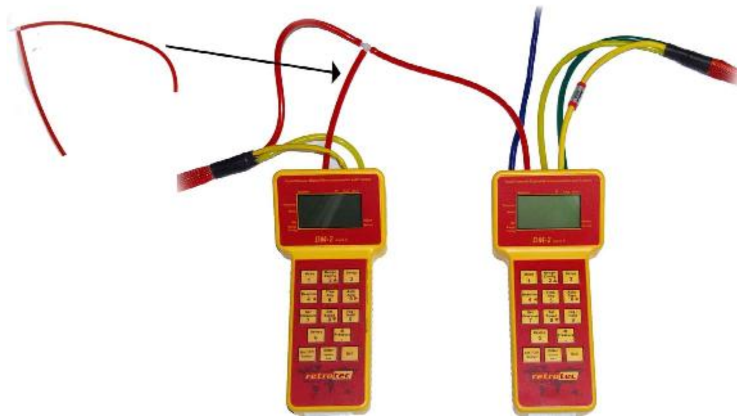


Method# 1

Method #1:

Set both gauges to -25 Pa **

- ☐ Connect the red T-connected tubes to red ports per diagram.
- ☐ Press **[Set Pressure] [25] [Enter]** on DucTester gauge then on Blower Door gauge.
- ☐ Press **[@ Pressure]** on DucTester gauge to display the results "@25Pa".
- ☐ When "25 Pa" +/– 1 is achieved on both gauges, record duct leakage to outdoors from the DucTester gauge.

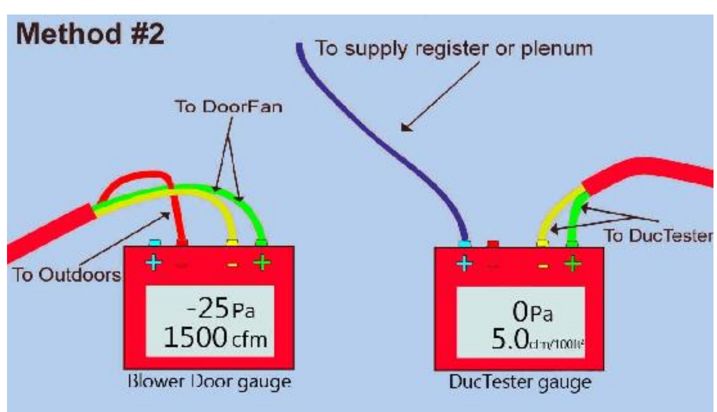


Blower Door gauge DucTester gauge

Method #2:

Set DucTester gauge to 0 Pa,
Blower Door gauge to -25 Pa **

- ☐ Connect tubes to gauges per diagram.
- ☐ With DucTester off, set the Blower Door gauge to -25 Pa by pressing **[Set Pressure] [25] [Enter]**.
- ☐ Press **[@ Pressure]** on DucTester to remove "@25Pa" from the display.
- ☐ Set the DucTester to "0 Pa" by pressing **[Set Pressure] [0] [Enter]**. When "0 Pa" +/– 1 is achieved, record duct leakage to outdoors from the DucTester gauge.



** If 50 Pa test pressure required, use 50 in all instructions.

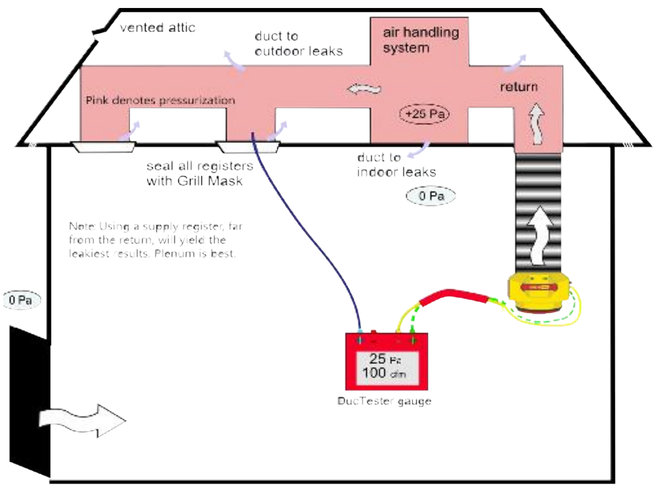
Options

Total Duct Leakage: Pressurize

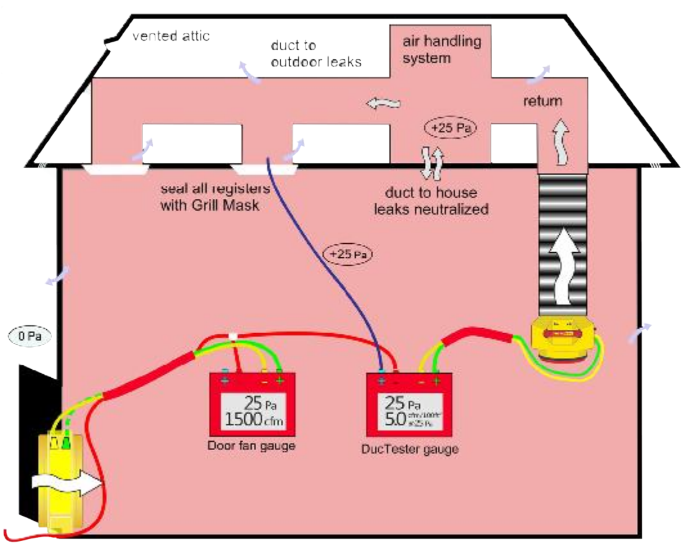
☐ Connect Flex Duct to fan **exhaust**.

☐ Check that tubing is connected the same as for depressurize test (step 3).
☐ Conduct test (step 4).

Pressurizing can blow the Grill Mask off the registers!



Duct Leakage to Outdoors: Pressurize



Follow depressurize test method (page 6) except both fan directions are reversed.

Using the optional Flow Hood

Connect it quickly to ceiling level returns to measure duct leakage or use it with your DucTester as a Powered Flow Hood to accurately measure HVAC system flow rates.

☐ Pass the Flange through the 10 inch hole in the Flow Hood and tape it inside.
☐ Attach the Flex Duct.
☐ Secure the Flow Hood over the register

To measure Duct leakage:

☐ Connect the Flex Duct to the fan and test as usual.

To measure HVAC System Flow:

☐ For measuring supply flows, attach the Flex Duct to the inlet (suction) side of the fan.
☐ For measuring return flows, attach the Flex Duct to the exhaust (discharge) side of the fan.
☐ Connect the umbilical to the DucTester.
☐ Attach the blue tube to the Flow Hood and gauge.
☐ Press **[@ Pressure]** until "@" is removed from display
☐ Press **[Mode]** to select "Flow"

When a definite pressure appears on "PrA":

☐ Adjust the speed until "PrA" reads a pressure of 0 Pa.
Or
☐ Press **[Set Pressure] [0]** to have the DucTester automatically achieve a 0 pressure.

☐ Read the HVAC system flow result directly from the gauge

Field check system monthly

Check the DucTester system monthly with a known setup—if flow is outside the acceptable range then system needs full calibration.

- ☐ Tape the optional flow Verification Plate to the Flange and attach the red tube.
- ☐ Attach the Flex Duct to the exhaust side of the fan to pressurize the Flex Duct.
- ☐ Stretch the Flex Duct to it's full length.
- ☐ Set the DM-2 to measure "Flow" in "CFM @25 Pa".
- ☐ Adjust the speed until "PrA" reads close to 25 Pa.
- ☐ Read the Verification Plate to determine the acceptable range for flow.

Typically, 100 to 110 CFM is a pass.

Optional DU159 Verification Plate shown.

Field check gauge weekly

Check gauge operation and check for blocked, leaking or pinched tubes weekly, and anytime results are in question.

To perform the gauge check, you will need the gauge and Umbilical.

- ☐ Press **[Exit] [Time Average]** until "4s" appears.
- ☐ Press **[Mode]** repeatedly to display "PrB".
- ☐ Connect the yellow tube between the red and yellow ports.

If readings on "PrA" and "PrB" are within 2% and don't drop rapidly, the tube is not blocked or leaking and the gauge is correct.

- ☐ Repeat between different ports with each of the tubes you use for testing.

Checking your gauge and tubes regularly will eliminate a common source of error in readings.

Optional accessories

Flange to connect Flex Duct to register

Part #: DU157

Verification Plate

Part #: DU159

Flow Hood 24 x 24 inches (61 x 61 cm)

Part #: PP105

12.5ft (3.8m) Flex Duct for DucTester

Part #: DU161

Mid-Range Ring & Low-Range Ring

(Mid) Part #: DU154
(Low) Part #: DU155

Tubing Accessory Kit

35 ft (10 m) of blue, red, yellow and green 1/4 inch (12mm) outside diameter tubing. Static Pressure Probe, 4 inch (100 mm) x 1/8 inch (6 mm) outside diameter metal probe, 2 T and 2 male-to-male connectors. Red L for duct leakage to outdoors test.

Part #: TU119

Umbilical for DucTester fans, 7ft (2 m)

Part #: DM240

Grill Mask 12in x 216ft, 12in perfs, Hi-stick White, Single Roll

Part #: GR116
Part #: GR117 (for case of 3)

Deluxe Cordura Toolbag with Shoulder Strap

Part #: TL118

QuickGuide

Blower Door

Step 1: Prepare the building

- ☐ Close outside doors and windows.
- ☐ Open all interior doors leading to conditioned spaces.
- ☐ Turn gas, hot water, to Pilot.
- ☐ Fireplaces and stoves must be cold with doors closed (cover ashes).
- ☐ Shut off HVAC, combustion appliances, exhaust fans, dryers, A/C and furnaces.

See: *Manual-Residential Pressure & Air Leakage Testing* for additional information.

		
Remove or cover ashes.	Turn gas valve to Pilot.	Close all windows and outside doors.

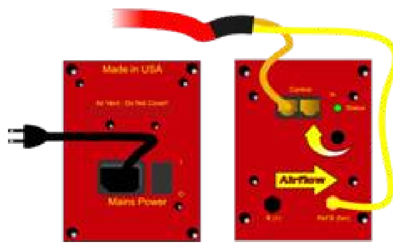
Step 2: Install the system

☐ Set up the Door Panel.
See: *DoorPanel-Cloth* or *DoorPanel-Modular QuickGuide*

- ☐ Connect the yellow tube between yellow ports marked "Ref B" on fan and DM-2. If the fan has a green port ("Input B"), connect the green tube.
- ☐ Connect the Speed Control Cable from fan to gauge. Do not connect to the Internet!
- ☐ Pass long red tube through the Door Panel and toss the end at least 5 feet away from the fan's airstream.

Water in the tube will result in erroneous readings.

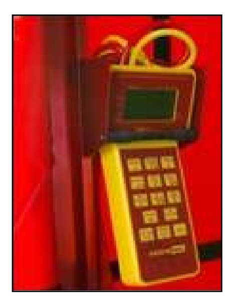

- ☐ Install the fan blowing outdoors. Cover fan.
- ☐ Connect the fan power plug to a wall outlet.



1000
Device="Retrotec 1000"

Q46, Q56
Device= "Retrotec 2000"

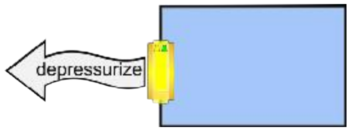
Q4E, Q5E, QMG
Device= "Retrotec 3000SR"

Place gauge case near fan, or attach gauge to Door Panel.

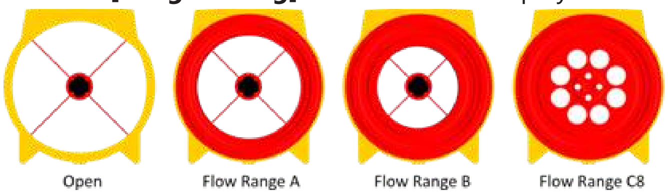
QuickGuide Blower Door

Step 3: Conduct depressurization test, (CFM@50)



See: *QuickGuide DM-2 mark II Digital Gauge*

- ☐ Press **[On]** twice. Gauge will start at previous setup.
- ☐ Press **[Baseline]**. Wait 20 seconds on a calm day and 60 seconds on a windy day, the press **[Enter]**.
- ☐ Uncover fan. Install Range Ring B.
- ☐ Press **[Range Config]** to show "B" on display.

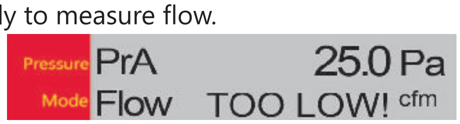


- ☐ Disconnect Speed Control Cable, then adjust Speed Control knob until pressure is about 50 Pa.
- ☐ Record results.

Step 4: Desired results not achieved?

Flow reads "TOO LOW" or "----" at test pressure?

If the test pressure has been reached, but "TOO LOW" or "----" appears, the fan is running too slowly to measure flow.

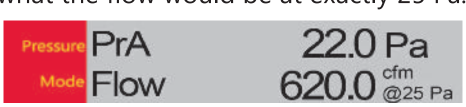


- ☐ Add the next Low-Range Ring.
- ☐ Change **[Range Config]** on the DM-2 to match.
- ☐ Re-adjust speed.

Cannot achieve test pressure at full speed?

If fan reaches 100% speed before reaching the target pressure:

- ☐ Remove a Range Ring and try again.
- ☐ Change **[Range Config]** on the DM-2 to match.
- ☐ Check seals on all registers. Look for disconnected ducts or ducts open to outdoors.
- ☐ Press **[@ Pressure]** to get the gauge to calculate what the flow would be at exactly 25 Pa.



620 CFM is the flow rate that would occur at 25 Pa, even though only 22 Pa was achieved.

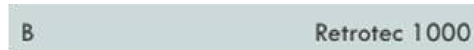
Gauge set up

Auto Zero 6 ▶

Turn **[Auto Zero]** "On" to zero gauge (every 8 seconds). This is normally left on unless batteries are low.

Device 0

Press **[Device]** until "Retrotec 1000" is displayed for 1000 systems, "Retrotec 2000" for Q46 & Q56 systems, "Retrotec 3000SR" for QMG, Q4E & Q5E systems, or, "Retrotec DU200" for DU200 Systems.



Other devices can be removed using the Setup Menu.

Range Config 2 ▲

Use Range Ring B for most houses, try "C8" for tighter new houses, or "A" for looser older houses, if required.

Mode 1

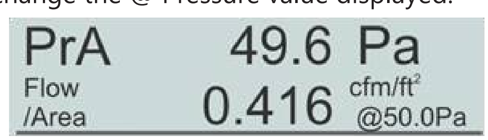
Press **[Mode]** to cycle through results. Check the *Door Fan Operation Manual* to see the results required for your region.

Setup 3

Follow the *QuickGuide DM-2 mark II* to eliminate unused Devices, Range Configurations and Modes.

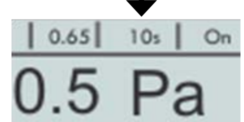
@ Pressure .

Press **[@ Pressure]** to display results exactly at (@) a test pressure. Use **[Set Pressure]**, or the menu in **[Setup]**, to change the @ Pressure value displayed.



Time Avg 5

Set **[Time Avg]** to "10s". Increase if the test pressure fluctuates over 1 Pa.
Wait for twice the Time Average length before taking a reading. *e.g.* Set **[Time Avg]** to "10s", then wait for 20 seconds before taking a reading.



Tip: Use longer time averaging in windy conditions.

QuickGuide Blower Door

Different Results

Press **[Mode]** to access the available results, or use **[Setup]** to access even more results. Some popular options are shown below:

CFM 50 is required in the USA. The flow displayed is what it would be at exactly 50 Pa, eliminating the need for an exact test pressure.

Normalized leakage area ($m^3/h \cdot m^2$), required in Europe.

Air Changes shown directly on the gauge.

Display custom units. *e.g.* units specified by WA state.

Area and volume are input using the **[Enter]** key.

Show results as leakage area

Equivalent Leakage Area (EqLA) describes the leakage area in terms of one large hole in a flat surface.

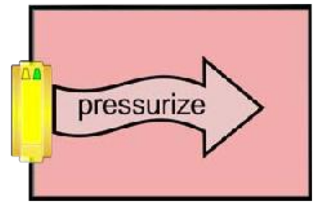
☐ Press **[Mode]** until "EqLA" appears.

"PrA" displays the building pressure and "EqLA" shows the combined size of all the holes in the building.

Leakage area is not a required result, but is a nice way to visualize the size of the hole in the house.

Pressurization test

Turn the fan around to blow air into the house.



Tubing configuration is the same as for the depressurization test.

Adjust fan speed with gauge

Connect Speed Control Cable to fan.
Solid green Status light indicates DM-2 is connected.

Press **[Set Pressure] [25] [Enter]** to get gauge to control to a pressure of 25 Pa.

Any test pressure can be entered. High test pressures over 60 Pa are more likely to disturb building contents and cause damage.

Press **[Set Speed] [50] [Enter]** to set speed to 50%.

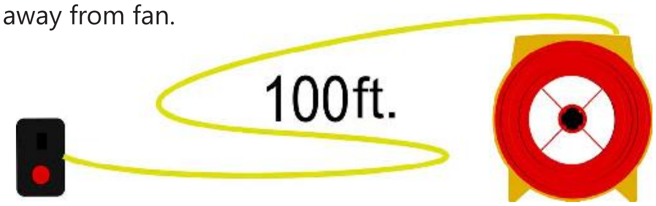
The fan will accept any Set Speed from 1 to 100%.

When speed or pressure is set, press **[Jog/Hold]** until "Jog" appears, then **[▲] [▼]** to adjust up or down. Click once to change by 1%, hold to increase by 5%.

Press **[Exit]** to turn the fan off.

Adjust fan speed remotely

Use optional remote speed control from up to 300 feet away from fan.



QuickGuide Blower Door

Control Fan speed with software

Speed control is handled automatically with FanTestic software, for complete automation.

Field check gauge weekly

Check gauge operation and check for blocked, leaking or pinched tubes weekly, and anytime results are in question.

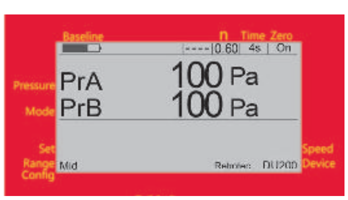
To perform the gauge check, you will need the gauge and Umbilical.

- ☐ Press **[Exit] [Time Average]** until “4s” appears.
- ☐ Press **[Mode]** repeatedly to display “PrB”.
- ☐ Connect the yellow tube between the red and yellow ports.

If readings on “PrA” and “PrB” are within 2% and don’t drop rapidly, the tube is not blocked or leaking and the gauge is correct.

- ☐ Repeat between different ports with each of the tubes you use for testing.

Checking your gauge and tubes regularly will eliminate a common source of error in readings.



Field system check monthly

- ☐ Perform a Blower Door test on the building and record the EqLA at 50 Pa.
- ☐ Install cardboard in upper part of doorway with a 20 x 20 inch hole cut in it.
- ☐ Perform a second Blower Door test on the building, record the EqLA at 50 Pa.
- ☐ Subtract the first result from the second result and the value should be 400 sq. in. (+/-10%).

Alternatively, use a Verification Plate in an optional double hole Door Panel, or use the optional Flex Duct with a 400 sq. in. hole in a plate on the end.

Quick Guide 1 – Pressurization Testing (blowing air into the duct system)

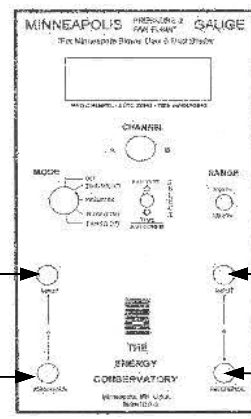
Conducting a Total Duct Leakage Test Using the Minneapolis Duct Blaster® and DG-3 Digital Gauge

1. **Connect the Duct Blaster fan to the duct system.**
   a) Choose a location to install the Duct Blaster fan. In single, double or triple returned systems, the largest and closest return to the air handler is usually the best choice. **Note:** In multi-return systems (a return in every room), installing at the air handler cabinet is often best.
   b) Remove any remote filters from the chosen return and then connect the black square transition piece to the return using temporary tape. Completely seal the remaining open area of the return with tape.
   c) Pull the Duct Blaster fan and flex duct out of the carrying case. Connect the flex duct to the ***exhaust side*** of the fan (i.e. the side with the metal guard) using the round transition piece and connect trim. Connect the open end of the flex duct to the square transition piece using the velcro strap on the flex duct.
   d) Connect the fan speed controller to the fan and plug it into a 110V outlet.
   e) Install the flow ring which you think best matches the needed fan flow.

Fan Configuration	Flow Range (CFM)
Open	1,500 - 600
Ring 1	800 – 225
Ring 2	300 – 90
Ring 3	125 – 20

2. **Prepare the duct system and house for the test.**
   a) Adjust the HVAC system controls so that the air handler does not turn on during the test.
   b) Temporarily seal off all remaining supply and return registers, and combustion or ventilation air inlets which are connected to the duct system. Use ***Duct Mask™*** temporary register sealing material provided with your Duct Blaster, or use painters tape and paper.
   c) Turn off any exhaust fans, vented dryers, and room air conditioners.
   d) Remove all central filters (i.e. in air handler or return plenum).
   e) Open a door or window between the house and outside to prevent changes in house pressure when the Duct Blaster is running.
   f) If the Duct Blaster is installed in an attic, garage or crawlspace - open vents or access panels or doors from these spaces to the outside.

3. **Connect hoses to DG-3 Pressure Gauge.**
   a) Select a location to measure duct pressure. The best location for measuring duct pressure is often in the supply trunkline or plenum. Drill a small hole (1/4" to 3/8" OD) into the duct to allow a static pressure probe to be installed. Install the static pressure probe with the end of the probe pointing into the air flow from the Duct Blaster fan. If the duct system is reasonably airtight (e.g. less than 200 cfm25 of leakage), duct pressures can be measured at any supply register by inserting a hose through the temporary register seal.
   b) Use **CHANNEL A** to measure duct pressure, and **CHANNEL B** to measure Duct Blaster fan flow. Connect hoses to the DG-3 as shown in the diagram.



To Duct System (insert into register or connect to static pressure probe)

To Duct Blaster Fan (brass tap in middle of fan housing)

Connect to inside of house (if fan is installed in the house, leave this tap open). Be sure window is open.

Connect to space where fan is installed (if fan and gauge are in the same space, leave open).

4. **Gauge Settings for DG-3.**
   a) Turn the **MODE** switch to the **FAN SELECT** position and choose the Duct Blaster fan and current flow ring configuration. To change the fan type to the Minneapolis Duct Blaster fan, toggle the **SELECT** switch <u>up twice</u>.

   -8-0 This indicates that you have chosen the Minneapolis Duct Blaster fan, and that the fan is in the "Open" inlet configuration (e.g. no flow rings installed).

   To change the flow ring configuration for the Duct Blaster fan, toggle the **SELECT** switch <u>down.</u>

   -8-1 Duct Blaster with Ring 1 installed.
   -8-2 Duct Blaster with Ring 2 installed.
   -8-3 Duct Blaster with Ring 3 installed.

   b) Put the **RANGE** switch in the **High Range** position (2000 Pa), and turn the **CHANNEL** knob to **"A".**
   c) Turn the **MODE** switch to **PRESSURE**.

5. **Conducting the Test.**
   a) With the **CHANNEL** knob set to **"A"**, turn on the Duct Blaster fan by slowly turning the fan controller clockwise. As the fan speed increases, duct pressure indicated on **CHANNEL A** should also increase. Increase fan speed until the duct system is pressurized to the specified Test Pressure (typically 25 Pa).
   b) While leaving the fan speed unchanged from **a)** above, turn the **CHANNE**L knob to **"B"**, and turn the **MODE** switch to **FLOW**.
   c) The gauge will now display the total duct leakage reading in cubic feet per minute (cfm).

   If the cfm leakage reading displayed on the gauge is blinking, either install a flow ring, or install the next smaller flow ring. If you change flow rings, be sure to use the **Fan Select** feature to update the gauge with the new flow ring installed before reconducting the leakage test. **Note:** <u>Never monitor **CHANNEL A** (duct pressure) with the **MODE** switch in the **FLOW** position.</u>

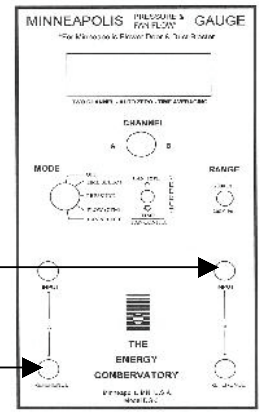
Quick Guide 1
One Point Depressurization Test
Using the Minneapolis Blower Door™ and DG-3 Digital Gauge

1. Install the Blower Door system.

a) Install the aluminum frame and nylon panel in an exterior doorway of a large open room.
b) Attach the gauge mounting board and fan speed controller to a door, or to the aluminum frame gauge hanger bar, using the C-clamp on the back of the mounting board.
c) Place the DG-3 pressure gauge onto the mounting board (using the Velcro strips) and connect tubing to the DG-3 as shown below.
d) Once the tubing has been attached, turn the **CHANNEL** knob to "*A*", turn the **MODE** switch to ***Pressure***, and put the **RANGE** switch in the ***200.0 Pa*** *setting* (***Low Range).***
e) Run approximately 3 - 5 feet of the remaining end of the **Green** tubing outside through one of the patches in the bottom corners of the nylon panel. Be sure the outside end of the tubing is well away from the exhaust flow of the Blower Door fan.
f) Install the Blower Door fan, with the flow rings and no-flow plate installed, into the large hole in the nylon panel. The exhaust side of the fan should be outside, and the inlet side of the fan (the side with the flow rings) should be inside the building.

Connect the **Red** tubing to the Channel B Input tap. ***Channel B is used to measure fan pressure and flow.***

Connect the **Green** tubing to the Channel A Reference tap. ***Channel A is used to measure building pressure with reference to outside.***



g) Insert the female plug from the fan speed controller into the receptacle located on the fan electrical box. The remaining cord (power cord) should be plugged into a power outlet that is compatible with the voltage/frequency of the fan motor and speed controller.
h) Check that the fan direction switch is set to exhaust air out of the building.
i) The remaining end of the **Red** tubing should now be connected to the pressure tap on the Blower Door fan electrical box.

2. Prepare the building for the test.

a) Close all exterior doors and windows, and open all interior doors. Because few house basements can be completely sealed from the house and usually some conditioning of the basement is desirable, they are typically included as conditioned space.
b) Adjust all combustion appliances so that they do not turn on during the test.
c) Be sure all fires are out in fireplaces and woodstoves. Close all fireplace and wood stove doors to prevent scattering of ashes.
d) Turn off any exhaust fans, vented dryers, and room air conditioners.

3. Conducting the Test.

a) With the fan sealed off, record the baseline building pressure, including the sign of the reading (i.e. negative or positive reading). Baseline building pressure is read from ***Channel A.*** If the pressure is fluctuating too much to determine the reading, try changing the Time Averaging setting on the gauge by turning the **MODE** Switch to ***Time Select***, choosing the ***5*** or ***10*** second or ***Long-term*** average, and then return the **MODE** Switch to the ***Pressure*** setting.
b) Remove the No-Flow Plate and install the Flow Ring which you think best matches the needed fan flow.
c) Turn the **MODE** switch on the DG-3 to the ***Fan Select*** position and choose the Blower Door fan and current Flow Ring configuration. To select the Model 3 fan, toggle the **SELECT** switch up once.

Fan Configuration	Flow Range (cfm) for Model 3 Fan
Open (no Flow Ring)	6,300 - 2,430
Ring A	2,800 - 915
Ring B	1,100 - 300

-3-0 This indicates that you have chosen the Model 3 fan, and that the fan is in the "Open" inlet configuration.

To change the Flow Ring configuration for the chosen fan, toggle the **SELECT** switch down.

-3-1 Model 3 fan with Ring A installed. -3-2 Model 3 fan with Ring B installed.

d) Turn the **MODE** knob back to ***Pressure***, and then flip the **RANGE** switch to the ***2000*** setting (***High Range***).
e) With the **CHANNEL** knob set to "*A*", turn on the Blower Door fan by slowly turning the fan controller clockwise. As the fan speed increases, building pressure indicated on ***Channel A*** should also increase. Increase fan speed until the building is depressurized by 50 Pascals from the baseline pressure measured in **3(a)** above (i.e. change the building pressure by 50 Pa from the baseline).
f) While leaving the fan speed unchanged from **3e)** above, turn the **CHANNEL** knob to "***B***", and turn the **MODE** switch to ***Flow***. The gauge will now display the CFM50 reading for the building.

If the CFM leakage reading displayed on the gauge is blinking, install the next smaller Flow Ring. If you change Flow Rings, be sure to use the **Fan Select** feature to update the gauge with the new Flow Ring installed before reconducting the test. **Note:** Never monitor ***Channel A*** (building pressure) with the **MODE** switch in the ***Flow*** position, because the readings will be invalid.

CHEERS

Unmatched Service with Integrity

FIELD CALIBRATION GUIDES

Procedure for Field Checking the Model 3 Blower Door and Series B Duct Blaster Fans

1. Introduction

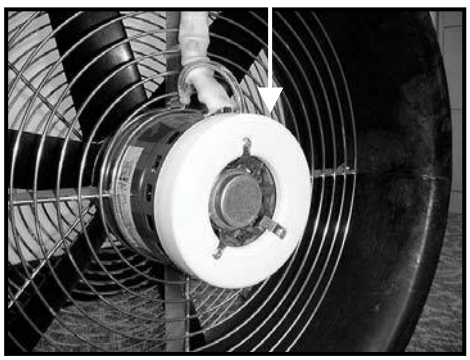
Model 3 Blower Door and Series B Duct Blaster fans maintain their calibration unless physical damage occurs to the fan. Conditions which could cause the fan calibration to change are primarily damaged flow sensors, leaks in the flow sensor or tubing running from the flow sensor to the fan pressure tap, or improper positioning of the flow sensor relative to the fan housing. These conditions are easily detected and should be tested for on a regular basis.

2. Checking for a Leaky or Damaged Flow Sensor

a. Model 3 Blower Door Fan

Model 3 Blower Door fans use a round white plastic flow sensor that is mounted on the end of the fan motor opposite the fan blades.

Model 3 Blower Door Flow Sensor



First visually confirm that the flow sensor is not broken or deformed due to impact. Check that the flow sensor is firmly attached to the motor using the 3 metal attachment clips.

Next, perform a test for air leaks in the flow sensor and the tubing connecting the sensor to the fan pressure tap (this test is easier if you first place the fan in an elevated position such as on a bench top or table.)

1) Attach a piece of tubing to the pressure tap on the Blower Door fan electrical box. Leave the other end of the tubing open.
2) Find the 4 intentional sensing holes in the outside rim of the flow sensor (the sensing holes are located at 2, 4, 8, and 10 o'clock). Temporarily seal the 4 sensing holes by carefully covering them with masking tape.

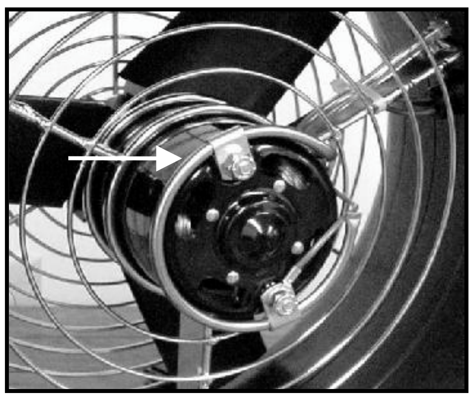
3) Create a vacuum in the tubing connected to the fan pressure tap by sucking on the open end of the tubing. While creating a vacuum in the tubing, place your tongue over the end of the tubing. The vacuum in the tubing should cause the end of the tubing to stick to your tongue. If the tubing remains stuck to the end of your tongue for at least 5 seconds, the fan and flow sensor pass this part of the test. (Be sure to remove the masking tape from the flow sensor holes.)

   If a vacuum can not be created (i.e. air is easily sucked through the tubing), or a vacuum will not persist for at least 5 seconds (i.e. the end of the tubing will not stick to your tongue for at least 5 seconds), there is a leak in either the flow sensor itself or in the tubing that connects the flow sensor to the fan pressure tap. Contact TEC for help in further diagnosing the problem.

b. Series B Duct Blaster Fan

The Duct Blaster uses a flow sensor manufactured out of thin stainless steel tubing. The flow sensor is permanently attached to the end of the fan motor opposite the fan blades.

Series B Duct Blaster Flow Sensor



First visually confirm that the sensor is not broken or deformed due to impact. Check that the sensor is firmly attached to the motor. Next, perform a test for leaks in the sensor and the tubing connecting the sensor to the fan pressure tap.

1. Attach a piece of tubing to the brass pressure tap on the Duct Blaster fan housing. Leave the other end of the tubing open.
2. Find the 3 intentional sensing holes in the flow sensor - they are evenly spaced on the back side of the sensor. Temporarily seal the 3 holes by covering them with masking tape.
3. Create a vacuum in the tubing connected to the fan pressure tap by sucking on the open end of the tubing. While creating a vacuum in the tubing, place your tongue over the end of the tubing. The vacuum in the tubing should cause the end of the tubing to stick to your tongue. If the tubing remains stuck to the end of your tongue for at least 5 seconds, the fan and flow sensor pass this part of the test. (Be sure to remove the masking tape from the flow sensor holes.)

If a vacuum can not be created (i.e. air is easily sucked through the tubing), or a vacuum will not persist for at least 5 seconds (i.e. the end of the tubing will not stick to your tongue for at least 5 seconds), there is a leak in either the flow sensor itself or in the tubing that connects the flow sensor to the fan pressure tap. Contact The Energy Conservatory for help in further diagnosing the problem.

3. Checking the Flow Sensor Position

The position of the flow sensor relative to the inlet of the fan housing is a important component of the fan's air flow sensing system. Because the fan flow sensor is attached to end of the fan motor, the position of the flow sensor can change if the position of the motor changes. If a fan has been dropped, the motor may have shifted from its proper position in the motor mount, or the motor mount itself can sometimes bend. This movement of the motor and flow sensor can degrade the fan calibration.

a. Model 3 Blower Door Fan

To check the flow sensor position, lay the fan on its side with the flow sensor facing up and all flow rings removed. Place a straightedge (such as a heavy yardstick on edge) across the inlet of the fan. Use a ruler to measure the distance from the bottom of the straightedge to the face of the flow sensor (see diagram #1 below). This distance should be in the range of 3/16th to 5/16th of an inch. If the flow sensor is within this range, the fan passes this part of the field check procedure. If the flow sensor is not in the proper position, contact The Energy Conservatory for further instructions.

b. Series B Duct Blaster Fan

To check the flow sensor position, lay the fan on its side with the flow sensor facing up and all flow rings removed. Place a straightedge (such as a heavy yardstick on edge) across the inlet of the fan. Use a ruler to measure the distance from the bottom of the straightedge to the tip of the motor bearing's domed cover (see diagram #2 below). This distance should be in the range of 5/8th to 7/8th of an inch. If the flow sensor is within this range, the fan passes this part of the field check procedure. If the flow sensor is not in the proper position, contact The Energy Conservatory for further instructions.

Diagram #1 (Model 3 Blower Door Fan)

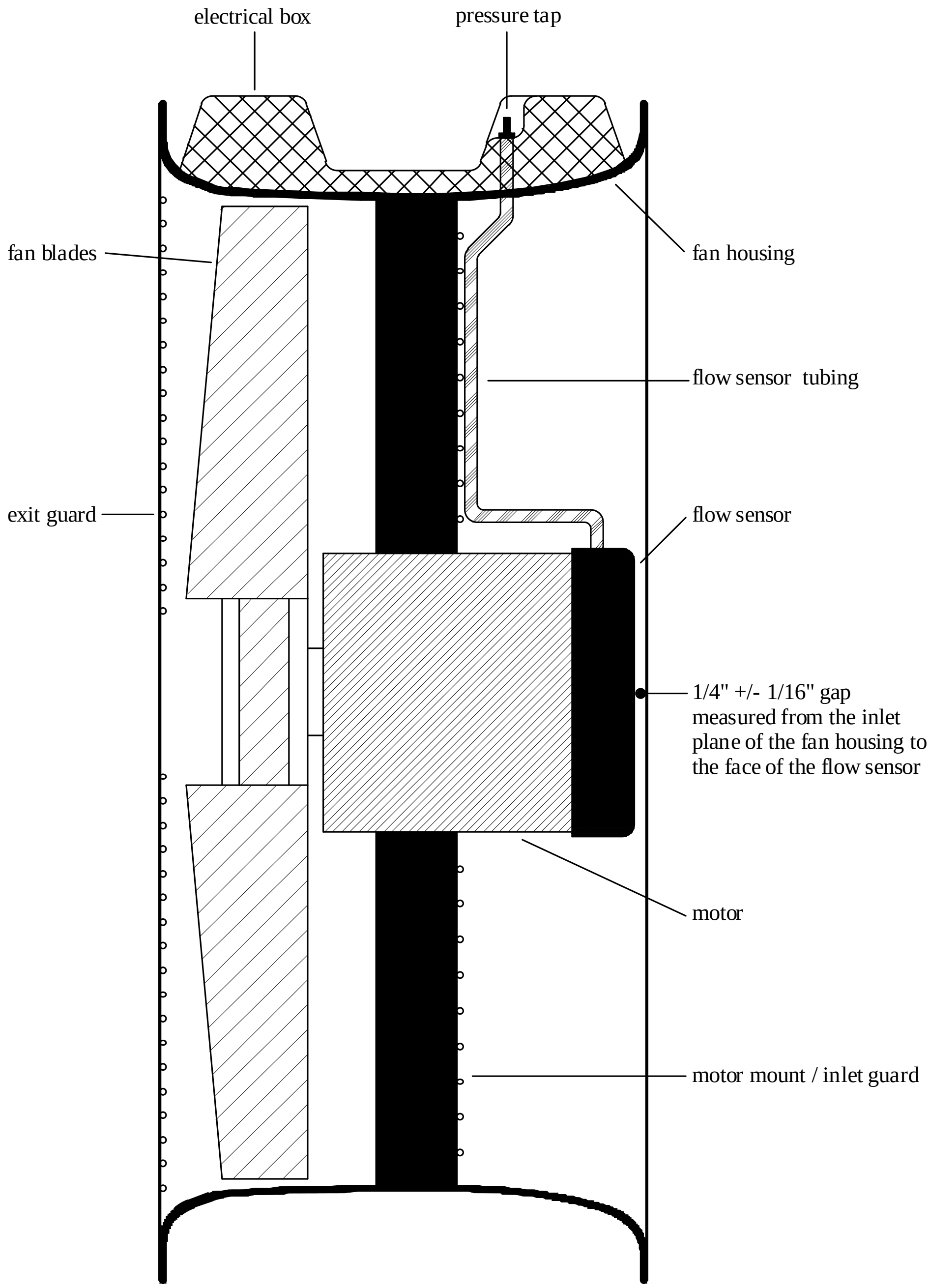
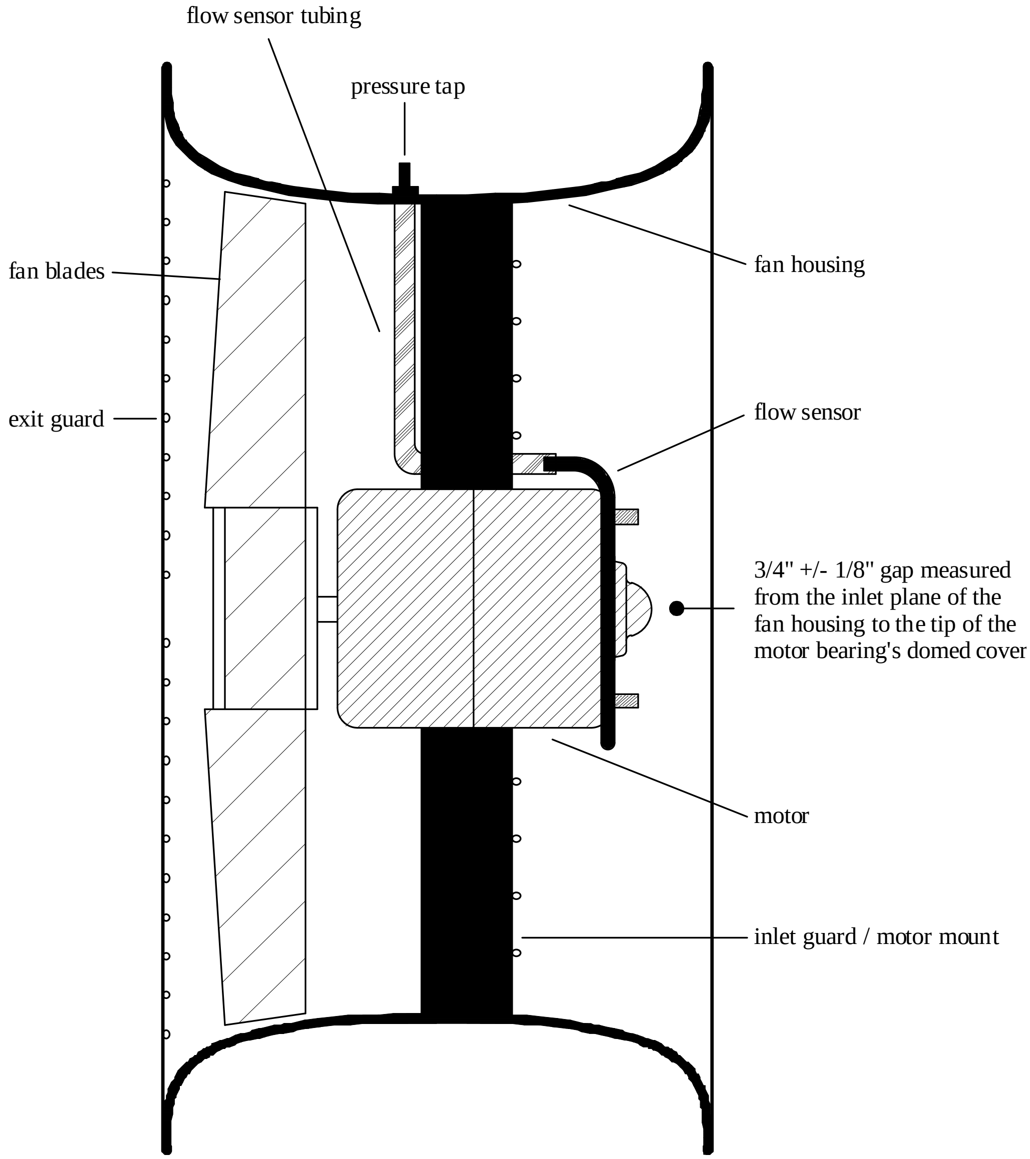


Diagram #2 (Series B Duct Blaster Fan)



4. Other Issues Affecting the Accuracy of Fan Flow Measurements

a. Model 3 Blower Door Fan

Upstream Air Flow Conditions:

The calibration for all Blower Door fans are slightly sensitive to upstream air flow conditions (e.g. orientation of walls, doors, stairs etc. relative to the fan inlet). This is particularly true when measurements are taken using the “open fan” configuration. As a result, follow these simple rules whenever possible.

- It is always best to install the fan in a doorway leading to a large open room. Try to avoid installing the fan in a doorway where there are stairways or major obstructions to air flow very close (1-5 feet) to the fan inlet.
- If the fan must be installed next to a stairway or major obstruction, it is best to take measurements using one of the Flow Rings and not “open fan”.
- Always open the inside door and outside storm door as much as possible during the Blower Door test to prevent restrictions to air flow.

Operating Under High Backpressure Conditions:

Note: For most testing applications, backpressure is not a concern and can be ignored.

The term "backpressure" is used to describe the pressure that the Blower Door fan is working against when it is running. Backpressure is determined by measuring the static pressure difference between the air directly upstream of the fan, and the air directly exiting the fan.

Under typical testing applications, the backpressure seen by the fan is simply the test pressure at which the building airtightness measurement is being measured made (e.g. 50 Pascals). However, there are applications where the Blower Door fan could see backpressures that are greater than the test pressure. For example, if the Blower Door fan is exhausting air into a confined area (such as an attached porch), it is possible that the porch area could become pressurized relative to outside creating a backpressure condition that is greater than the test pressure. Although the Blower Door 's flow sensor was designed to be affected as little as possible by variations in backpressure, under certain high backpressure operating conditions (described below) the calibration of the fan can degrade.

High Backpressure Conditions

Model 3 fans can be used in testing applications with backpressures up to 80 Pascals with no significant effect on calibration accuracy. This is true for all fan flow configurations (Open through Ring E), provided that the fan is operated within the accepted flow range for each configuration. Backpressures above 80 Pa can diminish the accuracy of the fan calibration and should be avoided.

b. Series B Duct Blaster Fan

Upstream Air Flow Conditions:

- When using the Duct Blaster fan to conduct a duct leakage depressurization test (i.e. the flex duct is connected to the inlet side of the fan), always position the fan so that the flex duct is stretched relatively straight for about 4 feet in front of the fan.
- When the fan inlet is open to the room, try to install the fan so that there is not a large obstruction within 2 feet in front of the fan.

Operating Under High Backpressure Conditions:

Note: For most testing applications, backpressure is not a concern and can be ignored.

The term "backpressure" is used to describe the pressure that the Duct Blaster fan is working against when it is running. Backpressure is determined by measuring the static pressure difference between the air directly upstream of the fan, and the air directly exiting the fan. High backpressures are typically caused by a large restriction between the Duct Blaster fan and the location where the test pressure is being made.

Although the Duct Blaster's flow sensor was carefully designed to be affected as little as possible by variations in backpressure, under certain very high backpressure operating conditions (described below) the calibration of the fan can degrade.

High Backpressure Conditions

Series B Duct Blaster fans can be used in most testing applications with backpressures up to 100 Pascals with no significant effect on calibration accuracy. This is true for all fan flow configurations (Open through Ring 3), provided that the fan is operated within the accepted flow range for each configuration. The only exception to this rule is for flow measurements below 20 CFM (Ring 3 will measure down to 10 CFM). When measuring flows between 20 and 10 CFM using Ring 3, backpressures should be kept below 40 Pascals. Backpressures above these values can diminish the accuracy of the fan calibration and should be avoided.

One example of an application that could cause high backpressure is when the flexible extension duct is connected to a small, high resistance register. The high resistance register can cause the pressure in the flex duct to be very high (i.e. over 150 Pascals) even if the test pressure in the duct system is only 25 Pascals. Operating the Duct Blaster fan under these operating conditions is not advised. To avoid this problem:

- Always try to avoid connecting the Duct Blaster fan to the duct system using a relatively high resistance connection (such as a small supply register).
- If you are using a high resistance connection and suspect a high backpressure condition, try to measure the backpressure. If the measured backpressure is less than the values listed above, then there should not be a problem. If the flexible extension duct is being used, the backpressure can be easily determined by measuring the pressure difference between the room where the Duct Blaster fan is installed and pressure inside the flex duct (measured from the plastic tap on the round transition piece).

5. General Maintenance Information for Model 3 Blower Door and Series B Duct Blaster Fans

a. Model 3 Blower Door Fan

- Examine the motor cooling holes for excessive dust build-up. Use a vacuum with a brush attachment to remove dust, or blow out the dust with compressed air.
- Inspect housing, blades and guards. Especially note clearance of blade tips relative to the fan housing. There should be about 1/4 inch of clearance.
- Inspect electrical wiring and electrical connections on the fan and the fan speed controller.
- Do not reverse the fan (using the flow direction switch) while the blades are turning. Turn off the fan and wait for it to come to a complete stop before reversing the flow direction.
- For long-term operation, such as maintaining house pressure while air-sealing, use a Flow Ring whenever possible to ensure good airflow over the fan. This will minimize the heating of the fan and is especially important in warmer weather. In particular, do not operate the fan for long periods of time on low speed with open fan.
- Do not run the fan for long periods of time in reverse.
- If the motor gets too hot, it may experience a shut-down due to the thermal overload protection. If this happens, make sure to turn off the controller so that the fan does not restart unexpectedly after it cools down.
- Make sure to press the power plug firmly into the power receptacle on the fan. Failure to do so can cause overheating of the power cord and possible damage.
- Do not use ungrounded outlets or adapter plugs.
- The fan should not be left running unattended.
- Do not operate if the motor, controller or any of the electrical connections are wet.
- Keep people and pets away from the fan when it is operating.
- If the fan housing, fan guards, blade, controller or cords become damaged, do not operate the fan until repairs have been made.

b. Series B Duct Blaster Fan

- Examine the motor cooling holes for excessive dust and dirt build-up. Use a vacuum with a brush attachment to remove dust, or blow out the dust with compressed air.
- Inspect housing, blades and guards. Especially note clearance of blade tips relative to the fan housing. There should be about 1/4 to 1/8 inch of clearance.
- Inspect electrical wiring and electrical connections on the fan and the fan speed controller.
- The Duct Blaster fan motor is not a continuous duty motor and should not be run for extended periods of time (more than 2 hours at one time).
- The fan should not be left running unattended.
- Do not use ungrounded outlets or adapter plugs.
- Do not operate if the motor, controller or any of the electrical connections are wet.
- Keep people and pets away from the fan when it is operating.
- If the fan housing, fan guards, blade, controller or cords become damaged, do not operate the fan until repairs have been made.

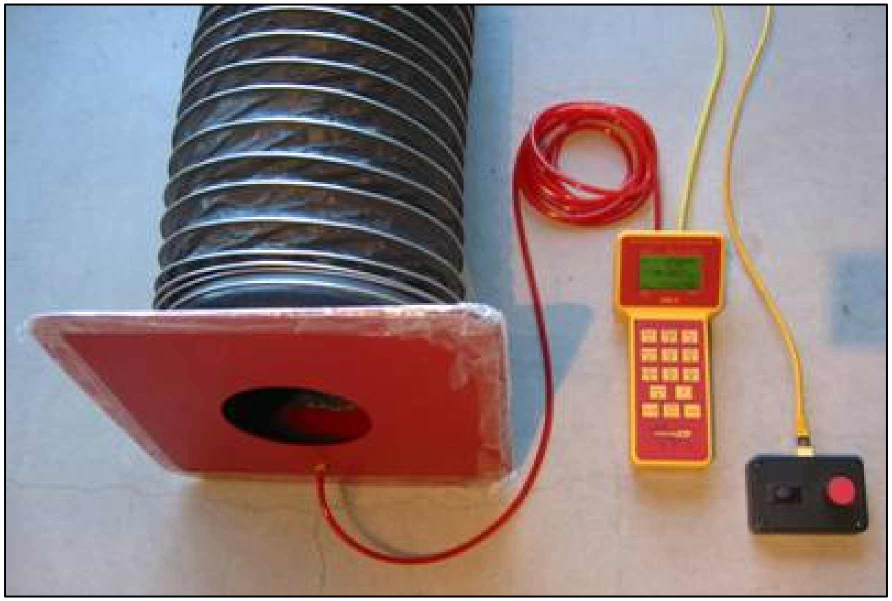
Field Check Form
Model 3 Blower Door and Series B Duct Blaster Fans

Company: ____

Fan Model (circle)	Serial Number	Date	Technician	Passed Flow Sensor Leakage Test?	Passed Flow Sensor Position Test?
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No
Model 3 Blower Door Series B Duct Blaster				Yes No	Yes No

Retrotec

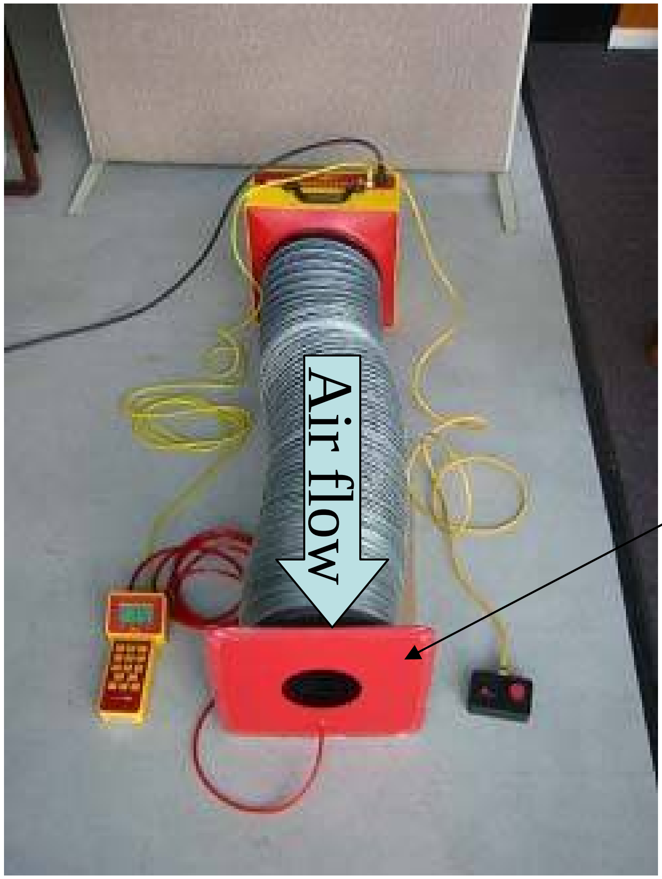
Duc-Tester Field Calibration Check



Use this 5 minute check to verify each new Duc-Tester and operator. Repeat every month or after 20 tests to detect problems early. If readings fall outside the specified range, use the Problem/Solution Checklist to fix the problem. No further calibration of the system is ever required unless the Duc-Tester fails this Check.

Problems causing inaccurate readings in order of frequency are:

#	Problem	Problem Frequency	Typical error	Details
1.	Wrong Range Configuration or Device	Constant	-80% to +400%	Setting the Digital Gauge to the wrong Range Config or Device is the most common error. Often occurs just after a change of Range or Device.
2.	Tubing Connections incorrect	Sometimes	20%	Especially for pressurizing houses and depressurizing ducts, tubes are hooked up incorrectly most of the time.
3.	Plugged tubes	Seldom	20% to 200%	Wide range of errors but not that common.
4.	Leaking tubes	Less Seldom	10% to 50%	Wide range of errors but not that common. Usually the pressure source will restore some leaked away air but if excessive, pressure indications will fall.
5.	Flex duct leaking	Slow degradation	1% to 25%	Very common but small. Always there to some degree. This procedure will identify a leaking duct so it may be patched with duct tape.
6.	gauge channels read differently	Rare	1% to 20%	One of 2 channels reading differently. Uncommon but could be a big error. If both channels have an identical error, the effect on the result is negligible.
7.	Gauge won't zero	Rare	1% to 5%	One of 2 channels reading differently. Uncommon but could be a big error. If both channels have an identical error, the effect on the result is negligible. It is the difference between the channels that causes the errors.



Retrotec

Duc-Tester
Field Calibration Check

for pressurization

Tape on the Plate (calibrated for 104 cfm at 25 Pa).

Measure the flow rate at 25 Pa.

Detailed Duc-Tester Pressurization Field Calibration Check Procedure

Tape the Field Calibration Plate to the flex duct flange & attach the red tube.

Attach the flex-duct to the outlet side to pressurize the duct. Install the Mid flow ring.

Connect up as if you were testing a duct.

Set to "Flow @ 25 Pa", time averaging to 8 seconds. Adjust the speed until PrA reads close to 25 Pa. Allow the flex duct to straighten out to its full length.

Wait for 30 seconds after fan speed stabilizes.

Depressurization

is the same as Pressurization except the flex-duct is mounted on the Duc-Tester inlet.

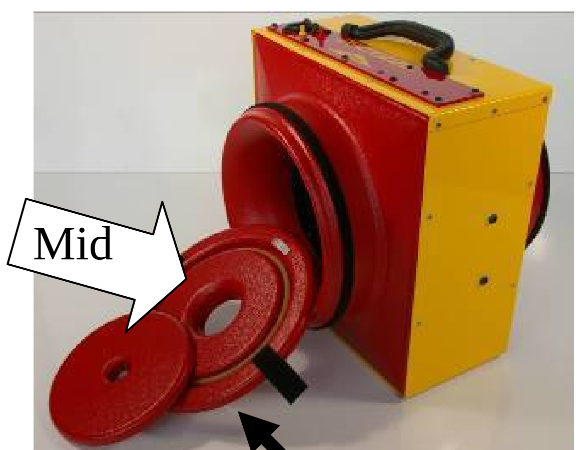
Gauge Model ____ Serial # _________	Fan model Serial # _______		97 to 106 cfm is a Pass	Field Calibration Plate for Duc-Tester, 100 cfm @25 Pa. Part number DU-159
Date of Verification	Technician	CFM @ 25 Pa result on Range _	P= pressurize D= depressurize	Comments

Duc-Tester Problem/Solution Checklist

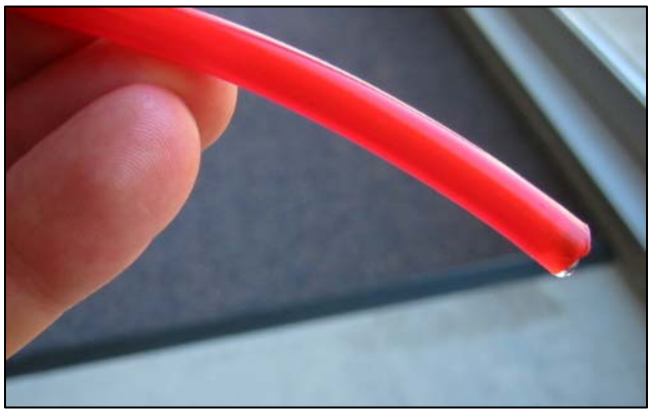
Record results.

If Flow is less than 97cfm and greater than 106 cfm, use the Problem/Solution Checklist.

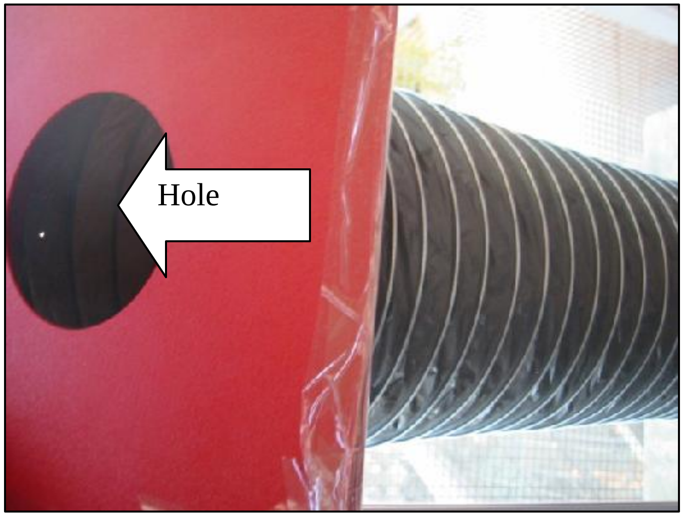
Note: even though the accuracy is within 3% of measured flow, this is a calibration check to see if something is wrong.

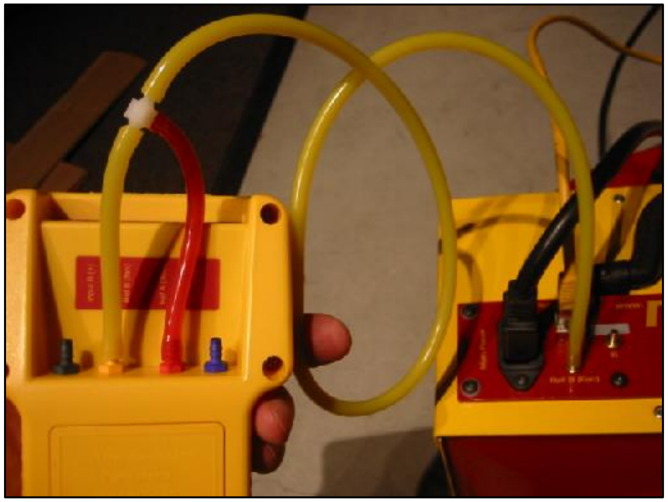
#	Problem	Solution	Details
1	Wrong Range Configuration or Device	DM-2 "Range Config" must be set to Mid,  the Device must be set to "DU200"  Ensure the Mid sized flow ring is mounted.	For the Verification test the Range Configuration must be set on the DM-2 to "Mid" and the Device set to "DU200". The Mid sized low flow plate must be installed. Getting one of these 3 settings wrong, is the most common error. Incorrectly setting the Range Configuration will result in a -80% error for setting it one range to low to +400% error for setting it one range too high. Setting the Device incorrectly would give a wide range of errors. All large. The DM-2 retains its previous settings when turned off. If the range changes or the DM-2 is used on a different Device then these settings must be changed also. Always mark down the range configuration and device used on a test form. If you always test on the Mid Range Configuration and always use the DU200 fan there is no problem but when you change ranges or use your DM-2 on your blower door, then forgetting to change these settings will be a massively largest source of error.

2	Tubing Connections incorrect	Ensure all tubes are connected properly. 	Red tube between Verification Plate (which is substituting for the duct leak) and the Blue port on DM-2. You can use the Red port but the duct pressure will show negative when pressurizing. Yellow tube between the “Ref B (Fan)” port on Duc-Tester and the yellow port on DM-2.

3	Plugged tubes	Watch for water in the tubes. 	One drop of water in any of the tubes will allow readings to be taken but they will be very inaccurate. Avoid letting any of the tubes be dragged through puddles of water and check them if water is dropped onto an tube end or gauge fitting. Tubes can be blown out with dry air or simply twirled around to eject the water by centrifugal force. Water drops in the Duc-Tester body can be blown out. Water in the gauge fittings require careful disassembly and should not be attempted. Tubes can also be twisted inside the equipment, causing restricted flow or may prevent pressure from being transmitted altogether. Do not attempt to repair this.

4	Leaking tubes	Check for leaking tubes.  	Leaking tubes are less of a problem since the tubes don't have to be perfectly tight to work properly. But, moderate leaks could degrade readings. Check this by blowing in the tubes and crimping them off with a vice grip or paper clip. Don't hold onto the tubes since heat will cause the pressure to increase. If the pressure drops more than 25% in a minute, the connections must be checked. Often cutting one eight of an inch of tubing off the end of a doubtful connection will solve the problem. Other times, putting an extremely small amount of silicone grease from a barely greasing finger will suffice to stop the leak.

5	Flex duct leaking	Check visually with bright light  	If the reading is above 106 cfm ensure the duct is not leaking. Tape up any holes from the inside if you pressurize ducts mostly. Smoke may be useful for finding leaks or try shining a light inside and notice where it leaks out in a darkened room. Or hold the duct up to the Sun and notice the light coming in as shown in this picture. This hole could not be seen otherwise.

6	One of 2 channels reading differently	Check one channel against the other.  	If the gauge is having a problem, normally one channel is OK. Compare the two to detect the problem. Run the Duc-Tester up to maximum speed on the Mid Range Configuration. Set Time Averaging to 8s. T the flow pressure signal from the Duc-Tester to the Yellow and Red ports of the DM-2. Compare Channel A & B at maximum pressure and 50 Pa. Differences of more than 2% require exchange or factory calibration. Now, move the tubes to the Green and Blue ports of the DM-2. Compare Channel A & B at maximum pressure and 50 Pa.

7	Gauge won't zero		Remove all tubes and see if the gauge will hold zero. Make sure Auto Zero is ON.

The above Solutions will fix most problems. If your Duc-Tester still fails the Verification Test, request an exchange or loaner from your distributor while yours is sent back to the factory.

Retrotec Blower-Door Field Calibration Check Procedure

Blower Doors can be tested in a similar fashion using larger calibration plates like the one shown.

Install your Aluminum frame in a small, tight room with the vents and exhaust fans taped shut. Install this panel in the upper hole. Alternatively, cut a piece of cardboard with a one foot by 3 foot hole in it, centered in above the fan.

Measure the background leakage. Measure the increased leakage with the hole open. The Blower Door should be able to measure the difference within 15% otherwise something may be wrong. Follow a procedure similar to the one outlined in the **Duc-Tester Problem/Solution Checklist**

CHEERS

Unmatched Service with Integrity

FIELD GUIDE

DUCT LEAKAGE (New or Complete Replacement Systems)

- **Hook up the duct blaster in the same manner as explained in the duct leakage section, slides 47-50 for total duct leakage and slides 57-62 for Leakage to Outside.**
- **Is CFI ventilation installed in the system? If so, do not tape shut.**
- **Decide what method you will use to determine the nominal airflow.**

☐ Cooling (AC Tonnage x 400) ☐ Heating (Furnace KBTU x 21.7) ☐ Measured Airflow Method

TEST RESULTS

Nominal Airflow:	
Measured Airflow (CFM):	
Leakage %:	(Measured Airflow / Nominal Airflow) x 100=

Case	User Application	Leakage Compliance Criteria (% of Air Handler Airflow)	Procedure(s)
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Final HERS Rater Testing	6%	RA3.1.4.3.1
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Rough-in, Air Handling Unit Installed	6% Installer Inspection at Final	RA3.1.4.3.2 RA3.1.4.3.2.1 RA3.1.4.3.3
Sealed and tested new duct systems in single family homes and townhomes	Installer Testing at Rough-in, Air Handling Unit Not Installed	4% Installer Inspection at Final	RA3.1.4.3.2 RA3.1.4.3.2.2 RA3.1.4.3.3
Sealed and tested new duct systems in multi-family homes regardless of duct system location.	Installer Testing at Final HERS Rater Testing	12%Total Duct Leakage	RA3.1.4.3.1
Sealed and tested new duct systems in multi-family homes regardless of duct system location.	Installer Testing at Final HERS Rater Testing	6% Leakage to Outside	RA3.1.4.3.4

- **Complete all visual verifications as explained in duct leakage section, slides 45-46.**

☐ **PASS** ☐ **FAIL**

INFILTRATION TEST- Single Point Test

- **The single point test is the most commonly and widely used infiltration test by HERS Raters.**
- **Prepare the house as explained in the Building Air Leakage section, slides 11-29.**
- **Setup the blower door as explained in the Building Air Leakage section, slides 32-39.**
- **Conduct the single-point blower door test as explained in the Building Air Leakage, slides 44-59.**

TEST RESULTS

Target CFM50 *(From CF1R)*:	
Min. CFM50 *(From CF1R)*:	
Measured CFM50:	

☐ **PASS** *(Measured CFM50 is between Target and Minimum CFM50 = PASS)* ☐ **FAIL**

EER

- **Visually verify TXV if necessary.**
- **Visually verify time delay relay if necessary as explained in the HVAC Components and Devices Section, slides 13-14.**
- **Go to www.ahridirectory.org and verify the EER and AHRI number for the HVAC equipment.**

TEST RESULTS

	Installed Make	Installed Model
Furnace		
Condenser		
Coil		

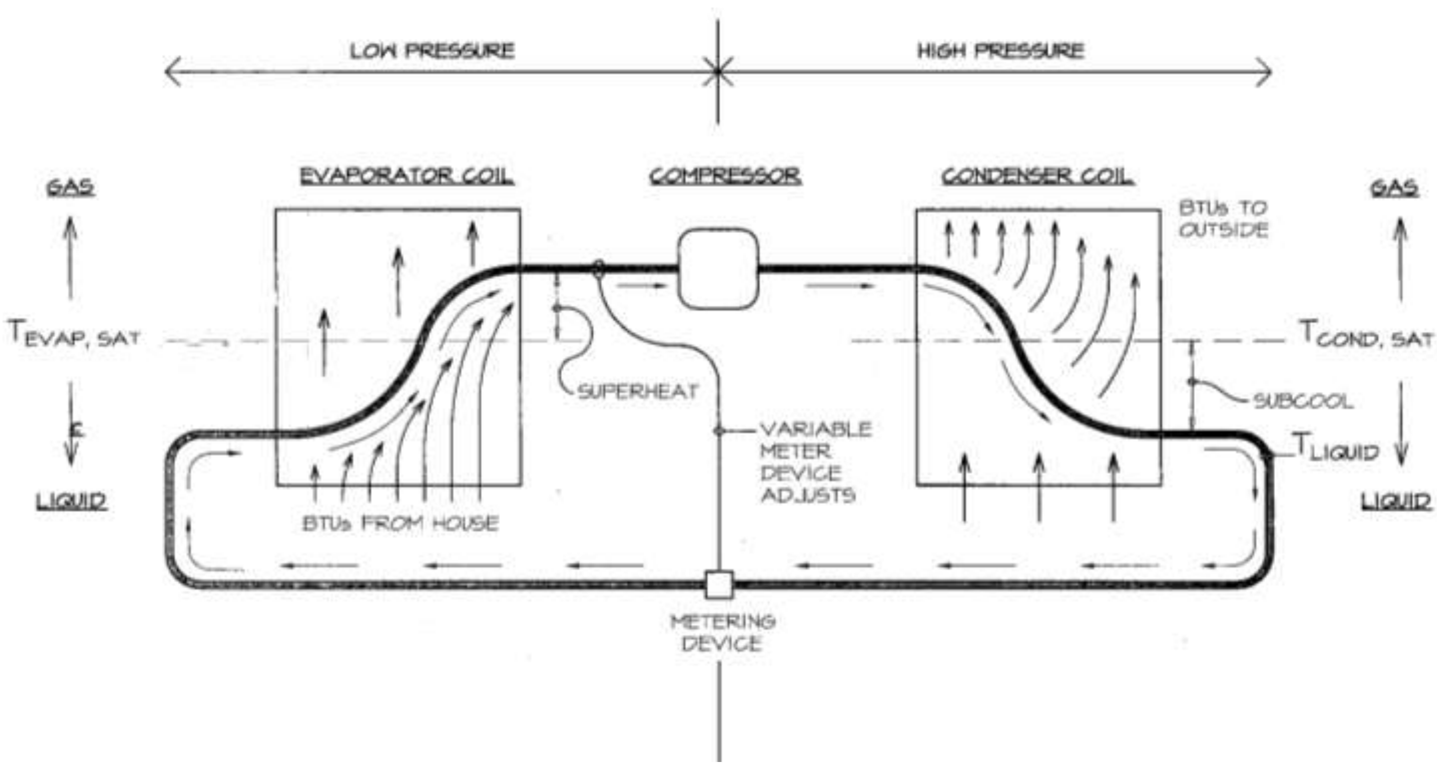
Target EER *(From CF1R)*	**Actual EER**	**AHRI Cert #** *(From AHRI Website)*

☐ **PASS** *(Actual EER matches or exceeds Target EER= PASS)* ☐ **FAIL**

ADEQUATE AIRFLOW	
- **The nominal airflow will be determined by multiplying the AC tonnage by 400 for new or complete replacement systems, or by 350 for altered systems** - **Visually verify HSPP or PSPP probes are installed to standard** - **Visually verify either bypass ducts are installed or not, compared to the CF1R.** - **Conduct airflow test with one of the approved procedures explained in the Forced Air System, Fan Watt Draw and Fan Efficacy section, slides 22-57**	
TEST RESULTS	
Nominal Airflow:	(AC tonnage x 400) new, (AC tonnage x 350) altered=
Measured Airflow:	
☐ **PASS** *(Probes are installed to standard and measured airflow $\geq$ nominal airflow*= *PASS)* ☐ **FAIL**	

FAN WATT DRAW	
- **Measure the watt draw with one of the approved procedures explained in the Forced Air System, Fan Watt Draw and Fan Efficacy section, slides 60-79** - **The target Watt Draw will be specified by the CF1R. The default maximum is .58 w/cfm**	
TEST RESULTS	
Watt/CFM Requirement *(From CF1R)*:	
Measured Airflow:	From the previously measured Airflow
Measured Watts:	
Measured Watt/CFM:	(Measured Watts/Measured Airflow)=
☐ **PASS** *(Measured Watt/CFM $\leq$ Watt/CFM requirement = PASS)* ☐ **FAIL**	

THE REFRIGERATION CYCLE



REFRIGERANT CHARGE (New or Complete Replacement Systems)

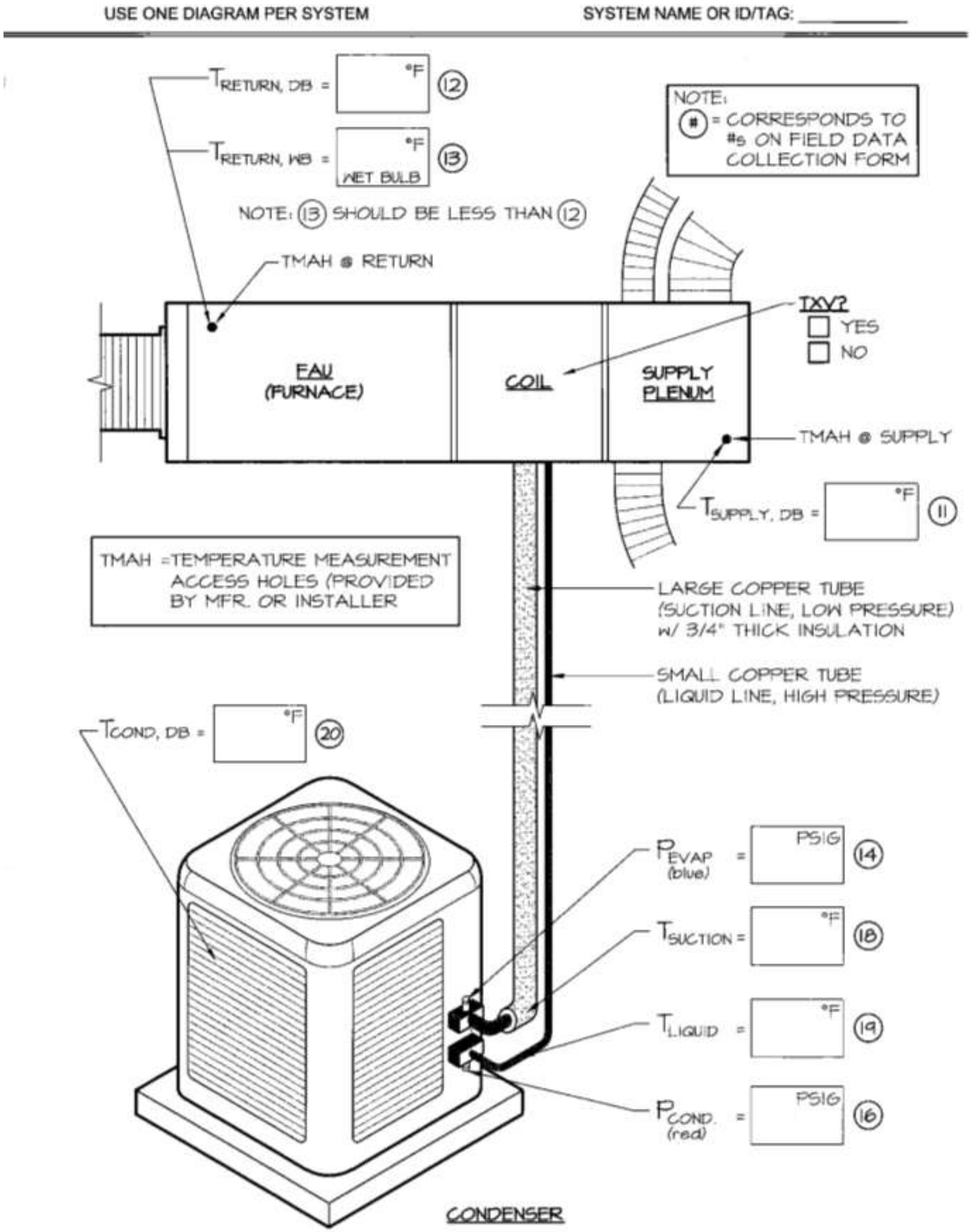
- **The outdoor temperature for a standard RC verification has to be 55F or above, if not, the weigh-in observation procedure has to be used**
- **Measurement Access Holes (MAH) have to be present as explained in the Refrigerant Charge Section, slides 24-27**
- **Conduct the standard verification procedure as explained in the Refrigerant Charge Section, slides 41-68**
- **Alternatively, observe the weigh-in procedure as explained in the Refrigerant Charge Section, slides 77-87**
- **Use the quick reference worksheet below to collect all data necessary for the standard RC verification.**

	Space Conditioning System	Notes			
1	System Name or Identification/Tag	Create name or ask (e.g. AC-1)			
2	System Location or Area Served	Describe			
3	Outdoor Unit Serial #	From Condenser			
4	Outdoor Unit Make	From Condenser			
5	Outdoor Unit Model	From Condenser			
6	Nominal Cooling Capacity Btu/hr	Tons X 12000			
7	Date of Verification	Date of Test			

	Calibration of Diagnostic Instruments	Notes			
8	Date of Refrigerant Gauge Calibration	Less than 1 month ago		(must be re-calibrated monthly)	
9	Date of Thermocouple Calibration	Less than 1 month ago		(must be re-calibrated monthly)	

	Measured Temperatures (°F)	Notes			
10	System Name or Identification/Tag	See Diagram			
11	Supply (evaporator leaving) air dry-bulb temperature ($T_{supply,db}$)	See Diagram			
12	Return (evaporator entering) air dry-bulb temperature ($T_{return,db}$)	See Diagram			
13	Return (evaporator entering) air wet-bulb temperature ($T_{return,wb}$)	See Diagram			
14	Evaporator saturation pressure (P_{evap}) from BLUE low side gauge	See Diagram			
15	Evaporator saturation temperature ($T_{Evap,sat}$)	From P/T Table and #14 or STMS			
16	Condenser saturation pressure ($P_{condenser}$) from RED high side gauge	See Diagram			
17	Condenser saturation temperature ($T_{condenser,sat}$)	From P/T Table and #16 or STMS			
18	Suction line temperature ($T_{suction}$)	See Diagram			
19	Liquid line temperature (T_{liquid})	See Diagram			
20	Condenser (entering) air dry-bulb temperature ($T_{condenser,db}$)	See Diagram			

- **Use the following worksheet to determine the collection points for each line items 11-14, 16, and 18-20**



- **Use the Pressure/Temperature Chart below to determine items 15 and 17.**

Pressure-Temperature Chart for R-410A and R-22

°F	R-410A	R-22	°F	R-410A	R-22	°F	R-410A	R-22	°F	R-410A	R-22
-40	10.8	0.6	10	62.2	32.8	60	169.6	101.6	110	364.1	226.4
-39	11.5	1.0	11	63.7	33.8	61	172.5	103.5	111	369.1	229.6
-38	12.1	1.4	12	65.2	34.8	62	175.4	105.4	112	374.2	232.8
-37	12.8	1.8	13	66.8	35.8	63	178.4	107.3	113	379.4	236.1
-36	13.5	2.2	14	68.3	36.8	64	181.5	109.3	114	384.6	239.4
-35	14.2	2.6	15	69.9	37.8	65	184.5	111.2	115	389.9	242.8
-34	14.9	3.1	16	71.5	38.8	66	187.6	113.2	116	395.2	246.1
-33	15.6	3.5	17	73.2	39.9	67	190.7	115.3	117	400.5	249.5
-32	16.3	4.0	18	74.9	40.9	68	193.9	117.3	118	405.9	253.0
-31	17.1	4.5	19	76.6	42.0	69	197.1	119.4	119	411.4	256.5
-30	17.8	4.9	20	78.3	43.1	70	200.4	121.4	120	416.9	260.0
-29	18.6	5.4	21	80.0	44.2	71	203.6	123.5	121	422.5	263.5
-28	19.4	5.9	22	81.8	45.3	72	207.0	125.7	122	428.2	267.1
-27	20.2	6.4	23	83.6	46.5	73	210.3	127.8	123	433.9	270.7
-26	21.1	6.9	24	85.4	47.6	74	213.7	130.0	124	439.6	274.3
-25	21.9	7.4	25	87.2	48.8	75	217.1	132.2	125	445.4	278.0
-24	22.7	8.0	26	89.1	50.0	76	220.6	134.5	126	451.3	281.7
-23	23.6	8.5	27	91.0	51.2	77	224.1	136.7	127	457.3	285.4
-22	24.5	9.1	28	92.9	52.4	78	227.7	139.0	128	463.2	289.2
-21	25.4	9.6	29	94.9	53.7	79	231.3	141.3	129	469.3	293.0
-20	26.3	10.2	30	96.8	55.0	80	234.9	143.6	130	475.4	296.9
-19	27.2	10.8	31	98.8	56.2	81	238.6	146.0	131	481.6	300.8
-18	28.2	11.4	32	100.9	57.5	82	242.3	148.4	132	487.8	304.7
-17	29.2	12.0	33	102.9	58.8	83	246.0	150.8	133	494.1	308.7
-16	30.1	12.6	34	105.0	60.2	84	249.8	153.2	134	500.5	312.6
-15	31.1	13.2	35	107.1	61.5	85	253.7	155.7	135	506.9	316.7
-14	32.2	13.9	36	109.2	62.9	86	257.5	158.2	136	513.4	320.7
-13	33.2	14.5	37	111.4	64.3	87	261.4	160.7	137	520.0	324.8

- **Airflow has to be verified as explained in the Refrigerant Charge Section, slides 29 for new systems**

	Minimum Airflow Requirement	Notes			
	Temperature Split Method Calculations for determining Minimum Airflow Requirements for Refrigerant Charge Verification. The temperature split method is specified in Reference Residential Appendix RA3.2.				
21	System Name or Identification/Tag	Same as Line 1			
22	Calculate: Actual Temperature Split = $T_{return,db} - T_{supply,db}$	Line 12 - Line 11			
23	Target Temperature Split from Table RA3.2-3 using $T_{return,wb}$ & $T_{return,db}$	Line 13 & Line 12 Go to Table			
24	Calculate difference: Actual Temperature Split - Target Temp. Split =	Line 22 - Line 23			
25	Passes if difference is between -4°F and +4°F or upon remeasurement, if between -4°F and -100°F **Enter Pass or Fail**	High temp split usually means low airflow Line 24 ≤ 4 = Pass			
	Note: Temperature Split Method Calculation is not necessary if actual Cooling Coil Airflow is verified using one of the airflow measurement procedures specified in Reference Residential Appendix RA3.3 If actual cooling coil airflow is measured, the value must be equal to or greater than Calculated Minimum Airflow Requirement in the table below.				

	Calculated Minimum Airflow Requirement (CFM) = Nominal Cooling Capacity (ton) X 400 for new systems				
26	System Name or Identification/Tag				
27	Calculated Minimum Airflow Requirement (CFM)	Tons X 400			
28	Measured Airflow using RA3.3 procedures (CFM)	flow hood, flow grid or plenum pressure match			
29	Passes if measured airflow is greater than or equal to the calculated minimum airflow requirement. **Enter Pass or Fail**	Line 28 ≥ Line 27 = Pass			

- **The Superheat calculation method will be used for fixed metering device systems (NO TXV)**

Superheat Charge Method Calculations for Refrigerant Charge Verification. This procedure is required to be used for fixed orifice metering device systems.					
(30)	System Name or Identification/Tag				
(31)	Calculate: Actual Superheat = $T_{suction} - T_{evaporator,\ sat}$	Line 18 - Line 15			
(32)	Target Superheat from Table RA3.2-2 using $T_{return,wb}$ & $T_{condenser,db}$	Line 13 & Line 20 Go to Table			
(33)	Calculate difference: Actual Superheat - Target Superheat	Line 31 - Line 32			
(34)	System passes if difference is between -6°F and +6°F **Enter Pass or Fail**	-6 ≤ Line 33 ≤ 6 = Pass			

- **For the superheat method use the following tables to determine item 32 above**

2013 Residential Appendices *RA3-25*

Table RA3.2-2 Target Superheat (Suction Line Temperature - Evaporator Saturation Temperature)

Condenser Air Dry-Bulb Temperature (°F) (T condenser, db)	Return Air Wet-Bulb Temperature (°F) (T return, wb)																										
	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
55	8.8	10.1	11.5	12.8	14.2	15.6	17.1	18.5	20.0	21.5	23.1	24.6	26.2	27.8	29.4	31.0	32.4	33.8	35.1	36.4	37.7	39.0	40.2	41.5	42.7	43.9	45.0
56	8.6	9.9	11.2	12.6	14.0	15.4	16.8	18.2	19.7	21.2	22.7	24.2	25.7	27.3	28.9	30.5	31.8	33.2	34.6	35.9	37.2	38.5	39.7	41.0	42.2	43.4	44.6
57	8.3	9.6	11.0	12.3	13.7	15.1	16.5	17.9	19.4	20.8	22.3	23.8	25.3	26.8	28.3	29.9	31.3	32.6	34.0	35.3	36.7	38.0	39.2	40.5	41.7	43.0	44.2
58	7.9	9.3	10.6	12.0	13.4	14.8	16.2	17.6	19.0	20.4	21.9	23.3	24.8	26.3	27.8	29.3	30.7	32.1	33.5	34.8	36.1	37.5	38.7	40.0	41.3	42.5	43.7
59	7.5	8.9	10.2	11.6	13.0	14.4	15.8	17.2	18.6	20.0	21.4	22.9	24.3	25.7	27.2	28.7	30.1	31.5	32.9	34.3	35.6	36.9	38.3	39.5	40.8	42.1	43.3
60	7.0	8.4	9.8	11.2	12.6	14.0	15.4	16.8	18.2	19.6	21.0	22.4	23.8	25.2	26.6	28.1	29.6	31.0	32.4	33.7	35.1	36.4	37.8	39.1	40.4	41.6	42.9
61	6.5	7.9	9.3	10.7	12.1	13.5	14.9	16.3	17.7	19.1	20.5	21.9	23.3	24.7	26.1	27.5	29.0	30.4	31.8	33.2	34.6	35.9	37.3	38.6	39.9	41.2	42.4
62	6.0	7.4	8.8	10.2	11.7	13.1	14.5	15.9	17.3	18.7	20.1	21.4	22.8	24.2	25.5	27.0	28.4	29.9	31.3	32.7	34.1	35.4	36.8	38.1	39.4	40.7	42.0
63	5.3	6.8	8.3	9.7	11.1	12.6	14.0	15.4	16.8	18.2	19.6	20.9	22.3	23.6	25.0	26.4	27.8	29.3	30.7	32.2	33.6	34.9	36.3	37.7	39.0	40.3	41.6
64	-	6.1	7.6	9.1	10.6	12.0	13.5	14.9	16.3	17.7	19.0	20.4	21.7	23.1	24.4	25.8	27.3	28.7	30.2	31.6	33.0	34.4	35.8	37.2	38.5	39.9	41.2
65	-	5.4	7.0	8.5	10.0	11.5	12.9	14.3	15.8	17.1	18.5	19.9	21.2	22.5	23.8	25.2	26.7	28.2	29.7	31.1	32.5	33.9	35.3	36.7	38.1	39.4	40.8
66	-		6.3	7.8	9.3	10.8	12.3	13.8	15.2	16.6	18.0	19.3	20.7	22.0	23.2	24.6	26.1	27.6	29.1	30.6	32.0	33.4	34.9	36.3	37.6	39.0	40.4
67	-	-	5.5	7.1	8.7	10.2	11.7	13.2	14.6	16.0	17.4	18.8	20.1	21.4	22.7	24.1	25.6	27.1	28.6	30.1	31.5	33.0	34.4	35.8	37.2	38.6	39.9
68	-	-	-	6.3	8.0	9.5	11.1	12.6	14.0	15.5	16.8	18.2	19.5	20.8	22.1	23.5	25.0	26.5	28.0	29.5	31.0	32.5	33.9	35.3	36.8	38.1	39.5
69	-	-	-	5.5	7.2	8.8	10.4	11.9	13.4	14.8	16.3	17.6	19.0	20.3	21.5	22.9	24.4	26.0	27.5	29.0	30.5	32.0	33.4	34.9	36.3	37.7	39.1
70	-	-	-	-	6.4	8.1	9.7	11.2	12.7	14.2	15.7	17.0	18.4	19.7	20.9	22.3	23.9	25.4	27.0	28.5	30.0	31.5	33.0	34.4	35.9	37.3	38.7
71	-	-	-	-	5.6	7.3	8.9	10.5	12.1	13.6	15.0	16.4	17.8	19.1	20.3	21.7	23.3	24.9	26.4	28.0	29.5	31.0	32.5	34.0	35.4	36.9	38.3
72	-	-	-	-	-	6.4	8.1	9.8	11.4	12.9	14.4	15.8	17.2	18.5	19.7	21.2	22.8	24.3	25.9	27.4	29.0	30.5	32.0	33.5	35.0	36.5	37.9
73	-	-	-	-	-	5.6	7.3	9.0	10.7	12.2	13.7	15.2	16.6	17.9	19.2	20.6	22.2	23.8	25.4	26.9	28.5	30.0	31.5	33.1	34.6	36.0	37.5
74	-	-	-	-	-	-	6.5	8.2	9.9	11.5	13.1	14.5	15.9	17.3	18.6	20.0	21.6	23.2	24.8	26.4	28.0	29.5	31.1	32.6	34.1	35.6	37.1
75	-	-	-	-	-	-	5.6	7.4	9.2	10.8	12.4	13.9	15.3	16.7	18.0	19.4	21.1	22.7	24.3	25.9	27.5	29.1	30.6	32.2	33.7	35.2	36.7
76	-	-	-	-	-	-	-	6.6	8.4	10.1	11.7	13.2	14.7	16.1	17.4	18.9	20.5	22.1	23.8	25.4	27.0	28.6	30.1	31.7	33.3	34.8	36.3
77	-	-	-	-	-	-	-	5.7	7.5	9.3	11.0	12.5	14.0	15.4	16.8	18.3	20.0	21.6	23.2	24.9	26.5	28.1	29.7	31.3	32.8	34.4	36.0
78	-	-	-	-	-	-	-	-	6.7	8.5	10.2	11.8	13.4	14.8	16.2	17.7	19.4	21.1	22.7	24.4	26.0	27.6	29.2	30.8	32.4	34.0	35.6
79	-	-	-	-	-	-	-	-	5.9	7.7	9.5	11.1	12.7	14.2	15.6	17.1	18.8	20.5	22.2	23.8	25.5	27.1	28.8	30.4	32.0	33.6	35.2
80	-	-	-	-	-	-	-	-	-	6.9	8.7	10.4	12.0	13.5	15.0	16.6	18.3	20.0	21.7	23.3	25.0	26.7	28.3	29.9	31.6	33.2	34.8
81	-	-	-	-	-	-	-	-	-	6.0	7.9	9.7	11.3	12.9	14.3	16.0	17.7	19.4	21.1	22.8	24.5	26.2	27.9	29.5	31.2	32.8	34.4
82	-	-	-	-	-	-	-	-	-	5.2	7.1	8.9	10.6	12.2	13.7	15.4	17.2	18.9	20.6	22.3	24.0	25.7	27.4	29.1	30.7	32.4	34.0
83	-	-	-	-	-	-	-	-	-	-	6.3	8.2	9.9	11.6	13.1	14.9	16.6	18.4	20.1	21.8	23.5	25.2	26.9	28.6	30.3	32.0	33.7
84	-	-	-	-	-	-	-	-	-	-	5.5	7.4	9.2	10.9	12.5	14.3	16.1	17.8	19.6	21.3	23.0	24.8	26.5	28.2	29.9	31.6	33.3
85	-	-	-	-	-	-	-	-	-	-	-	6.6	8.5	10.3	11.9	13.7	15.5	17.3	19.0	20.8	22.6	24.3	26.0	27.8	29.5	31.2	32.9
86	-	-	-	-	-	-	-	-	-	-	-	5.8	7.8	9.6	11.3	13.2	15.0	16.7	18.5	20.3	22.1	23.8	25.6	27.3	29.1	30.8	32.6
87	-	-	-	-	-	-	-	-	-	-	-	5.0	7.0	8.9	10.6	12.6	14.4	16.2	18.0	19.6	21.6	23.4	25.1	26.9	28.7	30.4	32.2
88	-	-	-	-	-	-	-	-	-	-	-	-	6.3	8.2	10.0	12.0	13.9	15.7	17.5	19.3	21.1	22.9	24.7	26.5	28.3	30.1	31.8
89	-	-	-	-	-	-	-	-	-	-	-	-	5.5	7.5	9.4	11.5	13.3	15.1	17.0	18.8	20.6	22.4	24.3	26.1	27.9	29.7	31.5

Shaded area requires return plenum temperature of 70°F or higher.

Table RA3.2-2 Target Superheat (Suction Line Temperature - Evaporator Saturation Temperature)

		Return Air Wet-Bulb Temperature (°F) (T return, wb)																										
		50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76
Condenser Air Dry-Bulb Temperature (°F) (T condenser, db)	90	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	8.8	10.9	12.8	14.6	16.5	18.3	20.1	22.0	23.8	25.6	27.5	29.3	31.1
	91	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1	8.1	10.3	12.2	14.1	15.9	17.8	19.7	21.5	23.4	25.2	27.1	28.9	30.8
	92	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4	7.5	9.8	11.7	13.5	15.4	17.3	19.2	21.1	22.9	24.8	26.7	28.5	30.4
	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	9.2	11.1	13.0	14.9	16.8	18.7	20.6	22.5	24.4	26.3	28.2	30.1
	94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.7	10.6	12.5	14.4	16.3	18.2	20.2	22.1	24.0	25.9	27.8	29.7
	95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.6	8.1	10.0	12.0	13.9	15.8	17.8	19.7	21.6	23.6	25.5	27.4	29.4
	96	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.5	9.5	11.4	13.4	15.3	17.3	19.2	21.2	23.2	25.1	27.1	29.0
	97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.0	8.9	10.9	12.9	14.9	16.8	18.8	20.8	22.7	24.7	26.7	28.7
	98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	8.4	10.4	12.4	14.4	16.4	18.3	20.3	22.3	24.3	26.3	28.3
	99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.8	7.9	9.9	11.9	13.9	15.9	17.9	19.9	21.9	24.0	26.0	28.0
	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3	7.3	9.3	11.4	13.4	15.4	17.5	19.5	21.5	23.6	25.6	27.7
	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8	8.8	10.9	12.9	15.0	17.0	19.1	21.1	23.2	25.3	27.3
	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.3	10.4	12.4	14.5	16.6	18.6	20.7	22.8	24.9	27.0
	103	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.7	7.8	9.9	11.9	14.0	16.1	18.2	20.3	22.4	24.5	26.7
	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2	7.2	9.3	11.5	13.6	15.7	17.8	19.9	22.1	24.2	26.3
	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	8.8	11.0	13.1	15.2	17.4	19.5	21.7	23.8	26.0
	106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.3	10.5	12.6	14.8	17.0	19.1	21.3	23.5	25.7
	107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.7	7.9	10.0	12.2	14.4	16.6	18.7	21.0	23.2	25.4
	108	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2	7.4	9.5	11.7	13.9	16.1	18.4	20.6	22.8	25.1
	109	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.9	9.1	11.3	13.5	15.7	18.0	20.2	22.5	24.7
	110	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	8.6	10.8	13.1	15.3	17.6	19.9	22.1	24.4
	111	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9	8.1	10.4	12.6	14.9	17.2	19.5	21.8	24.1
	112	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.4	7.6	9.9	12.2	14.5	16.8	19.1	21.5	23.8
	113	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.2	9.5	11.8	14.1	16.4	18.8	21.1	23.5
	114	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.7	9.0	11.4	13.7	16.1	18.4	20.8	23.2
	115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.2	8.6	10.9	13.3	15.7	18.1	20.5	22.9

- **The Subcooling method will be used for thermostatic or electronic expansion device systems (TXV or EXV)**

Subcooling Charge Method Calculations for Refrigerant Charge Verification. This Procedure is required to be used for thermostatic expansion valve (TXV) and electronic expansion valve (EXV) systems.					
		Notes			
35	System Name or Identification/Tag	Same as Line 1			
36	Calculate: Actual Subcooling = $T_{condenser,sat} - T_{liquid}$	Line 17 - Line 19			
37	Target Subcooling specified by manufacturer	From Condenser			
38	Calculate difference: Actual Subcooling - Target Subcooling =	Line 36 - Line 37			
39	System Passes if difference is between -4°F and +4°F **Enter Pass or Fail**	-4 ≤ Line 38 ≤ 4 = Pass			

Metering Device Calculations for Refrigerant Charge Verification. This procedure is required to be used for thermostatic expansion valve (TXV) and electronic expansion valve (EXV) systems.					
40	System Name or Identification/Tag	Same as Line 1			
41	Calculate: Actual Superheat = $T_{suction} - T_{evaporator,sat}$	Line 18 - Line 15			
42	Enter allowable superheat range from manufacturers specifications (or use range between 3°F and 26°F if manufacturer's specification is not available)	Have installer provide target from manufacturer's literature or use range given			
43	System passes if actual superheat is within the allowable superheat range. **Enter Pass or Fail**	3 ≤ Line 42 ≤ 26 = Pass or use manuf #			

Connecting and Removing Refrigerant Manifold Gauges - for HERS Raters

(HERS Raters must be certified "EPA 608, Type II or Universal" to use refrigerant gauges.)

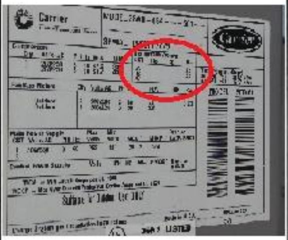
CONNECTING GAUGES

Always wear proper skin and eye protection

1. Turn A/C system OFF at thermostat.

(Turn fan switch to AUTO and mode switch to OFF)

Note the original thermostat setting so you can set it back when finished.



2. IMPORTANT: Verify refrigerant type and appropriate gauge type before attaching gauges **by looking at the equipment label.**

Raters should have two separate sets of hoses, one for each each type of refrigerant, R-410a and R22.

Keep ends of hoses clean and free of debris.

3. **Zero your gauges according to the manufacturer's specifications and instructions.**

4. Remove plastic cap from suction line service port (This is the larger diameter copper refrigerant tube, aka "low side", aka "vapor port", etc.).

Make sure small o-ring stays inside cap. Put cap on an open port on back of gauges for safekeeping. NOTE: If refrigerant leaks out of valve, replace cap and discontinue test. Schrader valve is faulty. Call technician.

5. Carefully attach BLUE hose to suction line service port. If hose has a closeable hand-valve on end, it should be closed before attaching to new system.

Be extra careful not to cross thread the connector. Make sure the threaded end of the hose is properly lined up with the service port. Use firm, even pressure. Don't force it. A small amount of refrigerant may spray out while attaching. Turn threaded ring until firmly seated. No refrigerant should be leaking out.

REMOVING GAUGES

Always wear proper skin and eye protection

1. Turn system off at thermostat.

   Raise set temperature until above room temperature.

   A/C condenser should turn off. Let settle for about 5 minutes.

2. Close hand-valves on end of both hoses.

3. Carefully, but quickly unscrew end of BLUE hose from service port.

   Caution: a small amount of refrigerant will spray out. This is OK.

4. Point end of hose away from you and open hand-valve on end of hose to release refrigerant trapped in hose.

   Take care not to breathe refrigerant.

5. Repeat steps 3 and 4 for RED hose.

   Caution: a larger amount of refrigerant will spray out than from the blue hose. This is OK.

6. IMPORTANT: Replace plastic caps with o-rings on both service ports.

COMPLIANCE FORMS

CHEERS

Unmatched Service with Integrity

COMPLIANCE FORMS

#	Doc Type	Doc Category	Category Description	Document Description
CF1R's – Certificate of Compliance				
1	CF1R-	NCB-01-E	Newly Constructed Buildings	Newly Constructed Buildings and Additions Greater Than 1000 ft2 (Prescriptive)
2	CF1R-	ADD-01-E	Additions	Additions less than 1,000 ft2 (Prescriptive)
3	CF1R-	ALT-01-E	Alterations	Non-HVAC Alterations (Prescriptive) Break Out by Type
4	CF1R-	ALT-02-E	Alterations	HVAC Alterations
5	CF1R-	ALT-03-E	Alterations-HVAC	Paper version of ALT-HVAC for CZ 1, 3-7,16
6	CF1R-	ALT-04-E	Alterations-HVAC	Paper version of ALT HVAC-CZ 2, 8-15
7	CF1R-	ENV-02-E	Envelope	Area Weighted Average Calculation Worksheet
8	CF1R-	ENV-03-E	Envelope	Solar Heat Gain Coefficient (SHGC) Worksheet
9	CF1R-	ENV-04-E	Envelope	Cool Roof and SRI Worksheet
10	CF1R-	PLB-01-E	Plumbing	Hydronic Heating System Worksheet
11	CF1R-	SRA-01-E	Solar Ready	Solar Ready Areas
12	CF1R-	SRA-02-E	Solar Ready	Minimum Solar Zone Area Worksheet
13	CF1R-	STH-01-E	Solar Thermal	OG 300 Solar Water Heating System Worksheet
14	CF1R-	STH-02-E	Solar Thermal	OG 100 Solar Water Heating System Worksheet (California F-Chart)
CF2R's – Certificate of Installation				
15	CF2R-	ENV-01-E	Envelope-NonHERS	Fenestration; and Site-built Fenestration
16	CF2R-	ENV-02-E	Envelope-NonHERS	Envelope Air Sealing Requirements
17	CF2R-	ENV-03-E	Envelope-NonHERS	Insulation Installation
18	CF2R-	ENV-04-E	Envelope-NonHERS	Roofing; Radiant Barriers
19	CF2R-	ENV-20a-H	Envelope-HERS	Building Envelope Air Leakage - Single-Point Test with Manual Meter
20	CF2R-	ENV-20b-H	Envelope-HERS	Building Envelope Air Leakage - Single-Point Test with Automatic Meter
21	CF2R-	ENV-20c-H	Envelope-HERS	Building Envelope Air Leakage - Multi-Point Test
22	CF2R-	ENV-20d-H	Envelope-HERS	Building Envelope Air Leakage - Repeated Single Point with Manual Meter
23	CF2R-	ENV-20e-H	Envelope-HERS	Building Envelope Air Leakage - Repeated Single Point with Automatic Meter
24	CF2R-	ENV-21-H	Envelope-HERS	Quality Insulation Installation (QII) –Air Infiltration Sealing - Framing Stage for Batt, Loose Fill, and SPF
25	CF2R-	ENV-22-H	Envelope-HERS	Quality Insulation Installation (QII) - Air Infiltration Sealing - Ceiling/Roof Deck

#	Doc Type	Doc Category	Category Description	Document Description
26	CF2R-	ENV-23-H	Envelope-HERS	Quality Insulation Installation (QII) - Insulation Stage
27	CF2R-	ENV-24-H	Envelope-HERS	Quality Insulation Installation (QII) – Air Infiltration Sealing - Framing Stage for SIP and ICF
28	CF2R-	LTG-01-E	Lighting-NonHERS	Lighting - Single Family Dwellings
29	CF2R-	LTG-02-E	Lighting-NonHERS	Lighting - Multifamily Dwellings
30	CF2R-	MCH-01a-E	Mechanical-NonHERS	HVAC Systems, Ducts and Fans - Performance
31	CF2R-	MCH-01b-E	Mechanical-NonHERS	HVAC Systems, Ducts and Fans - Prescriptive Alterations
32	CF2R-	MCH-01c-E	Mechanical-NonHERS	HVAC Systems, Ducts and Fans - Prescriptive Newly Constructed Buildings
33	CF2R-	MCH-02-E	Mechanical-NonHERS	Whole House Fan
34	CF2R-	MCH-04-E	Mechanical-NonHERS	Evaporative Coolers
35	CF2R-	MCH-20a-H	Mechanical-HERS	Duct Leakage Measurement - New System
36	CF2R-	MCH-20b-H	Mechanical-HERS	Duct Leakage Measurement - Low Leakage Ducts in Conditioned Space – Compliance Credit;
37	CF2R-	MCH-20c-H	Mechanical-HERS	Duct Leakage Measurement - Low Leakage Air-Handling Units
38	CF2R-	MCH-20d-H	Mechanical-HERS	Duct Leakage Measurement - – Altered (Existing) System
39	CF2R-	MCH-20e-H	Mechanical-HERS	Duct Leakage Measurement - Sealing of All Accessible Leaks
40	CF2R-	MCH-21-H	Mechanical-HERS	Duct Location Verification
41	CF2R-	MCH-22a-H	Mechanical-HERS	Forced Air System Fan Efficacy (Watt/cfm) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling
42	CF2R-	MCH-22b-H	Mechanical-HERS	Forced Air System Fan Efficacy (Watt/cfm) - Zonally Controlled Systems in Every Zonal Control Mode
43	CF2R-	MCH-23a-H	Mechanical-HERS	Forced Air System Airflow Rate (cfm/ton) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling - compliance using RA3.3 methods
44	CF2R-	MCH-23b-H	Mechanical-HERS	Forced Air System Airflow Rate (cfm/ton) - Zonally Controlled Systems in Every Zonal Control Mode - compliance using RA3.3 methods
45	CF2R-	MCH-23c-H	Mechanical-HERS	Forced Air System Airflow Rate - compliance using Alternative Compliance using RA3.2.2.7.3 methods
46	CF2R-	MCH-23d-H	Mechanical-HERS	Forced Air System Airflow Rate - Measurement Only (CFM) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling - compliance using RA3.3 methods
47	CF2R-	MCH-24a-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Single-Point Test with Manual Meter
48	CF2R-	MCH-24b-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Single-Point Test with Automatic Meter
49	CF2R-	MCH-24c-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Multi-Point Test

#	Doc Type	Doc Category	Category Description	Document Description
50	CF2R-	MCH-24d-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Repeated Single Point with Manual Meter
51	CF2R-	MCH-24e-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Repeated Single Point with Automatic Meter
52	CF2R-	MCH-25a-H	Mechanical-HERS	Refrigerant Charge Verification - superheat method (Standard Charge Procedure)
53	CF2R-	MCH-25b-H	Mechanical-HERS	Refrigerant Charge Verification - subcooling (Standard Charge Procedure)
54	CF2R-	MCH-25c-H	Mechanical-HERS	Refrigerant Charge Verification - Weigh-in Procedure
55	CF2R-	MCH-25d-H	Mechanical-HERS	Refrigerant Charge Verification - Charge Indicator Display (CID) (note: not a standalone document - embedded in CF2R-MCH-25a,b,e)
56	CF2R-	MCH-25e-H	Mechanical-HERS	Refrigerant Charge Verification - Winter Setup for Standard Charge Verification
57	CF2R-	MCH-25f-E	Mechanical-NonHERS	Refrigerant Charge Verification - Packaged System Manufacturer Refrigerant Charge Certification
58	CF2R-	MCH-26-H	Mechanical-HERS	Rated Space Conditioning System Equipment Verification
59	CF2R-	MCH-27a-H	Mechanical-HERS	Mechanical Ventilation - Continuous Whole-Building Mechanical Ventilation Airflow - Fan Vent Rate Method
60	CF2R-	MCH-27b-H	Mechanical-HERS	Mechanical Ventilation - Continuous Whole-Building Mechanical Ventilation Airflow - Total Vent Rate Method
61	CF2R-	MCH-27c-H	Mechanical-HERS	Mechanical Ventilation - Intermittent Whole-Building Mechanical Ventilation Airflow- Fan Vent Rate Method
62	CF2R-	MCH-27d-H	Mechanical-HERS	Mechanical Ventilation - Intermittent Whole-Building Mechanical Ventilation Airflow - Total Vent Rate Method
63	CF2R-	MCH-28-H	Mechanical-HERS	Return Duct And Filter Grille Design According to Tables 150.0-C or D
64	CF2R-	MCH-29-H	Mechanical-HERS	Supply Duct Surface Area and R-Value; Buried Ducts; Deeply Buried Ducts
65	CF2R-	MCH-30-H	Mechanical-HERS	Ventilation cooling compliance credit
66	CF2R-	PLB-01-E	Plumbing-DHW-NonHERS	Multifamily Central Hot Water System Distribution - NON-HERS
67	CF2R-	PLB-02-E	Plumbing (DHW)-NonHERS	Single Dwelling Unit Hot Water System Distribution
68	CF2R-	PLB-03-E	Plumbing (DHW)-NonHERS	Pool and Spa Systems
69	CF2R-	PLB-21-H	Plumbing (DHW)-HERS	HERS - Multifamily Central Hot Water System Distribution
70	CF2R-	PLB-22-H	Plumbing (DHW)-HERS	HERS - Single Dwelling Unit Hot Water System Distribution
71	CF2R-	SPV-01a-E	Photovoltaic	PV Systems - Photo Voltaic Systems Compliance Credits
72	CF2R-	SPV-01b-E	Photovoltaic	PV Systems - Exception to Solar Ready Area requirements
73	CF2R-	SPV-01c-E	Photovoltaic	PV Systems - PV Compliance Credits + Exceptions to SRA requirements
74	CF2R-	STH-01-E	Solar Thermal	Solar Water Heating Systems

#	Doc Type	Doc Category	Category Description	Document Description
CF3R's – Certificate of Verification				
75	CF3R-	ENV-20a-H	Envelope-HERS	Building Envelope Air Leakage - Single-Point Test with Manual Meter
76	CF3R-	ENV-20b-H	Envelope-HERS	Building Envelope Air Leakage - Single-Point Test with Automatic Meter
77	CF3R-	ENV-20c-H	Envelope-HERS	Building Envelope Air Leakage - Multi-Point Test
78	CF3R-	ENV-20d-H	Envelope-HERS	Building Envelope Air Leakage - Repeated Single Point with Manual Meter
79	CF3R-	ENV-20e-H	Envelope-HERS	Building Envelope Air Leakage - Repeated Single Point with Automatic Meter
80	CF3R-	ENV-21-H	Envelope-HERS	Quality Insulation Installation (QII)-Framing Stage - wood frame
81	CF3R-	ENV-22-H	Envelope-HERS	Quality Insulation Installation (QII) - Ceiling/Roof Deck - Air Infiltration Sealing
82	CF3R-	ENV-23-H	Envelope-HERS	Quality Insulation Installation (QII) - Insulation Stage
83	CF3R-	ENV-24-H	Envelope-HERS	Quality Insulation Installation (QII)-Framing Stage - sip and icf
84	CF3R-	EXC-20-H	Existing Conditions	HERS Verification for Existing Conditions for performance compliance for alterations.
85	CF3R-	MCH-20a-H	Mechanical-HERS	Duct Leakage Measurement - New System
86	CF3R-	MCH-20b-H	Mechanical-HERS	Duct Leakage Measurement - Low Leakage Ducts in Conditioned Space – Compliance Credit;
87	CF3R-	MCH-20c-H	Mechanical-HERS	Duct Leakage Measurement - Low Leakage Air-Handling Units
88	CF3R-	MCH-20d-H	Mechanical-HERS	Duct Leakage Measurement - – Altered (Existing) System
89	CF3R-	MCH-20e-H	Mechanical-HERS	Duct Leakage Measurement - Sealing of All Accessible Leaks
90	CF3R-	MCH-21-H	Mechanical-HERS	Duct Location Verification
91	CF3R-	MCH-22a-H	Mechanical-HERS	Forced Air System Fan Efficacy (Watt/cfm) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling
92	CF3R-	MCH-22b-H	Mechanical-HERS	Forced Air System Fan Efficacy (Watt/cfm) - Zonally Controlled Systems in Every Zonal Control Mode
93	CF3R-	MCH-23a-H	Mechanical-HERS	Forced Air System Airflow Rate (cfm/ton) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling - compliance using RA3.3 methods
94	CF3R-	MCH-23b-H	Mechanical-HERS	Forced Air System Airflow Rate (cfm/ton) - Zonally Controlled Systems in Every Zonal Control Mode - compliance using RA3.3 methods
95	CF3R-	MCH-23c-H	Mechanical-HERS	Forced Air System Airflow Rate compliance using Alternative Compliance using RA3.2.2.7.3 methods (best that I can do)
96	CF3R-	MCH-23d-H	Mechanical-HERS	Forced Air System Airflow Rate - Measurement Only (CFM) - Single Zone Systems or Zonally Controlled Systems with All Zones Calling - compliance using RA3.3 methods
97	CF3R-	MCH-24a-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Single-Point Test with Manual Meter

#	Doc Type	Doc Category	Category Description	Document Description
98	CF3R-	MCH-24b-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Single-Point Test with Automatic Meter
99	CF3R-	MCH-24c-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Multi-Point Test
100	CF3R-	MCH-24d-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Repeated Single Point with Manual Meter
101	CF3R-	MCH-24e-H	Envelope-HERS	Building Envelope Air Leakage Worksheet - Repeated Single Point with Automatic Meter
102	CF3R-	MCH-25a-H	Mechanical-HERS	Refrigerant Charge Verification - superheat method (Standard Charge Procedure)
103	CF3R-	MCH-25b-H	Mechanical-HERS	Refrigerant Charge Verification - subcooling (Standard Charge Procedure)
104	CF3R-	MCH-25c-H	Mechanical-HERS	Refrigerant Charge Verification - Weigh-in Procedure (observation only)
105	CF3R-	MCH-25d-H	Mechanical-HERS	Refrigerant Charge Verification - Charge Indicator Display (CID)
106	CF3R-	MCH-25e-H	Mechanical-HERS	Refrigerant Charge Verification - Winter Setup for Standard Charge Verification
107	CF3R-	MCH-26-H	Mechanical-HERS	Rated Space Conditioning System Equipment Verification
108	CF3R-	MCH-27a-H	Mechanical-HERS	Mechanical Ventilation - Continuous Whole-Building Mechanical Ventilation Airflow - Fan Vent Rate Method
109	CF3R-	MCH-27b-H	Mechanical-HERS	Mechanical Ventilation - Continuous Whole-Building Mechanical Ventilation Airflow - Total Vent Rate Method
110	CF3R-	MCH-27c-H	Mechanical-HERS	Mechanical Ventilation - Intermittent Whole-Building Mechanical Ventilation Airflow
111	CF3R-	MCH-27d-H	Mechanical-HERS	Mechanical Ventilation - Intermittent Whole-Building Mechanical Ventilation Airflow - Total Vent Rate Method
112	CF3R-	MCH-28-H	Mechanical-HERS	Return Duct And Filter Grille Design According to Tables 150.0-C or D
113	CF3R-	MCH-29-H	Mechanical-HERS	Supply Duct Surface Area and R-Value; Buried Ducts; Deeply Buried Ducts
114	CF3R-	MCH-30-H	Mechanical-HERS	Ventilation cooling compliance credit
115	CF3R-	PLB-21-H	Plumbing (DHW)-HERS	HERS - Multifamily Central Hot Water System Distribution
116	CF3R-	PLB-22-H	Plumbing (DHW)-HERS	HERS - Single Dwelling Unit Hot Water System Distribution
117	NRCV-	MCH-04a-H	Mechanical-HERS	Duct Leakage Measurement - New System
118	NRCV-	MCH-04c-H	Mechanical-HERS	Duct Leakage Measurement - Low Leakage Air-Handling Units
119	NRCV-	MCH-04d-H	Mechanical-HERS	Duct Leakage Measurement - – Altered (Existing) System
120	NRCV-	MCH-04e-H	Mechanical-HERS	Duct Leakage Measurement - Sealing of All Accessible Leaks
121	NRCV-	PLB-21-H	Plumbing (DHW)-HERS	HERS - High Rise Multifamily Central Hot Water System Distribution
122	NRCV-	PLB-22-H	Plumbing (DHW)-HERS	HERS - High Rise Single Dwelling Unit Hot Water System Distribution

CF1R

CF3R

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CF1R

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A. General Information

01	Project Name:		02	Date Prepared:	
03	Project Location:		04	Building Front Orientation (deg or cardinal):	
05	CA City:		06	Number of Dwelling Units:	
07	Zip Code:		08	Fuel Type:	
09	Climate Zone:		10	Total Conditioned Floor Area (ft^2):	
11	Building Type:		12	Slab Area (ft^2):	
13	Project Scope:		14	Exceptions to Fenestration U-factor & SHGC 150.1(c)3A	

B. Opaque Surface Details – Framed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11
					Proposed				Required	
								Appendix JA4 Reference		
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Table	Cell	U-Factor from Package A	Comments

C. Opaque Surface Details – Non-framed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11
				Proposed					Required	
							Appendix JA4 Reference			
Tag/ID	Assembly Type	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Table	Cell	U-Factor from Package A	Comments

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D. Opaque Surface Details – Mass Walls (Section 150.1(c)1)

01	02	03	04	05	06		07		08	09	10		11	
					Proposed						**Required**			
					Interior Insulation		Exterior Insulation		Appendix JA4 Reference		Interior Insulation		Exterior Insulation	
Tag/ID	Walls Above Grade	Mass Type	Mass Thickness (inches)	Furring Strip Thickness (inches)	R-value	U-factor	R-value	U-factor	Table	Cell	R-value	U-factor	R-value	U-factor

E. Slab Insulation (Table 150.1-A)

01	02		03		04
	Proposed		**Required**		
Floor Type	R-value	U-factor	Insulation R-value	Insulation U-factor	Comments

- **Heated slab floors require mandatory slab insulation (see Table 110.8-A).**

F. Radiant Barrier (Section 150.1(c)2

01	02
Radiant Barrier installed below the roof deck and on all gable end walls	Comment

A radiant barrier is required (for Climate Zones 2-15)

- Radiant barriers shall meet specific eligibility and installation criteria to receive energy credit for compliance with the Building Energy Efficiency Standards for low-rise residential buildings. Refer to RA4.2.1
- The emittance of the radiant barrier shall be less than or equal to 0.05 as tested in accordance with ASTM C1371 or ASTM E408.
- For Prescriptive Compliance the attic shall be ventilated to provide a minimum free ventilation area of not less than one square foot of vent area for each 300 ft^2 of attic floor area with no less than 30 percent upper vents. Ridge vents or gable end vents are recommended to achieve the best performance. The material should be cut to allow for full airflow to the venting.

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G. Roofing Products (Cool Roof) (Section 150.1(c)11)

01	02	03	04	05	06	07	08	09	10	11	12	13
						Proposed				Minimum Required		
Tag/ID	Mass Roof 25 lb/ft^2 or greater	Roof Pitch	Method of compliance	Product Type	CRRC Product ID Number	Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)

NOTES:

- Any roof area covered by building integrated photovoltaic panels and solar thermal panels is exempt from the above Cool Roof requirements.
- Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.

H. Fenestration/Glazing Allowed Areas and Efficiencies (Section 150.1(c)3)

01	02	03	04	05	06	07
Maximum Allowed Fenestration Area for All Orientation (ft^2)	Maximum Allowed West-Facing Fenestration Area Only (ft^2)	Maximum Allowed U-factor (Windows)	Maximum Allowed U-factor (Skylights)	Maximum Allowed SHGC (Windows)	Maximum Allowed SHGC (Skylights)	Comments

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I. Fenestration Proposed Areas and Efficiencies

Note: If meeting Exception 1 to 150.1(c)3A, Installing ≤ 3ft^2 glass in door, it is assumed to meet the minimum required U-factor (0.32) & SHGC (0.25).
If meeting Exception 1 to 150.1(c)3A, Installing ≤ 3ft^2 tubular skylight, it is assumed to meet the minimum required U-factor (0.55) & SHGC (0.30).

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Tag/ID	Fenestration Type	Frame Type	Dynamic Glazing	Orientation N, S, W, E or Roof	Number of Panes	Proposed Fenestration Area (ft^2)	Proposed West Facing Fenestration Area (ft^2)	Proposed U-factor	Source	Proposed SHGC	Source	Exterior Shading Device	Combined SHGC from CF1R-ENV-03
15	Total Proposed Fenestration Area												
16	Maximum Allowed Fenestration Area												
17	Compliance Statement												
18	Total Proposed West-Facing Fenestration Area												
19	Maximum Allowed West-Facing Fenestration Area												
20	Compliance Statement												
21	Proposed Fenestration U-factor (Windows)												
22	Required Fenestration U-factor (Windows)												
23	Compliance Statement												
24	Proposed Fenestration SHGC (Windows)												
25	Required Fenestration SHGC (Windows)												
26	Compliance Statement												
27	Proposed Fenestration U-factor (Skylights)												
28	Required Fenestration U-factor (Skylights)												
29	Compliance Statement												
30	Proposed Fenestration SHGC (Skylights)												
31	Required Fenestration SHGC (Skylights)												
32	Compliance Statement												

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J. Space Conditioning (SC) Systems – Heating/Cooling/Ducts (Section 150.1(c)7)

01	02	03	04	05	06	07	08	09	10	11	12
Space Conditioning System Identification or Name	Heating System Type	Heating Efficiency Type	Heating Efficiency Value	Cooling System Type	Cooling Efficiency SEER	Cooling Efficiency EER	Distribution System Type	Duct Location	Duct R-value	Thermostat Type	Comments

- Central gas furnaces have a minimum efficiency of 78% AFUE, heat pumps 7.7 HSPF. Any gas heating appliance sold in California will meet the minimum appliance efficiency standard and is allowed. Heat pumps and mini-split heat pumps are the only type of electric heating system allowed.
- Central cooling systems and heat pumps have a minimum efficiency of 13 SEER. Any cooling appliance sold in California will meet the minimum appliance efficiency standard and is allowed.
- The prescriptive requirements preclude the use of bypass ducts in association with zonally controlled systems. A HERS Rater shall verify that zonally controlled systems have no bypass ducts.

K. Ventilation Cooling in Climate Zones 8-14 (Section 150.1(c)12)

01	02
Required Airflow Rate (CFM) (2 CFM per ft^2 of Conditioned Floor Area)	Minimum Attic Vent Free Area (in^2) (column 1 x 0.384)

L. Water Heating Systems (Section 150.1(c)8)

List water heaters and boilers for both domestic hot water (DHW) heaters and hydronic space heating.

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Back-Up Solar Savings Fraction	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type

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M. Space Conditioning Systems and Water Heating Systems in Multifamily Dwelling Units

01	02	03	04	05	06
Dwelling Unit Name	Dwelling Unit Total CFA (ft^2)	Central Water Heating System Identification or Name	Dwelling Unit Water Heating System Identification or Name	Dwelling Unit Space Conditioning System Identification or Name	Comments

N. HERS Verification Summary

The enforcement agency shall pay special attention to the HERS Measures specified in this checklist below. A registered Certificate of Verification for all the measures specified shall be submitted to the building inspector before final inspection.

Duct Leakage Verification- Section 150.0(m)11

- Duct leakage testing is required (Residential Appendix RA3.1) in all climate zones for ducted heating and cooling systems.
- System is zonally controlled. No bypass ducts are allowed, as confirmed by HERS verification.

Zonally Controlled Systems – Bypass Dampers - Section 150.1(c)13

- If system is zonally controlled, no bypass ducts are allowed, as confirmed by HERS verification (See RCM Appendix F)

Refrigerant Charge Verification – Section 150.1(c)7a

- Refrigerant Charge Testing is required (Residential Appendix RA3.2) in climate zones 2 and 8-15 for all air source A/C and heat pumps.
- Some exceptions apply to factory charged package systems

Central System Air Handlers – Air Flow and Fan Efficacy Verification - Section 150.0(m)13

- Airflow (min 350 cfm/ton) and Fan Efficacy (max 0.58 watts/cfm) on systems with ducted air conditioning will be field verified by a HERS rater or Return Duct and Filter System Design according to tables 150.0-C/D will be HERS verified
- Heat-only systems with Central Fan Integrated (CFI) ventilation are required to have less than 0.58 watts per cfm as verified by a HERS rater.

Indoor Air Quality Mechanical Ventilation

- Mechanical ventilation airflow rate according to ASHRAE 62.2 is required to be verified by a HERS rater (RA3.7)

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DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Compliance documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Signature Date:
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. That the energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a registered copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name:	Responsible Designer Signature:
Company :	Date Signed:
Address:	License:
City/State/Zip:	Phone:

For assistance or questions regarding the Energy Standards, contact the Energy Hotline at: 1-800-772-3300

CF1R-NCB-01-E User Instructions

Minimum requirements for prescriptive compliance can be found in Building Energy Efficiency Standards Section 150.1(c), and Table 150.1-A (Package A). Completing these forms will require that you have the Reference Appendices for the 2013 Building Energy Efficiency Standards, which contains the Joint Appendices used to determine climate zone and to complete the table for opaque surfaces. When the term CF-1R is used it means the CF-1R-PRSC-NCB-01. Worksheets are identified by their entire name and subsequently by only the worksheet number, such as CF1R-ENV-02.

Instructions for tables with column numbers and row letters are given separately.

A. General Information

1. Project Name: Identifying information, such as owner's name.
2. Date: Date of document preparation.
3. Project Location: Legal street address of property or other applicable location identifying information.
4. Building Front Orientation: Building front expressed in degrees, where North = 0, East = 90, South = 180, and West = 270. Indicate cardinal if it is a subdivision or multi-family project that will be built in multiple orientations. The standards (section 100.1) include the following additional details for determining orientation:
    - Cardinal covers all orientations (for buildings that will be built in multiple orientations);
    - North is oriented to within 45 degrees of true north, including 45 degrees east of north;
    - East is oriented to within 45 degrees of true east, including 45 degrees south of east;
    - South is oriented to within 45 degrees of true south, including 45 degrees west of south;
    - West is oriented to within 45 degrees of true west, including 45 degrees south of west.
5. CA City: Legal city/town of property.
6. Number of Dwelling Units: 1 for single-family, 2 or more for multifamily.
7. Zip Code: 5-digit zip code for the project location (used to determine climate zone).
8. Fuel Type: Natural Gas, Liquefied Propane Gas, or Electricity.

   NOTE: prescriptive compliance only allows electricity if existing appliances are electric and natural gas is not available in the building.

9. Climate zone: From Joint Appendix JA2.1.1.
10. Total Conditioned Floor Area: Enter the new conditioned floor area in ft^2, as measured from the outside of exterior walls. If the project is an addition, this form is used for additions that are greater than 1,000 ft^2.
11. Building Type: Single Family (includes duplex), or Multi Family (a building that shares common walls and common floors or ceilings).

12. Slab Area: Area of the first floor slab (if any) in ft^2.
13. Project Scope: Newly constructed building or new addition greater than 1,000 ft^2.
14. Exceptions to Fenestration U-factor and SHGC: Installing less than or equal to 3 ft^2 glass in door, Installing less than or equal to 3 ft^2 tubular skylight, or Installing less than or equal to 16 ft^2 skylight, or Not Applicable.

B. Opaque Surface Details – Framed

1. Tag/ID: A label (if any) from the plans, such as A1.4 or wall.
2. Assembly Type: Roof, Ceiling, Wall, Floor.
3. Frame type: Wood or Metal.
4. Frame Depth: Nominal dimensions (in inches) of framing material such as 2x4 or 2x6.
5. Frame Spacing: 16, 24, or 48 (inches on center).
6. Proposed Cavity R-value: Cavity R-value of insulation installed between framing members.

   NOTE: Wall U-factor required for all climate zones is 0.065. This U-factors can be met by wood framed 2x4 walls with R-13 cavity + R5 continuous insulation (not interrupted by framing), R-15 cavity plus R-4 continuous insulation, or any combination of cavity and/or continuous insulation that results in a U-factor equal to or less than 0.065.

   Proposed Continuous Insulation R-value: R-value of rigid or continuous insulation (not interrupted by framing).
7. Proposed U-factor: The U-factor for the proposed assembly. Must be less than or equal to column 10 or have an attached CF1R-ENV-02-E to show that a weighted U-factor for multiple assemblies will meet the maximum value in column 10.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an ICF wall is 4.3.13).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an 8-inch thick ICF wall with 2 inches of EPS (R-15.4) is A6).
10. Required U-factor from Package A: Value required based on climate zone and assembly type.
11. Comments: Any notes regarding location, unique conditions, or attachments.

C. Opaque Surface Details – Non-framed

1. Tag/ID: A label (if any) from the plans, for example, A1.4 or wall.
2. Assembly Type: Roof, Wall.
3. Assembly materials: SIP OSB, SIP I-Joist, SIP single 2x, SIP double 2x, see JA4 for guidance.
4. Thickness: Thickness in inches.
5. Proposed Core Insulation R-value: Insulation installed within the materials or on the inside. See Joint Appendix JA4 for guidance.
6. Proposed Continuous Insulation R-value: Insulation installed on the exterior. See Joint Appendix JA4 for guidance.
7. Proposed U-factor: Assembly U-factor from JA4 or WS-01. Must be less than or equal to column 10.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an ICF wall is 4.3.13).

9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an 8-inch thick ICF wall with 2 inches of EPS (R-15.4) is A6).
10. Required U-factor from Package A: Based on assembly type and climate zone.
11. Comments: Any notes regarding location, unique conditions, or attachments.

D. Opaque Surface Details – Mass Walls

1. Tag/ID: A label (if any) from the plans, for example, A1.4 or wall.
2. Walls Above Grade: Yes or No.
3. Mass Type: Clay Brick, Clay Hollow Unit, CMU Light Weight, CMU Medium Weight, CMU Normal Weight, concrete, ICF. See JA4 for guidance.
4. Mass Thickness: Thickness (in inches) of mass.
5. Furring Strips Thickness: If furring strips are required to meet the required wall R-value or U-factor shown in columns 10 and 11, indicate the thickness of the furring strip (in inches). See Table 4.3.14 of Joint Appendix 4.
6. Proposed Interior Insulation R-value or U-factor: Enter either the R-value or U-factor of proposed insulation on the inside surface of the mass wall. See column 10 for the required interior insulation value for the wall type selected. See JA4 for guidance. Use the same descriptor (R-value or U-factor) throughout Table D.
7. Proposed Exterior Insulation R-value or U-factor: Enter either the R-value or U-factor of proposed insulation on the outside surface of the mass wall. See column 11 for the required exterior insulation value for the wall type selected. See JA4 for guidance.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an ICF wall is 4.3.13).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an 8-inch thick ICF wall with 2 inches of EPS (R-15.4) is A6).
10. Required Interior Insulation R-value or U-factor: The required R-value or U-factor (whichever descriptor was selected in column 6) for interior insulation will be completed based on the Table 150.1-A requirements for the wall type.
11. Required Exterior Insulation R-value or U-factor: The required R-value or U-factor (whichever descriptor was selected in column 7) for exterior insulation will be completed based on the Table 150.1-A requirements for the wall type.

E. Slab Insulation

Slab edge performance specifications and installation criteria are found in Sections 150.0(l) and 150.1(c)1D (Table 150.1-A). Requirements vary by climate zone and slab conditions.

1. Floor type: Types include slab-on-grade or raised slab.
   - Slab-on-grade floors require slab edge insulation in climate zone 16 only.
   - Raised slab must be insulated to R8 in climate zones 1, 2, 11, 13, 14 and 16, R-4 in climate zones 12 and 15, and no insulation is required in climate zones 3-10.
2. Proposed R-value: When required, insulation can be specified by either R-value or U-factor. If specifying an R-value complete column 2.
3. Proposed U-Factor: When required, specify the U-factor of proposed insulation in column 3.

4. Required Insulation R-value: Whichever descriptor was used (R-value or U-factor) in column 2 or 3 will be used to specify the value required, which will vary by climate zone and type of slab. Values are from Table 150.1-A.
5. Required Insulation U-factor: Whichever descriptor was used (R-value or U-factor) in column 2 or 3 will be used to specify the value required, which will vary by climate zone and type of slab. Values are from Table 150.1-A.
6. Comments: Any notes regarding location, unique conditions, or attachments.

NOTE: A suggestion is provided to highlight that there is a mandatory slab edge insulation requirement for heated slab floors. Since mandatory requirements are not listed on the Certificate of Compliance, this is provided for information purposes only. The specific requirements are in Sections 110.8(g) and Table 110.8-A.

F. Radiant Barrier

1. Radiant Barrier installed below the roof deck and on all gable end walls: Yes or No
2. Comments: Any notes regarding location, unique conditions, or attachments.

Radiant barrier performance specifications and installation criteria are found in Sections 110.8(j) and 150.1(c)2, and in Residential Appendix RA4.2.1.

Radiant barriers are required by Package A in climate zones 2-15.

G. Roofing Products (Cool Roof)

Roofing requirements are found in Sections 110.8(i) and 150.1(c)11. Depending on the climate zone and roof slope, a cool roof (defined as a minimum aged solar reflectance and thermal emittance, or a minimum SRI) may be required by Package A.

Exceptions include (1) low-slope roofs (pitch 2:12 or less) in climate zones 1-12, 14 and 16; (2) steep slope roof (pitch greater than 2:12) in climate zones 1-9 and 16; (3) roof constructions that have thermal mass over the roof membrane with at least 25 lb/ft^2; and (4) any roof area covered by building integrated photovoltaic panels and solar thermal panels (the area of roof not covered by photovoltaic panels would still need to meet any applicable cool roof requirements).

1. Tag/ID: A label (if any) from the plans, such as R1.
2. Mass roof 25 lb/ft^2 or greater: Yes or No. Mass roofs are not required to have a cool roof even if the climate zone specifies minimum performance requirements.
3. Roof Pitch: Expressed as 4:12, for example, which means the roof rises 4 foot within a span of 12 feet. When roofs have multiple pitches the requirements are based on the pitch of 50% or more of the roof.

4. Method of Compliance: Indicate if the method of compliance is going to be based on Aged Solar Reflectance and Thermal Emittance or is it going to be based on the Solar Reflectance Index (SRI).
5. Product Type: See Cool Roof Rating Council's directory. Generally product types include single-ply roof, wood shingles, asphalt roof, metal roof, tile roof.
6. The CRRC Product ID Number is obtained from the Cool Roof Rating Council's Rated Product Directory at www.coolroofs.org/products/results. Products are listed by manufacturer, brand, type of installation, roofing material, and color, as well as product performance.
7. Proposed Initial Solar reflectance: Based on the product chosen from the Cool Roof Rating Council's Rated Product Directory. If using default assumption indicate NA since the Aged Solar Reflectance is available.
8. Proposed Aged Solar Reflectance: Value is from the Cool Roof Rating Council's Rated Product Directory. If the aged value is not available, calculate the calculated Aged Solar Reflectance using the Solar Reflectance Index (SRI) Calculation worksheet located on the California Energy Commission website or the aging equation ρ_{aged}=[0.2+β[$\rho_{initial}$-0.2], where $\rho_{initial}$= the initial solar reflectance and soiling resistance β is listed by product type below.

VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

Product Type	CRRC Product Category	β
Field-Applied Coating	Field-Applied Coating	0.65
Other	Not A Field-Applied Coating	0.70

9. Proposed Thermal Emittance: From the product specification default value. If using a calculated SRI place the Thermal Emittance used to calculate SRI.
10. Proposed SRI: It is optional to meet the SRI but if chosen to do so, use the Solar Reflectance Index (SRI) Calculation Worksheet found on the California Energy Commission website http://energy.ca.gov/title24/2013standards/documents/solar_reflectance/.
11. Minimum Required Aged Solar Reflectance: Based on climate zone and roof slope.
12. Minimum Required Thermal Emittance: Based on climate zone and roof slope.
13. Minimum Required SRI: Based on climate zone and roof slope.

If the cool roofing requirements will be met by a liquid field applied coating, Section 110.8(i)4 requires the coating be applied across the entire roof surface and meet the dry mil thickness or coverage recommended by the manufacturer.

H. Fenestration/Glazing Allowed Areas and Efficiencies

1. Maximum Allowed Fenestration Area for All Orientation: Calculated value based on conditioned floor area times 20 percent for all orientations.
2. Maximum Allowed West-Facing Fenestration Area Only: Calculated value based on conditioned floor area times 5 percent (Used in climate zones 2, 4, and 6-16 for west-facing fenestration).
3. Maximum Allowed U-factor (Windows): Maximum U-factor from Package A or Table 150.1-A. This field will always be 0.32 unless the U-factor will be the area weighted averaged, CF1R-ENV-02, with other higher fenestration windows.
4. Maximum Allowed U-factor (Skylights): Maximum U-factor from Package A or Table 150.1-A. This field will almost always be 0.32 unless meeting one of the Exceptions to 150.1(c)3A. If meeting one of the Exceptions, this field will be 0.55.
5. Maximum Allowed SHGC (Windows): Maximum SHGC from Package A or Table 150.1-A. This field will either be 0.25 or N/A, depending on the climate zone. N/A means there is no maximum SHGC required in this climate zone. The SHGC will be the area weighted averaged, CF1R-ENV-02, with other higher fenestration windows.
6. Maximum Allowed SHGC (Skylights): Maximum SHGC from Package A or Table 150.1-A. This field will almost always be 0.25 unless meeting one of the Exceptions to 150.1(c)3A. If meeting one of the Exceptions, this field will be 0.30.
7. Comments: Any notes regarding location, unique conditions, or attachments.

I. Fenestration Proposed Areas and Efficiencies

1. Tag/ID: Provide a name or designator for each unique type of fenestration surface. This designator should be used consistently throughout the plan set (elevations, finish schedules, etc.) such as Window-1, Skylight-1, etc. to identify each surface. It should also be consistently used on the other forms in the compliance documentation.
2. Fenestration Type: Indicate the type of fenestration construction e.g., Fixed Window, Operable Window, Skylight, Tubular Skylight, or Glass in Door.

   NOTE: Doors with glazing are counted in one of two ways. The entire door area of a door with 50% or more glazing is considered fenestration. A door with less than 50% glazing can be considered as all fenestration, or can be calculated as the actual glass area with a 2-inch (0.17 ft) frame all around.

3. Frame Type: Indicate the frame type as either metal, metal thermal break, or nonmetal.
4. Dynamic Glazing: Indicate whether the fenestration has an integrated shading device, chromogenic glazing, or none for no dynamic glazing. Chromogenic glazing shall be considered separately from other fenestration types.
5. Orientation: Orientation can be North, East, South, West. If documentation is for a building that may be built in any direction, in a climate zone that limits west-facing fenestration, complete this section assuming the side of the building with the most fenestration faces west.

   NOTE: West includes any vertical fenestration oriented to within 45 degrees of true west, excluding 45 degrees south of west; any skylights oriented west; and skylights facing any direction with a pitch of less than 1:12.

6. Number of Panes: Indicate the number of panes for each Tag/ID; is it a single, double, or triple pane window?
7. Proposed Fenestration Area (ft^2): Indicate the area (in square feet) of each exterior fenestration type, excluding west-facing fenestration.
8. Proposed West Facing Fenestration Area (ft^2): In climate zones 2, 4, and 6-16, indicate the area (in square feet) of each exterior west-facing fenestration type separately.

   NOTE: Skylights installed in a roof with a pitch less than 1:12 are considered to face west.

9. Proposed U-factor: Enter
   (a) the NFRC U-factor based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.org) certified values, or
   (b) the default value from Table 110.6-A, or
   (c) the NA6.2 alternate default U-factor (for non-rated site-built fenestration only), or
   (d) the Area-weighted Average from CF1R-ENV-02.

   If any products (other than the exceptions) have a higher U-factor than 0.32, first complete a form CF1R-ENV-02 to calculate the area-weighted average U-factor, which must be 0.32 or less, and attach it to the CF1R-NCB-01.

   NOTE: (1) For the exceptions – up to 3 ft^2 of tubular skylights and up to 16 ft^2 of skylight area, enter 0.55.
   (2) For the exception – up to 3 ft^2 of glass in door, enter 0.32.
   (3) Dynamic glazing is a glazing system that changes its performance U-factor and SHGC based on the physical environment. Dynamic glazing includes chromogenic glazing or integrated shading systems (this does not include internally or externally mounted shading devices). If using dynamic glazing, use the lowest tested U-factor and SHGC in Columns 9 and 10.

10. Source: NFRC, Tables 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the U-factor data for the fenestration product.
11. Proposed SHGC: In climate zones 2, 4, and 6-16, enter the SHGC from
    (a) NFRC-rated certification information, or
    (b) default table 110.6-B, or
    (c) the NA6.3 alternate default SHGC (for non-rated site-built fenestration only), or
    (d) the Area-weighted Average from CF1R-ENV-02.

    If any products (other than the exceptions) have a higher SHGC than required by Package-A, first complete a form CF1R-ENV-02 to calculate the area-weighted average SHGC and attach it to the CF1R-NCB-01.

NOTE: (1) For the exceptions – up to 3 ft^2 of tubular skylights and up to 16 ft^2 of skylight area, enter 0.30.
(2) For the exception – up to 3 ft^2 of glass in door, enter 0.25.

12. Source: NFRC, Tables 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the SHGC data for the fenestration product.
13. Exterior Shading Device: If exterior shading devices are used to meet the SHGC requirement, indicate the type of device (from Table S-1 of CF1R-ENV-03-E Solar Heat Gain Coefficient Worksheet) and attach the CF1R-ENV-03-E.

NOTE: An exterior shading device is not used for products with an NFRC rated U-factor and SHGC based on a factory integrated shading device.
Chromogenic glazing shall be considered separately from other fenestration.

14. Combined SHGC from CF1R-ENV-03: If exterior shading devices are combined with the SHGC value of the fenestration to meet the prescriptive SHGC requirements (as indicated in column I. 13), indicate the SHGC calculated on form CF1R-ENV-03 and attach the form for each window with an exterior shading device.
15.–32. Automatically completed entries; no user input required.

J. Space Conditioning (SC) Systems – Heating/Cooling/Ducts

1. Space Conditioning System Identification or Name: Provide a unique name for each unique space conditioning system type in the building. If the same space conditioning system type is used in more than one location in the building, it is sufficient to list the unique space conditioning system type only once. In order for one space conditioning system type to be considered the same as another, it must have the same description in fields 2 through 9.
2. Heating system type: Indicate heating system type as furnace, central heat pump, boiler, hydronic, wood heat, wall furnace, room heat pump, or electric resistance if it meets the exception. An exception to Section 150.1(c)6 allows electric resistance heating only when it is supplemental to another system, as indicated by a capacity of < 2 KW or 7,000 Btu/hr, and a time-limiting control device that allows it to be operated for 30-minutes at a time.
3. Heating Efficiency Type: AFUE, HSPF, COP
4. Heating Efficiency Value: For central gas heating systems, the minimum efficiency required by the appliance efficiency standards is 78% AFUE. Heat pumps have an HSPF of 7.7 or higher. Other appliance types will have different efficiency levels (e.g., a gas wall furnace may have a minimum requirement of 73% AFUE or lower, depending on the size and type). Any gas heating appliance (or heat pump) sold in California is acceptable. The only electric heating appliance allowed is a heat pump.
5. Cooling System Type: Indicate cooling system type or specify "no cooling system installed." Categories include central air split system, central air package system, heat pump, room air or room heat pump, mini-split heat pump, or no cooling.

6. Cooling Efficiency SEER: For central cooling systems, the minimum efficiency required by the appliance efficiency standards is 13 SEER.
7. Cooling Efficiency EER: Other appliance types will have different efficiency levels (e.g., a room air conditioner may have a minimum requirement of 9 EER (when an appliance standard is an EER this is considered equivalent to an SEER). Any cooling appliance sold in California is acceptable.
8. Distribution System Type: This could be ducted, radiant floor, piping, or ductless.
9. Duct Location: If the system has ducts, indicate where they will be installed. Locations include attic, garage, conditioned space, radiant floor.
10. Duct R-value: This value is from Package A. Ducted systems in Climate Zones 1-10 and 12-13 require R-6 duct insulation, and in climate zones 11 and 14-16 ducted systems require R-8 duct insulation. If ducts are installed in conditioned space (which must be field verified), this field will be N/A. If system is ductless this field will be N/A.
11. Thermostat Type: Select a setback thermostat or an Energy Management System (EMS) for most systems, or N/A if exempt. Controls for most systems can be by a device that allows a person to program up to 4 temperature setpoints within 24 hours. See Section P.1 for more information and for a list of systems that do not have to meet the setback thermostat requirements.
12. Comments: Include any comments here.

K. Ventilation Cooling

In climate zones 8-14, a whole house fan is required to provide ventilation. The requirement is found in Section 150.1(c)12.

1. Required Whole House Fan Airflow Rate (CFM): 2 CFM per ft^2 of conditioned floor area (auto complete).
2. Minimum Attic Free Vent Area (in^2):Minimum attic vent free area = column 1 multiplied by 144 and divided by 375, which is equivalent to multiplying by 0.384 (auto complete).

L. Water Heating Systems

1. Water Heating System Identification or Name: Provide a unique name for each unique water heating system type in the building. If the same water heating system type is used in more than one location in the building, it is sufficient to list the unique water heating system type only once. In order for one water heating system type to be considered the same as another, it must have the same description in fields 2 through 12.
2. Water Heating System Type: Domestic Hot Water (DHW), Hydronic, Combined Hydronic, or Central. DHW is for domestic hot water, hydronic is a water heating system used for space heating only; combined hydronic are when the water heater will provide both space conditioning and domestic hot water. A central water heater serves multiple dwelling units in a multi-family building.
3. Water Heater Type: Prescriptive Standards allow four options under Section 150.1(c)8 (see Section P.2 for more detailed information on these requirements.
    A. One gas or propane storage water heater for each dwelling unit, with an input of up to 75,000 Btu/hour and a storage capacity no greater than 60 gallons. Distribution system type for individual dwelling units shall be either trunk and branch (standard) with no recirculating system or a demand recirculation system with manual controls

B. One gas or propane instantaneous (tankless) water heater for each dwelling unit. With an input no greater than 200,000 Btu/hour. Distribution system type is limited to either trunk and branch system (standard) with no recirculating system or a demand recirculation system with manual controls.

C. All water heaters installed must comply with Section 110.1 and 110.3. The distribution system shall be equipped with a demand recirculation control allowing pump operation to be based on measurement of hot water demand and hot water return temperature. The system shall have at least two loops. Buildings with 8 or less units do not have to comply with the demand recirculation requirement.

D. If natural gas is not available, an electric-resistance storage or instantaneous water heater with additional criteria that it be located inside the conditioned space, has no recirculation pumps, and has a solar water-heating system with a solar fraction of at least 50 percent.

4. Number of Water Heaters in System: In single-family and multi-family with water heaters in each dwelling units the value is 1. For multi-family central systems serving multiple dwelling units enter the total number of water heaters.
5. Water Heater Storage Volume (gal): Tank capacity in gallons. For individual water heaters for a dwelling unit this will be 60 gallons or less. If instantaneous, enter n/a. For multi-family central systems enter the total storage volume.
6. Fuel Type: Gas, Propane, Electric (special conditions apply, see M.1.D and Q.4.D).
7. Rated Input Type: Enter the equipment input rating type, for gas or propane fired system the units are Btuh, for electric fired system the units are kW.
8. Rated Input Value: Enter the numeric value of rated input.
9. Heating Efficiency Type: Energy Factor, AFUE, or Thermal Efficiency. From product literature or a California Energy Commission directory.
10. Heating Efficiency Value: Enter the value from product literature or a California Energy Commission directory
11. Standby Loss (percent): Applies only to large storage water heaters, Enter n/a for small storage or instantaneous water heaters.
12. Exterior Insulation R-Value: Enter the R-value if exterior insulation on the storage tank is installed
13. Back-Up Solar Savings Fraction: If compliance requires a back-up solar system, indicate the solar contribution (e.g., 0.30). External calculations are required.
14. Central DHW System Distribution Type: For multi-family buildings with using a central distribution system a demand recirculation system with at least two distribution loops must be installed. This requirement applies to any building with eight or more units. If the system is non-central or project is individual units enter n/a.
15. Dwelling Unit DHW System Distribution Type: For a Central DHW this field shall be Standard. If non-central then pick from Standard, Demand Recirculation – Manual Control, Demand Recirculation – Sensor Control.

M. Space Conditioning Systems and Water Heating Systems in Multifamily Dwelling Units

1. Dwelling Unit Name: Enter one unique name for each of the number of dwelling units identified in Section A field 06.
2. Dwelling Unit Total CFA: Enter the conditioned floor area for the dwelling unit.
3. Central Water Heating System Identification or Name: Select one of the central DHW system names
4. Dwelling Unit Water Heating System Identification or Name: Select one of the Dwelling Unit water heating system names entered in section L. If more than one water heating system type is needed in the dwelling unit, enter another row of data for the dwelling unit and select the additional water heating system name.
5. Dwelling Unit Space Conditioning System Identification or Name: Select one of the Space conditioning system names that were entered in section J. If more than one space conditioning system type is needed in the dwelling unit, enter another row of data for the dwelling unit and select the additional space conditioning system name
6. Comments: Include any comments here.

N. HERS Verification Summary

1. Duct Leakage verification: All duct systems must meet maximum duct leakage requirements. Typically the maximum leakage is 6% but varies for when the duct leakage test is performed and the type of building (single family, townhouse, multifamily). The only exception is if the heating and cooling systems are ductless.
2. Zonally Controlled Systems - Bypass Dampers: The prescriptive requirements preclude the use of bypass ducts in association with zonally controlled systems. A HERS Rater will verify that zonally controlled systems have no bypass ducts.
3. Refrigerant Charge Verification: Some type of refrigerant charge verification or Charge Indicator Display is required in climate zones 2 and 8-15 for most common systems such as ducted split and packaged systems, and mini-split systems. See Section 150.1(c)7A. or Reference Residential Appendix RA3.2. If a building is built in climate zones 1, 3-17 or 16, or has no cooling system, no refrigerant charge verification is required.
4. Central System Air Handlers - Airflow Rate and Fan Efficacy Verification: Unless a building has no cooling system or has a non-ducted cooling system, the system must meet mandatory and prescriptive requirements for an airflow greater than 350 CFM per ton of nominal cooling capacity, and a fan efficacy less than or equal to 0.58 W/CFM. See 150.0(m)13, 150.1(c)10, and Reference Residential Appendix RA3.
5. Indoor Air Quality Mechanical Ventilation: All new dwellings are required to meet the whole-building mechanical ventilation airflow rate according to ASHRAE 62.2 is required (RA3.7).

Documentation Declaration Statements

1. The person who prepared the CF-1R will sign and complete the fields for their name, company (if applicable), address, phone number, certification information (if applicable), date and signature (may be electronic).
2. The person who is assuming responsibility for the project being built to comply with Title 24, Part 6, will complete the fields for their name, company (if applicable), address, phone number, license number (if applicable), date and signature (may be electronic).

Registration

The CF1R must be registered with a HERS provider prior to submitting for a building permit.

Standards References

1. Thermostats
   a. Thermostat requirements are found in Section 110.2(c) with special requirements for heat pumps in Section 110.2(b). Controls for most systems can be by a central energy management control system (“EMS”) or a setback thermostat with a mechanism allowing a person to program up to 4 temperature setpoints within 24 hours (“setback”).

   EXCEPTIONS: If the heating system type is a gravity gas wall, floor or room heater, non-central electric heater, fireplace or decorative gas appliance, or wood stove, a setback thermostat or energy management control system is not required.

   If the cooling system type is a room air conditioner or room air conditioner heat pump setback thermostat or energy management control system is not required.

2. Water Heaters:
   Section 150.1(c) allows a limited number of conditions for water heating. If conditions other than these are proposed, the prescriptive compliance approach cannot be used:
   A. 150.1(c)8A one gas or propane storage water heater, up to 75,000 Btu/hour input (typically 50 gallons or less), with either no recirculating system or a demand recirculation system with manual controls. If the Energy Factor is less than or equal to the federal minimum, it must have an R-12 external wrap. See D. below.
   B. 150.1(c)8B one gas or propane instantaneous (tankless) water heater with an input of 200,000 Btu per hour or less, no storage tank, and either no recirculating system or a demand recirculation system with manual controls. .
   C. 150.1(c)8C a central water-heating system that has includes the following components (1) gas or propane water heaters, boilers or other water heating equipment, (2) a water heating recirculation loop that meets the requirements of Section 110.3(c)2 and Section 110.3(c)5 equipped with automatic controls for the recirculation pump based on measurement of hot water demand and hot water return temperature, and if more than 8 dwelling units, two recirculation loops each serving half of the building; (3) a solar water-heating system with a minimum solar savings fraction of 0.20 in climate zones 1 through 9 or a minimum solar savings fraction of 0.35 in climate zones 10 through 16 (installation criteria is in Reference Residential Appendix RA4).
   D. 150.1(c)8D if natural gas is not available, an electric-resistance storage or instantaneous water heater with addition criteria that it be located inside the conditioned space, it has no recirculation pumps, and has a solar water-heating system with a minimum solar savings fraction of 0.50 (installation criteria is in Reference Residential Appendix RA4).

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 1 of 6)
Project Name:	Date Prepared:

A. General Information

01	Project Name:		02	Date Prepared:	
03	Project Location:		04	Building Front Orientation (deg):	
05	CA City:		06	Number of Dwelling Units with Additions:	
07	Zip Code:		08	Fuel Type:	
09	Climate Zone:		10	Total Conditioned Floor Area (ft^2) (Addition):	
11	Building Type		12	Slab Area (ft^2):	
13	Project Scope:		14	Exceptions to Fenestration U-factor and SHGC 150.1(c)3A	

B. Opaque Surface Details – Framed (Section 150.2(a))

01	02	03	04	05	06	07	08	09	10	11
					Proposed				Required	
							Appendix JA4 Reference			
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-Factor	Table	Cell	U-Factor	Comments

C. Opaque Surface Details – Non-framed (Section 150.1(c)1)

01	02	03	04	05	06	07	08	09	10	11
				Proposed					Required	
							Appendix JA4 Reference			
Tag/ID	Assembly Type	Assembly Materials	Thickness (inches)	Core Insulation R-value	Continuous Insulation R-value	U-Factor	Table	Cell	U-Factor from Package A	Comments

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 2 of 6)
Project Name:	Date Prepared:

D. Opaque Surface Details – Mass Walls (Section 150.1(c)1)

01	02	03	04	05	06		07		08	09	10		11	
					Proposed						**Required**			
					Interior Insulation		Exterior Insulation		Appendix JA4 Reference		Interior Insulation		Exterior Insulation	
Tag/ID	Walls Above Grade	Mass Type	Mass Thickness (inches)	Furring Strip Thickness (inches)	R-value	U-factor	R-value	U-factor	Table	Cell	R-value	U-factor	R-value	U-factor

E. Slab Insulation (Table 150.1-A)

01	02	03	04	05	06
	Proposed		**Required**		
Floor Type	R-value	U-factor	Insulation R-value	Insulation U-factor	Comments

- Heated slab floors require mandatory slab insulation (see Table 110.8-A).

F. Radiant Barrier (Section 150.1(c)2)

01	02
Radiant Barrier installed below the roof deck and on all gable end walls	Comment

A radiant barrier is required (for Climate Zones 2-15)

- Radiant barriers shall meet specific eligibility and installation criteria to receive energy credit for compliance with the Building Energy Efficiency Standards for low-rise residential buildings. Refer to RA4.2.1
- The emittance of the radiant barrier shall be less than or equal to 0.05 as tested in accordance with ASTM C1371 or ASTM E408.
- For Prescriptive Compliance the attic shall be ventilated to provide a minimum free ventilation area of not less than one square foot of vent area for each 300 ft^2 of attic floor area with no less than 30 percent upper vents. Ridge vents or gable end vents are recommended to achieve the best performance. The material should be cut to allow for full airflow to the venting.

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 3 of 6)
Project Name:	Date Prepared:

G. Roofing Products (Cool Roof) (Section 150.1(c)11)

01	02	03	04	05	06	07	08	09	10	11	12	13
						Proposed				Required		
Tag/ID	Mass Roof 25 lb/ft^2 or greater	Roof Pitch	Method of compliance	Product Type	CRRC Product ID Number	Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)

NOTES:
- Any roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
- Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.

H. Fenestration/Glazing Allowed Areas and Efficiencies (Section 150.2(a)1)

01	02	03	04	05	06	07	08	09	10
Addition Type ft^2	Maximum Allowed Fenestration Area for All Orientations ft^2		Maximum Allowed West-Facing Fenestration Area Only ft^2		Maximum Allowed U-factor (Windows)	Maximum Allowed U-factor (Skylights)	Maximum Allowed SHGC (Windows)	Maximum Allowed SHGC (Skylights)	Comments
	The Greater		The Greater						
	Maximum Calculated based on Allowed %	Maximum Calculated Allowed ft^2	Maximum Calculated based on Allowed %	Maximum Calculated Allowed ft^2					

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 4 of 6)
Project Name:	Date Prepared:

I. Fenestration Proposed Areas and Efficiencies

Note: If meeting Exception 1 to 150.1(c)3A, Installing ≤ 3ft^2 glass in door, it is assumed to meet the minimum required U-factor (0.32) & SHGC (0.25).
If meeting Exception 1 to 150.1(c)3A, Installing ≤ 3ft^2 tubular skylight, it is assumed to meet the minimum required U-factor (0.55) & SHGC (0.30).

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Tag/ID	Fenestration Type	Frame Type	Dynamic Glazing	Orientation N, S, W, E or Roof	Number of Panes	Proposed Fenestration Area ft2	Proposed West Facing Fenestration Area ft2	Proposed U-factor	Source	Proposed SHGC	Source	Exterior Shading Device	Combined SHGC from CF1R-ENV-03

15	Total Proposed Fenestration Area	
16	Maximum Allowed Fenestration Area	
17	Compliance Statement	
18	Total Proposed West-Facing Fenestration Area	
19	Maximum Allowed West-Facing Fenestration Area	
20	Compliance Statement	
21	Proposed Fenestration U-factor (Windows)	
22	Required Fenestration U-factor (Windows)	
23	Compliance Statement	
24	Proposed Fenestration SHGC (Windows)	
25	Required Fenestration SHGC (Windows)	
26	Compliance Statement	
27	Proposed Fenestration U-factor (Skylights)	
28	Required Fenestration U-factor (Skylights)	
29	Compliance Statement	
30	Proposed Fenestration SHGC (Skylights)	
31	Required Fenestration SHGC (Skylights)	
32	Compliance Statement	

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 5 of 6)
Project Name:	Date Prepared:

J. Space Conditioning (SC) Systems – Heating/Cooling – Single Family Dwelling (Section 150.2(b) or (Section 150.1(c)7)

01	02	03
Dwelling Unit Name	Dwelling Unit Total CFA = Sum of Existing + Addition (ft^2)	Comments

K. Water Heating Systems (Section 150.1(c)8)

List water heaters and boilers for both domestic hot water (DHW) heaters and hydronic space heating

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficienc y Type	Heating Efficienc y Value	Standb y Loss (%)	Exterio r Insul. R-Value	Back-Up Solar Savings Fraction	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type

L. Space Conditioning Systems and Water Heating Systems in Multifamily Dwelling Units

01	02	03	04	05	06
Dwelling Unit Name	Dwelling Unit Total CFA = Sum of Existing + Addition (ft^2)	Central Water Heating System Identification or Name	Dwelling Unit Water Heating System Identification or Name	Dwelling Unit: Installing a New Space Conditioning System?	Comments

CERTIFICATE OF COMPLIANCE	CF1R-ADD-01-E
Prescriptive Residential Additions 1,000 ft^2 or less	(Page 6 of 6)
Project Name:	Date Prepared:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Compliance documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Signature Date:
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. That the energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a registered copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name:	Responsible Designer Signature:
Company :	Date Signed:
Address:	License:
City/State/Zip:	Phone:

For assistance or questions regarding the Energy Standards, contact the Energy Hotline at: 1-800-772-3300

CF1R-ADD-01-E User Instructions

Minimum requirements for prescriptive addition compliance can be found in Building Energy Efficiency Standards Section 150.2(a), and Table 150.1-A (Package A). Completing these forms will require that you have the Reference Appendices for the 2013 Building Energy Efficiency Standards (P400-2012-005), which contain the Joint Appendices used to determine climate zone and to complete the section for opaque surfaces. When the term CF1R is used it means the CF1R-ADD-01. Worksheets are identified by their entire name and subsequently by only the worksheet number, such as WS-02.

Instructions for sections with column numbers and row letters are given separately.

If any part of the addition does not comply, prescriptive compliance fails, in which case the performance (or computer) compliance approach may be used in an attempt to achieve compliance. Only the new construction is required to meet the requirements specified in this documentation. If any alterations to the existing building are occurring, those are documented on one or more of the CF1R-ALT forms.

A. General Information

1. Project Name: Identifying information, such as owner's name.
2. Date Prepared: Date of document preparation.
3. Project Location: Legal street address of property or other applicable identifying information.
4. Building Front Orientation: Building front expressed in degrees, where North = 0, East = 90, South = 180, and West = 270. The standards (section 100.1) include the following additional details for determining orientation:
   - North is oriented to within 45 degrees of true north, including 45 degrees east of north;
   - East is oriented to within 45 degrees of true east, including 45 degrees south of east;
   - South is oriented to within 45 degrees of true south, including 45 degrees west of south;
   - West is oriented to within 45 degrees of true west, including 45 degrees north of west.
5. CA City: Legal city/town of property.
6. Number of Dwelling Units with Additions: 1 for single-family, 1 or more for multifamily.
7. Zip Code: 5-digit zip code for the project location (used to determine climate zone).
8. Fuel Type: Natural Gas, Liquefied Propane Gas, or Electricity.

   NOTE: Prescriptive compliance only allows electricity if existing appliances are electric and natural gas is not available in the building.

9. Climate Zone: From Joint Appendix JA2.1.1.
10. Total Conditioned Floor Area: Enter the new conditioned floor area, in ft^2, as measured from the outside of exterior walls of the addition.

11. Building Type: Single Family (includes duplex), or Multi Family (a building that shares common walls and common floors or ceilings).
12. Slab Area: Area of the first floor slab of the addition (if any) in ft^2.
13. Project Scope: 300 ft^2 or less, greater than 300 up to 400 ft^2, greater than 400 up to 700 ft^2, greater than 700 up to 1000 ft^2, space heating system, space cooling system, space conditioning duct system, water heating, or fenestration.
14. Exceptions to Fenestration U-factor and SHGC: Installing less than or equal to 3 ft^2 glass in door, Installing less than or equal to 3 ft^2 tubular skylight, or Installing less than or equal to 16 ft^2 skylight

B. Opaque Surface Details - Framed

Additions of 700 ft^2 or less require only R-13 wall insulation. Unless otherwise noted, all other requirements of Package A are required when using prescriptive compliance.

1. Tag/ID: A label (if any) from the plans, such as A1.4 or wall.
2. Assembly Type: Roof, Ceiling, Wall, or Floor.
3. Frame Type: Wood or Metal.
4. Frame Depth: Nominal dimensions (in inches) of framing material such as 2x4 or 2x6.
5. Frame Spacing: 16, 24, or 48 (inches on center).
6. Proposed Cavity R-value: Insulation installed between framing members.

   NOTE: Wall U-factor required for all climate zones is 0.065. This U-factor can be met by wood framed 2x4 walls with R-13 cavity + R5 continuous insulation (not interrupted by framing); R-15 cavity plus R-4 continuous insulation, or any combination of cavity and/or continuous insulation that results in a U-factor equal to or less than 0.065.

   Proposed Continuous Insulation: R-value of rigid or continuous insulation (not interrupted by framing). See Table 4.3.4. of the Reference Appendices for metal frame construction.
7. Proposed U-factor: The U-factor for the proposed assembly must be less than or equal to column 10 or have an attached Area Weighted Average Calculation Worksheet (CF1R-ENV-01-E) to show that a weighted U-factor for multiple assemblies will meet the maximum value in column 10.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an attic assembly is 4.2.1).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an R-38 ceiling with 24-inch on center framing is A21).
10. Required U-factor: From Package A or from Section 150.2. Value required based on climate zone and assembly type.
11. Comments: Any notes regarding location, unique conditions, or attachments.

C. Opaque Surface Details – Non-Framed

1. Tag/ID: A label (if any) from the plans, for example, A1.4 or wall.
2. Assembly Type: Roof, Wall.
3. Assembly Materials: SIP OSB, SIP I-Joist, SIP Single 2x, SIP Double 2x.
4. Thickness: Thickness in inches.
5. Proposed Core Insulation R-value: Insulation installed within the materials or on the inside. See Joint Appendix JA4 for guidance.
6. Proposed Continuous Insulation R-value: Insulation installed on the exterior. See Joint Appendix JA4 for guidance.
7. Proposed U-factor: Proposed assembly U-factor from JA4 or CF1R-ENV-02-E. Must be less than or equal to column 10.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., a SIP wall is 4.3.2).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., a 4.5-inch thick OSB wall with R-18 core insulation and no continuous insulation is A5).
10. Required U-factor from Package A: Based on assembly type and climate zone.
11. Comments: Any notes regarding location, unique conditions, or attachments.

D. Opaque Surface Details – Mass Walls

1. Tag/ID: A label (if any) from the plans, for example, A1.4 or wall.
2. Walls Above Grade: Yes or No.
3. Mass Type: Clay Brick, Clay Hollow Unit, CMU Light Weight, CMU Medium Weight, CMU Normal Weight, concrete, ICF. See JA4 for guidance.
4. Mass Thickness: Thickness (in inches) of mass.
5. Furring Strips Thickness: If furring strips are required to meet the wall R-value or U-factor shown in columns 10 & 11, indicate the thickness of the furring strip (in inches). See Table 4.3.14 of Joint Appendix 4.
6. Proposed Interior Insulation R-value or U-factor: Enter either the R-value or U-factor of proposed insulation on the inside surface of the mass wall. See JA4 for guidance. Use the same descriptor (R-value or U-factor) throughout Table D.
7. Proposed Exterior Insulation R-value or U-factor: Enter either the R-value or U-factor of proposed insulation on the outside surface of the mass wall. See JA4 for guidance.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an ICF wall is 4.3.13).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an 8-inch thick ICF wall with 2 inches of EPS (R-15.4) is A6).
10. Required Interior Insulation: The required R-value or U-factor (whichever descriptor was selected in column 6) for interior insulation will be completed based on the Table 150.1-A requirements for the wall type.
11. Required Exterior Insulation: The required R-value or U-factor (whichever descriptor was selected in column 7) for exterior insulation will be completed based on the Table 150.1-A requirements for the wall type.

E. Slab Insulation

Slab edge performance specifications and installation criteria are found in Sections 150.0(l) and 150.1(c)1D (Table 150.1-A). Requirements vary by climate zone and slab conditions.

1. Floor type: Types include slab-on-grade or raised slab.
   - Slab-on-grade floors require slab edge insulation in climate zone 16 only.
   - Raised slab must be insulated to R8 in climate zones 1, 2, 11, 13, 14 and 16, R-4 in climate zones 12 and 15, and no insulation is required in climate zones 3-10.
2. Proposed R-value: When required, insulation can be specified by either R-value or U-factor (use the same descriptor throughout Table E). When specifying an R-value complete column 2.
3. Proposed U-Factor: When required, specify the U-factor of proposed insulation in column 3.
4. Required Insulation R-value: Specify the value required, which will vary by climate zone and type of slab. Values are from Table 150.1-A.
5. Required Insulation U-factor: Specify the value required, which will vary by climate zone and type of slab. Values are from Table 150.1-A.
6. Comments: Any notes regarding location, unique conditions, or attachments.

NOTE: There is a mandatory slab edge insulation requirement for heated slab floors. Since mandatory requirements are not listed on the Certificate of Compliance, this is provided for information purposes only. The specific requirements are in Sections 110.8(g) and Table 110.8-A.

F. Radiant Barrier

1. Radiant Barrier installed below the roof deck and on all gable end walls: Yes or No. Radiant barriers are required in climate zones 2-15.
2. Comments: Any notes regarding location, unique conditions, or attachments.

NOTE: Radiant barrier performance specifications and installation criteria are found in Sections 110.8(j) and 150.1(c)2, and in Residential Appendix RA4.2.1.

G. Roofing Products (Cool Roof)

Roofing requirements are found in Section 110.8(i) and 150.1(c)11. Depending on the climate zone and roof slope, a cool roof (defined as a minimum aged solar reflectance and thermal emittance, or a minimum SRI) may be required by Package A.

NOTE: Exceptions include (1) additions of 300 ft^2 or less, (2) low-slope roofs (pitch 2:12 or less) in climate zones 1-12, 14 and 16; (3) steep slope roof (pitch greater than 2:12) in climate zones 1-9 and 16; (4) roof constructions that have thermal mass over the roof membrane with at least 25 lb/ft^2; and (5) any roof area covered by building integrated photovoltaic panels and solar thermal panels (the area of roof not covered by photovoltaic panels would still need to meet any applicable cool roof requirements).

1. Tag/ID: A label (if any) from the plans, such as R1.
2. Mass Roof 25 lb/ft^2 or greater: Yes or No. Mass roofs are not required to have a cool roof even if the climate zone specifies minimum performance requirements.
3. Roof Pitch: Expressed as 4:12, for example, which means the roof rises 4 foot within a span of 12 feet. When roofs have multiple pitches the requirements are based on the pitch of 50% or more of the roof.
4. Method of Compliance: Indicate if the method of compliance is going to be based on Aged Solar Reflectance and Thermal Emittance or is it going to be based on the Solar Reflectance Index (SRI).
5. Product Type: See Cool Roof Rating Council's directory. Generally product types include single-ply roof, wood shingles, asphalt roof, metal roof, tile roof.
6. The CRRC Product ID Number is obtained from the Cool Roof Rating Council's Rated Product Directory at www.coolroofs.org/products/results. Products are listed by manufacturer, brand, type of installation, roofing material, and color, as well as product performance.
7. Proposed Initial Solar Reflectance: Based on the product chosen from the Cool Roof Rating Council's Rated Product Directory. If using default assumption indicate NA since the Aged Solar Reflectance is available.
8. Proposed Aged Solar Reflectance: Value is from the Cool Roof Rating Council's Rated Product Directory. If the aged value is not available, calculate the calculated Aged Solar Reflectance using the Solar Reflectance Index (SRI) Calculation worksheet located on the California Energy Commission website or the aging equation $\rho_{aged}=[0.2+\beta[\rho_{initial}-0.2]$, where $\rho_{initial}$ = the initial solar reflectance and soiling resistance β is listed by product type below.

VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

Product Type	CRRC Product Category	β
Field-Applied Coating	Field-Applied Coating	0.65
Other	Not A Field-Applied Coating	0.70

9. Proposed Thermal Emittance: From the product specification default value. If using a calculated SRI, enter the thermal emittance used to calculate SRI.
10. Proposed SRI: It is optional to meet the SRI, but if chosen to do so use the Solar Reflectance Index (SRI) Calculation Worksheet found on the California Energy Commission website http://energy.ca.gov/title24/2013standards/documents/solar_reflectance/.
11. Required Aged Solar Reflectance: Based on climate zone and roof slope.
12. Required Thermal Emittance: Based on climate zone and roof slope.
13. Required SRI: Based on climate zone and roof slope.

If the cool roofing requirements will be met by a liquid field applied coating, Section 110.8(i)4 requires the coating be applied across the entire roof surface and meet the dry mil thickness or coverage recommended by the manufacturer.

H. Fenestration/Glazing Allowed Areas and Efficiencies

Fenestration areas are expressed in square feet, not square inches.

The climate zone and size of the addition will affect the area of fenestration (also known as glazing) allowed. If limited to 20%, for example, this is calculated as Conditioned Floor Area (CFA) of the addition x 0.20 = Total ft^2 of fenestration allowed.

For additions that are $1000ft^2$ or less, but greater than $700ft^2$, the limit of total fenestration is the greater of $175ft^2$ or 20% of the CFA of the addition.
For additions that are $700ft^2$ or less, but greater than $400ft^2$, the limit of total fenestration is the greater of $120ft^2$ or 25% of the CFA of the addition.
For additions that are $400ft^2$ or less, the limit of total fenestration is the greater of $75ft^2$ or 30% of the CFA of the addition.
For additions that are $1000ft^2$ or less, when west-facing fenestration is limited (in climate zones 2, 4, and 6-16), it is limited to either $70ft^2$ (for additions greater than $700ft^2$) or $60ft^2$ (for additions that are $700ft^2$ or less).

1. Addition Type: Based on "Project Scope." The addition's area in square feet—whether ≤300, >300 to ≤400, >400 to ≤700, or >700 to ≤1,000.

(2. through 9.—These fields will be completed based on conditioned floor area of the addition and/or climate zone. The values in these fields will be entered into Section I.)

Maximum allowed fenestration area for all orientations is the greater of the values in column 2 or 3:

2. Maximum Calculated based on Allowed %: The addition's CFA multiplied by the allowed %. The maximum total fenestration area is 30% for additions up to 400 ft^2, 25% for additions greater than 400 ft^2 but no greater than 700 ft^2, and 20% for additions greater than 700 ft^2.
3. Maximum Calculated Allowed ft^2: The maximum total fenestration area is 75ft^2 for additions up to 400 ft^2, 120ft^2 for additions greater than 400 ft^2 but no greater than 700 ft^2, and 175 ft^2 for additions of greater than 700 ft^2.

Maximum allowed west-facing area is the greater of the values in column 4 or 5:

4. Maximum Calculated based on Allowed %: The maximum west-facing fenestration area (in climate zones 2, 4, and 6-16) is 5% for additions greater than 700ft^2.
5. Maximum Calculated Allowed ft^2: The maximum west-facing fenestration area (in climate zones 2, 4, and 6-16) is 60ft^2 for additions no greater than 700ft^2, and 70ft^2 for additions of greater than 700 ft^2.

Addition CFA:	**≤ 400 ft^2**		**> 400 to ≤ 700 ft^2**		**> 700 to ≤ 1,000 ft^2**	
	The Greater Of:		**The Greater Of:**		**The Greater Of:**	
Orientation	**Percentage**	**Area (ft^2)**	**Percentage**	**Area (ft^2)**	**Percentage**	**Area (ft^2)**
West-facing (CZs 2, 4, 6-16)	-	60	-	60	-	70
All Orientations	30%	75	25%	120	20%	175

NOTE: West includes any vertical fenestration oriented to within 45 degrees of true west (in either direction), including 45 degrees north of west, any skylights oriented west, and skylights facing any direction with a pitch of less than 1:12.

6. Maximum Allowed U-factor (Windows): Maximum area-weighted average of 0.32 for all climate zones.
7. Maximum Allowed U-factor (Skylights): Maximum area-weighted average of 0.32 for all climate zones, unless meeting one of the Exceptions to 150.1(c)3A. If meeting one of the Exceptions, this field will be 0.55.
8. Maximum Allowed SHGC (Windows): Maximum area-weighted average of 0.25 for climate zones 2, 4, and 6-16; otherwise N/A.
9. Maximum Allowed SHGC (Skylights): Maximum area-weighted average of 0.25 for all climate zones, unless meeting one of the Exceptions to 150.1(c)3A. If meeting one of the Exceptions, this field will be 0.30.
10. Comments: Any notes regarding location, unique conditions, or attachments.

I. Fenestration/Glazing Proposed Areas and Efficiencies

1. Tag/ID: Provide a name or designator for each unique type of fenestration surface. This designator should be used consistently throughout the plan set (elevations, finish schedules, etc.) such as Window-1, Skylight-1, etc. to identify each surface. It should also be consistently used on the other forms in the compliance documentation.
2. Fenestration Type: Indicate the type of fenestration construction e.g., Fixed Window, Operable Window, Skylight, Tubular Skylight, or Glass in Door.

   NOTE: Doors with glazing are counted in one of two ways. The entire area of a door with 50% or more glazing is considered fenestration. A door with less than 50% glazing can be considered as all fenestration, or can be calculated as the actual glass area with a 2-inch (0.17 ft) frame all around.

3. Frame Type: Metal, metal thermal break, or non-metal.
4. Dynamic Glazing: Indicate whether the fenestration has an integrated shading device, chromogenic glazing, or none for no dynamic glazing. Chromogenic glazing shall be considered separately from other fenestration types.
5. Orientation: Orientation can be North, East, South, or West. If documentation is for a building that may be built in any direction, in a climate zone that limits west-facing fenestration, complete this section assuming the side of the building with the most fenestration faces west.

   NOTE: West includes any vertical fenestration oriented to within 45 degrees of true west, excluding 45 degrees south of west; any skylights oriented west; and skylights facing any direction with a pitch of less than 1:12.

6. Number of Panes: Indicate the number of panes for each Tag/ID; is it a single, double, or triple pane window?
7. Proposed Fenestration Area (ft^2): The size of any windows, doors with glass, or skylights within the floor area of the addition (combine windows with the same characteristics). Indicate the area (in square feet) of each exterior fenestration type, including west-facing fenestration.
8. Proposed West-Facing Fenestration Area ft^2: In climate zones 2, 4, and 6-16, enter the size of any west-facing windows, doors with glass, or skylights within the floor area of the addition. Indicate the area (in square feet) of each exterior west-facing fenestration type separately.
9. Proposed U-factor: Enter
   (a) the NFRC U-factor based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.org) certified values, or
   (b) the default value from Table 110.6-A, or
   (c) the NA6.2 alternate default U-factor (for non-rated site-built fenestration only), or
   (d) the Area-weighted Average from CF1R-ENV-02

   If any products (other than the exceptions noted below) have a higher U-factor than 0.32, first complete a CF1R-ENV-02-E to calculate the area-weighted average U-factor, which must be 0.32 or less, and attach it to the CF1R-ADD-01-E.

NOTES: (1) For the exceptions - up to 3 ft^2 of tubular skylights and up to 16 ft^2 of skylight area, enter 0.55.
(2) For the exception – up to 3 ft^2 of glass in door, enter 0.32.
(3) Dynamic glazing is a glazing system that changes its performance U-factor and SHGC based on the physical environment. Dynamic glazing includes chromogenic glazing or integrated shading systems (this does not include internally or externally mounted shading devices). If using dynamic glazing, use the lowest tested U-factor and SHGC in Columns 9 and 10.

10. Source: The source of the U-factor data for the fenestration product—indicate whether NFRC, Tables 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02).
11. Proposed SHGC: In climate zones 2, 4, and 6-16, enter
(a) the NFRC SHGC based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.org) certified values, or
(b) the default value from Table 110.6-B, or
(c) the NA6.3 alternate default SHGC (for non-rated site-built fenestration only), or
(d) the Area-weighted Average from CF1R-ENV-02.

If any products (other than the exceptions noted below) have a higher SHGC than 0.25 in a climate zone with a maximum SHGC value, first complete a CF1R-ENV-02-E to calculate the area-weighted average SHGC, which must be 0.25 or less, and attach it to the CF1R-ADD-01-E.

NOTES: (1) For the exceptions - up to 3 ft^2 of tubular skylights and up to 16 ft^2 of skylight area, enter 0.30.
(2) For the exception – up to 3 ft^2 of glass in door, enter 0.25.

12. Source: The source of the SHGC data for the fenestration product—indicate whether NFRC, Tables 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02).
13. Exterior Shading Device: If exterior shading devices are used to meet the SHGC requirement, indicate the type of device (from Table S-1 of CF1R-ENV-03-E Solar Heat Gain Coefficient Worksheet) and attach the CF1R-ENV-03-E.

NOTES: (1) An exterior shading device is not used for products with an NFRC rated U-factor and SHGC based on a factory integrated shading device.
(2) Chromogenic glazing shall be considered separately from other fenestration.
14. Combined SHGC from CF1R-ENV-03: If exterior shading devices are combined with the SHGC value of the fenestration to meet the prescriptive SHGC requirements (as indicated in column I. 13), indicate the SHGC calculated on form CF1R-ENV-03 and attach the form for each window with an exterior shading device.
15.-32. Automatically completed entries; no user input required.

J. Space Conditioning Systems – Heating/Cooling – Single Family Dwelling

If an existing space system will condition an addition, the prescriptive requirements do not apply to that system (Exception 4 to Section 150.2(a)). The enforcement agencies may require verification that the capacity of the existing heating system is adequate to meet the added load of the additional conditioned floor area. Since there is no health and safety code requirement to provide cooling, the enforcement agency will not ask for verification that the capacity of the existing system is adequate to meet the added load of the additional conditioned floor area.

If a new system is installed complete a Certificate of Compliance for Alterations to Space Conditioning Systems (CF1R-ALT-02).

1. Dwelling Unit Name: Name of dwelling unit or any other identifying name.
2. Dwelling Unit Total CFA – Sum of Existing Plus Addition (ft^2): Total dwelling unit conditioned floor area in ft^2, as measured from the outside of exterior walls of the dwelling unit or building being altered.
3. Comments: Any notes regarding location or unique conditions.

K. Water Heating Systems for Additions

Water heating compliance for an addition is described in Section 150.2(a). When a water heater is added as part of an addition in a single dwelling, a gas or propane water heater, with a storage tank of 60 gallons maximum or instantaneous, can be used. Electric water heaters can only be used if gas or propane is not available and no recirculation pump can be used.

1. Water Heating System Identification or Name: Enter a unique name for the Water Heating System.
2. Water Heating System Type: Domestic Hot Water (DHW), Hydronic, Combined Hydronic, or Central. DHW is for domestic hot water, hydronic is a water heating system used for space heating only; combined hydronic are when the water heater will provide both space conditioning and domestic hot water.
3. Water Heater Type: For non-central systems only Small Storage or Small Instantaneous are allowed. For central systems pick from Large Storage, Small Storage, Heat Pump, Boiler, Large Instantaneous, Small Instantaneous, or Indirect.
4. Number of Water Heaters in System: In single-family and multi-family with water heaters in each dwelling units the value is 1. For multi-family central systems serving multiple dwelling units enter the total number of water heaters.
5. Water Heater Volume (gal): Tank capacity in gallons. For individual water heaters for a dwelling unit this will be 60 gallons or less. If instantaneous, enter n/a. For multi-family central systems enter the total storage volume.
6. Fuel Type: Gas, Propane, or Electric (only if natural gas is not available)
7. Rated Input Type: Enter the equipment input rating type, for gas or propane fired system the units are Btuh, for electric fired system the units are kW.
8. Rated Input Value: Enter the numeric value of rated input.
9. Heating Efficiency Type: Energy Factor, AFUE, or Thermal Efficiency. From product literature or a California Energy Commission directory.

10. Heating Efficiency Value: Enter the value from product literature or a California Energy Commission directory
11. Standby Loss (percent): Applies only to large storage water heaters. Enter n/a for small storage or instantaneous water heaters.
12. Exterior Insulation R-Value: Enter the R-value if exterior insulation on the storage tank is installed
13. Back-up Solar Savings Fraction: If compliance requires a back-up solar system, indicate the solar contribution (e.g., 0.30). External calculations are required.
14. Central DHW System Distribution Type: For multi-family buildings using a central distribution system a demand recirculation system with at least two distribution loops must be installed. This requirement applies to any building with eight or more units. If the system is non-central or project has individual units enter n/a.
15. Dwelling Unit DHW System Distribution Type: For a Central DHW this field shall be Standard. If non-central then pick from Standard, Demand Recirculation – Manual Control, Demand Recirculation – Sensor Control. Non-central electric water heater must be Standard, no recirculation system shall be installed.

L. Space Conditioning and Water Heating in Multifamily Dwelling Units

If an existing space system will condition an addition, the prescriptive requirements do not apply to that system (Exception 4 to Section 150.2(a)). The enforcement agencies may require verification that the capacity of the existing heating system is adequate to meet the added load of the additional conditioned floor area. Since there is no health and safety code requirement to provide cooling, the enforcement agency will not ask for verification that the capacity of the existing system is adequate to meet the added load of the additional conditioned floor area. If a new space conditioning system is installed complete a Certificate of Compliance for Alterations to Space Conditioning Systems (CF1R-ALT-02)

1. Dwelling Unit Name: Enter one unique name for each of the number of dwelling units with additions as identified in Section A field 06.
2. Dwelling Unit Total CFA – Sum of Existing Plus Addition (ft^2): Total dwelling unit conditioned floor area in ft2, as measured from the outside of exterior walls of the dwelling unit or building being altered.
3. Central Water Heating System Identification or Name: Enter the central DHW system names from K. 01.
4. Dwelling Unit Water Heating System Identification or Name: Note the applicable water heating system name(s) that were entered in section K or L. If more than one water heating system type is needed in the dwelling unit, add another row of data for the dwelling unit and enter the additional water heating system name.
5. Dwelling Unit - Installing a New Space Conditioning System?: If a new Space Conditioning system is planned to be installed, then enter yes, otherwise enter no.
6. Comments: Any notes regarding location or unique conditions.

Documentation Declaration Statements

1. The person who prepared the CF1R will sign and complete the fields for their name, company (if applicable), address, phone number, certification information (if applicable), date and signature (may be electronic).
2. The person who is assuming responsibility for the project being built to comply with Title 24, Part 6, will complete the fields for their name, company (if applicable), address, phone number, license number (if applicable), date and signature (may be electronic).

Registration

The CF1R must be registered with a HERS provider prior to submitting for a building permit.

References

1. Water Heaters:

   Section 150.1(c) allows a limited number of conditions for water heating. If conditions other than these are proposed, the prescriptive compliance approach cannot be used:

   A. 150.1(c)8A one gas or propane storage water heater, up to 75,000 Btu/hour input (typically 50 gallons or less), with either no recirculating system or a demand recirculation system with manual controls. If the Energy Factor is less than or equal to the federal minimum, it must have an R-12 external wrap. See D. below.
   B. 150.1(c)8B one gas or propane instantaneous (tankless) water heater with an input of 200,000 Btu per hour or less, no storage tank, and either no recirculating system, or a demand recirculation system with manual controls. .
   C. 150.1(c)8C a central water-heating system that includes the following components (1) gas or propane water heaters, boilers or other water heating equipment; (2) a water heating recirculation loop that meets the requirements of Section 110.3(c)2 and Section 110.3(c)5 equipped with automatic controls for the recirculation pump based on measurement of hot water demand and hot water return temperature, and if more than 8 dwelling units, two recirculation loops each serving half of the building; (3) a solar water-heating system with a minimum solar savings fraction of 0.20 in climate zones 1 through 9 or a minimum solar savings fraction of 0.35 in climate zones 10 through 16 (installation criteria is in Reference Residential Appendix RA4).
   D. 150.1(c)8D if natural gas is not available, an electric-resistance storage, or instantaneous water heater with addition criteria that it be located inside the conditioned space, has no recirculation pumps, and has a solar water-heating system with a minimum solar savings fraction of 0.50 (installation criteria is in Reference Residential Appendix RA4).

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 1 of 6)
Project Name:	Date Prepared:

A. General Information

01	Project Name:		02	Date Prepared:	
03	Project Location:		04	Building Front Orientation (deg or cardinal):	
05	CA City:		06	Number of Altered Dwelling Units:	
07	Zip Code:		08	Fuel Type:	
09	Climate Zone:		10	Total Conditioned Floor Area (ft2):	
11	Building Type		12	Slab Area (ft2)	
13	Project Scope:		14	Exceptions to Minimum Aged Solar Reflectance and Minimum Thermal or SRI 150.2(b)1Hi	

B. Building Insulation Details (Section 150.2(b)1)

01	02	03	04	05	06		07	08	09	10	11
					Proposed					Required	
								Appendix JA4 Reference			
Tag/ID	Assembly Type	Frame Type	Frame Depth (inches)	Frame Spacing (inches)	Cavity R-value	Continuous Insulation R-value	U-factor	Table	Cell	U-Factor	Comments

C. Roof Replacement (Section 150.2(b)1H)

01	02	03	04	05	06	07	08	09	10	11	12		13	14
							Proposed				Minimum Required			
Tag/ ID	Method of Compliance	Roof Pitch	Exception	CRRC Product ID Number	Product Type	R-value Deck Insulation	Initial Solar Reflectance	Aged Solar Reflectance	Thermal Emittance	SRI (Optional)	Aged Solar Reflectance (Max)	Aged Solar Reflectance (Min)	Thermal Emittance	SRI (Optional)

NOTES

- Roof area covered by building integrated photovoltaic panels and solar thermal panels are exempt from the above Cool Roof requirements.
- Liquid field applied coatings must comply with installation criteria from section 110.8(i)4.

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 2 of 6)
Project Name:	Date Prepared:

D. Fenestration/Glazing Allowed Areas and Efficiencies (Section 150.2(b)1)

01	02	03	04		05		06		07
Alteration Type	Maximum Allowed Fenestration Area For All Orientations (ft^2)	Maximum Allowed West-Facing Fenestration Area Only (ft^2)	Existing Fenestration Area for All Orientations (ft^2)	Existing West-Facing Fenestration Area (ft^2)	Maximum Allowed U-factor (Windows)	Maximum Allowed U-factor (Skylights)	Maximum Allowed SHGC (Windows)	Maximum Allowed SHGC (Skylights)	Comments

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 3 of 6)
Project Name:	Date Prepared:

E. Fenestration/Glazing Proposed Areas and Efficiencies – Add (Section 150.2(b)1A)

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Tag/ID	Fenestration Type	Frame Type	Dynamic Glazing	Orientation N, S, W, E	Number of Panes	Proposed Fenestration Area (ft^2)	Proposed West Facing Fenestration Area (ft^2)	Proposed U-factor	Source	Proposed SHGC	Source	Exterior Shading Device	Combined SHGC from CF1R-ENV-03

15	Existing + Proposed Fenestration Area	
16	Maximum Allowed Fenestration Area	
17	Compliance Statement	
18	Existing + Proposed West-Facing Fenestration Area	
19	Maximum Allowed West Fenestration Area	
20	Compliance Statement	
21	Proposed Fenestration U-factor (Windows)	
22	Required Fenestration U-factor (Windows)	
23	Compliance Statement	
24	Proposed Fenestration SHGC (Windows)	
25	Required Fenestration SHGC (Windows)	
26	Compliance Statement	
27	Proposed Fenestration U-factor (Skylights)	
28	Required Fenestration U-factor (Skylights)	
29	Compliance Statement	
30	Proposed Fenestration SHGC (Skylights)	
31	Required Fenestration SHGC (Skylights)	
32	Compliance Statement	

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 4 of 6)
Project Name:	Date Prepared:

F. Fenestration/Glazing Proposed Areas and Efficiencies – Replace (Section 150.2(b)1B)

01	02	03	04	05	06	07	08	9	10	11	12	13	14
Tag/ ID	Fenestration Type	Frame Type	Dynamic Glazing	Orientation N, S, W, E	Area Removed (ft^2)	Area Added (ft^2)	Net Added Area (ft^2)	Proposed U-factor	Source	Proposed SHGC	Source	Exterior Shading Device	Combined SHGC from CF1R-ENV-03

15	Net Added West-facing Fenestration Area	
16	Is Net Added Fenestration Area ≤ 0 for west-facing fenestration?	
17	Net Added Fenestration Area (all orientations)	
18	Is Net Added Fenestration Area ≤ 0 for all orientations?	
19	Proposed Fenestration U-factor (Windows)	
20	Required Fenestration U-factor (Windows)	
21	Compliance Statement	
22	Proposed Fenestration SHGC (Windows)	
23	Required Fenestration SHGC (Windows)	
24	Compliance Statement	
25	Proposed Fenestration U-factor (Skylights)	
26	Required Fenestration U-factor (Skylights)	
27	Compliance Statement	
28	Proposed Fenestration SHGC (Skylights)	
29	Required Fenestration U-factor (Skylights)	
30	Compliance Statement	

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 5 of 6)
Project Name:	Date Prepared:

G. Space Conditioning (SC) Systems - Heating/Cooling (Section 150.2(b))

01	02	03
Dwelling Unit Name	Dwelling Unit Total CFA (ft^2)	Comments

H. Water Heating Systems (Section 150.2(b)1G)

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Water Heating System Identification or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Back-Up Solar Savings Fraction	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type

I. Space Conditioning Systems and Water Heating Systems in Multifamily Dwelling Unit

01	02	03	04	05	06
Dwelling Unit Name	Dwelling Unit Total CFA (ft^2)	Central Water Heating System Identification or Name	Dwelling Unit: Water Heating System Identification or Name	Dwelling Unit: Alteration to the Space Conditioning System(s)?	Comments

CERTIFICATE OF COMPLIANCE	CF1R-ALT-01-E
Prescriptive Residential Alterations	(Page 6 of 6)
Project Name:	Date Prepared:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Compliance documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Signature Date:
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. That the energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a registered copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name:	Responsible Designer Signature:
Company :	Date Signed:
Address:	License:
City/State/Zip:	Phone:

For assistance or questions regarding the Energy Standards, contact the Energy Hotline at: 1-800-772-3300

CF1R-ALT-01-E User Instructions

Minimum requirements for prescriptive alteration compliance can be found in Building Energy Efficiency Standards Section 150.2(b)1.

Completing these forms will require that you have the Reference Appendices for the 2013 Building Energy Efficiency Standards (P400-2012-005). This document contains the Joint Appendices which are used to determine climate zone and to complete the section for opaque surfaces. When the term CF1R is used it means the CF1R-ALT-01. Worksheets are identified by their entire name and subsequently by only the worksheet number, such as WS-02.

Instructions for sections with column numbers and row numbers are given separately.

If any part of the alteration does not comply, prescriptive compliance fails, in which case the performance compliance approach must be used in an attempt to achieve compliance.

A. General Information

1. Project Name: Identifying information, such as owner's name.
2. Date: Date of document preparation.
3. Project Location: Legal street address of property or other applicable identifying information.
4. Building Front Orientation: Building front expressed in degrees, where North = 0, East = 90, South = 180, and West = 270. Indicate cardinal if it is a subdivision or multi-family project built in multiple orientations. The standards (section 100.1) include the following additional details for determining orientation:
    - Cardinal covers all orientations (for buildings that will be built in multiple orientations);
    - North is oriented to within 45 degrees of true north, including 45 degrees east of north;
    - East is oriented to within 45 degrees of true east, including 45 degrees south of east;
    - South is oriented to within 45 degrees of true south, including 45 degrees west of south;
    - West is oriented to within 45 degrees of true west, including 45 degrees south of west.
5. CA City: Legal city/town of property.
6. Number of Altered Dwelling Units: 1 for single-family, 1 or more for multifamily.
7. Zip Code: 5-digit zip code for the project location (used to determine climate zone).
8. Fuel Type: Natural Gas, Liquefied Propane Gas, or Electricity.

   NOTE: prescriptive compliance only allows electricity if existing appliances are electric and natural gas is not available in the building.

9. Climate zone: From Joint Appendix JA2.1.1.

10. Total Conditioned Floor Area: Enter the new conditioned floor area in ft^2, as measured from the outside of exterior walls of the dwelling unit or building being altered.
11. Building Type: Single Family (includes duplex), or Multi Family (a building that shares common walls and common floors or ceilings).
12. Slab Area: Area of the first floor slab (if any) in ft^2.
13. Project Scope: Check all that apply – insulation, roof replacement > 50%, space heating system, space cooling system, duct system, water heating, adding fenestration/glazing, replacing fenestration/glazing, adding fenestration/glazing ≤ 75 ft^2 windows, replacing fenestration/glazing ≤ 75 ft^2 window, adding fenestration/glazing ≤ 16 ft^2 skylight and or replacing fenestration/glazing skylights
14. Exceptions to Minimum Aged Solar Reflectance and Minimum Thermal Emittance or SRI: No exception, Air-space of 1.0 inch (25mm) is provided between the top of the roof deck to the bottom of the roofing product, the installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product, existing ducts in the attic are insulated and sealed according to Section 150.1(c)9, building with at least R-38 ceiling insulation, buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2, buildings that have no ducts in attic, R-4 or greater insulation above the roof deck.

B. Building Insulation Details (Section 150.2(b)1)

1. Tag/ID: A label (if any) from the plans, such as A1.4 or wall.
2. Assembly Type: Roof, Ceiling, Wall, Floor.
3. Frame Type: Wood or Metal.
4. Frame Depth: Nominal dimensions (in inches) of framing material such as 2x4 or 2x6.
5. Frame Spacing: 16, 24, or 48 inches on center.
6. Proposed Cavity R-value: Insulation installed between framing.

NOTE: Section 110.8(d) specifies that if adding insulation to an existing attic, the resulting attic insulation must total R-30. However, the amount of insulation required is limited to the amount of room available for insulation without conflicting with Building Code Section 1203.2.

Proposed Continuous Insulation R-value: Insulation installed on the exterior. See Joint Appendix JA4 for guidance.

7. Proposed U-factor: The U-factor for the entire wall, roof or floor assembly.
8. Appendix JA4 Table: Table number used to determine the R-value or U-factor (e.g., an attic assembly is 4.2.1).
9. Appendix JA4 Cell: Cell number used to determine the R-value or U-factor (e.g., an R-38 ceiling with 24-inch on center framing is A21).
10. Required U-factor: From mandatory requirements in Sections 110.0 and 150.0.
11. Comments: Any notes regarding location or unique conditions.

C. Roof Replacement (Section 150.2(b)1H)

When 50% or more of the roof is being replaced the roofing requirements are triggered. Any areas of roof covered by building integrated photovoltaic panels and solar thermal panels (the area of roof not covered by photovoltaic panels would still need to meet any applicable cool roof requirements). Additionally, there are many alternatives/exceptions when a cool roof is required.

When the roof is steep slope (pitch greater than 2:12) the roof requirements include a cool roof in climate zones 10-15. The minimum requirement is 0.20 aged solar reflectance, 0.75 thermal emittance, or a minimum SRI of 16.

1. Tag/ID: A label, if any, from the plans, for example R-1.
2. Method of Compliance: Indicate if the method of compliance is going to be based on Aged Solar Reflectance and Thermal Emittance, the Solar Reflectance Index (SRI), or an Exception.
3. Roof Pitch: Expressed as 4:12, for example, which means the roof rises 4 foot within a span of 12 feet. When roofs have multiple pitches the requirements are based on the pitch of 50% or more of the roof.
4. Exception: If meeting one of the exceptions. Indicate which exception is, or will be, met.

EXCEPTIONS AND ALTERNATIVES FOR STEEP SLOPE ROOFS:

(a) Mass roof 25 lbs/ft^2 or greater (uncommon situation such as sod roof);
(b) Air space 1” from top of roof deck to bottom of roofing;
(c) Roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product;
(d) Ducts already meet Section 150.1(c) insulation and duct leakage requirements;
(e) Roof has R-38 insulation;
(f) Roof has a radiant barrier;
(g) No ducts are installed in the attic; or
(h) R-4 insulation above the roof deck.

In climate zones 13-15, when there is a low slope roof (pitch 2:12 or less) the cool roof requirements are for a minimum Aged Solar Reflectance of 0.63, a minimum 0.75 Thermal Emittance, or a minimum SRI of 75.

EXCEPTIONS AND ALTERNATIVES FOR LOW SLOPE ROOFS:

(a) Mass roof 25 lbs/ft^2 or greater (uncommon situation such as sod roof);
(b) No ducts are installed in the attic; or
(c) Roof deck installation—by installing roof deck insulation, a lower aged solar reflectance is required: R-2 (0.62-0.60), R-4 (0.59-0.55), R-6 (0.54-0.50), R-8 (0.49-0.45), R-12 (0.44-0.40), R-16 (0.39-0.35), R-20 (0.34-0.30), R-24 (0.29-0.25).

NOTE: If one of the exceptions above has been selected than the rest of Section c is Not Required.

5. The CRRC Product ID Number is obtained from the Cool Roof Rating Council's Rated Product Directory at www.coolroofs.org/products/results. Products are listed by manufacturer, brand, type of installation, roofing material, and color, as well as product performance.
6. Product Type: See Cool Roof Rating Council's directory. Generally product types include single-ply roof, wood shingles, asphalt roof, metal roof, tile roof.
7. R-value Deck Insulation: If one of the exceptions selected includes adding roof deck insulation, indicate the R-value of insulation.
8. Proposed Initial Solar Reflectance: Based on the product chosen from the Cool Roof Rating Council's Rated Product Directory. If using default assumption indicate NA since the Aged Solar Reflectance is available.
9. Proposed Aged Solar Reflectance: Value is from the Cool Roof Rating Council's Rated Product Directory. If the aged value is not available, calculate the calculated Aged Solar Reflectance using the Solar Reflectance Index (SRI) Calculation worksheet located on the California Energy Commission website or the aging equation ρ_{aged}=[0.2+β[$\rho_{initial}$-0.2], where $\rho_{initial}$ = the initial solar reflectance and soiling resistance β is listed by product type below.

VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

Product Type	**CRRC Product Category**	**β**
Field-Applied Coating	Field-Applied Coating	0.65
Other	Not A Field-Applied Coating	0.70

10. Proposed Thermal Emittance: From the product specification default value. If using a calculated SRI place the Thermal Emittance used to calculate SRI.
11. Proposed SRI: It is optional to meet the SRI but if chosen to do so, use the Solar Reflectance Index (SRI) Calculation Worksheet found on the California Energy Commission website http://www.energy.ca.gov/title24/2013standards/documents/solar_reflectance/.
12. Minimum Required Aged Solar Reflectance: Based on climate zone and roof slope.
13. Minimum Required Thermal Emittance: Based on climate zone and roof slope.
14. Minimum Required SRI: Based on climate zone and roof slope.

NOTE: If the cool roofing requirements will be met by a liquid field applied coating, Section 110.8(i)4 requires the coating be applied across the entire roof surface and meet the dry mil thickness or coverage recommended by the manufacturer.

D. Fenestration/Glazing Allowed Areas and Efficiencies (Section 150.2(b)1)

The climate zone and scope of the alteration will affect the amount of fenestration (also known as glazing) allowed. If limited to 20%, this is calculated as Conditioned Floor Area x 0.20 = total ft^2 of fenestration allowed (20%). Fenestration areas are expressed in feet, not inches. When west-facing fenestration is limited (in climate zones 2, 4, and 6-16), it is limited to a maximum of 5%. Additions of 1,000 ft^2 or less have alternate requirements. For example, the limit may be 120 ft^2 of fenestration or 25%. While west-facing fenestration may be limited, if there is no west fenestration the upper limit remains at 120 ft^2 or 25% (or the values shown in columns 2 and 3).

The Alteration Type and Fenestration Type will affect how the standards apply and whether the fenestration area is limited. Percentages are determined as Conditioned Floor Area x 0.20 = total ft^2 of fenestration allowed (20%). Depending on the climate zone, if west-facing fenestration is limited, it is limited to a maximum of 5%. The overall total fenestration area is limited to 20%, not 25%. Fenestration areas are expressed in feet, not inches.

1. Alteration Type. Auto-filled with the project scope in A13: adding fenestration/glazing, replacing fenestration/glazing, adding fenestration/glazing ≤ 75 ft^2 windows, replacing fenestration/glazing ≤ 75 ft^2 window, adding fenestration/glazing ≤ 16 ft^2 skylight and or replacing fenestration/glazing skylights.
2. Maximum Allowed Fenestration Area for All Orientations (ft^2): The maximum total fenestration area is 20%. Depending on the type of fenestration and the alteration type, this field may show values such as 75 ft^2 or 16 ft^2.
3. Maximum Allowed West-Facing Fenestration Area Only: Calculated value based on conditioned floor area time 5 percent (Used in climate zones 2, 4, and 6-16)

NOTE: (1) If adding fenestration/glazing ≤ 75 ft^2 window or ≤ 16 ft^2 skylight, enter NA
(2) West includes any vertical fenestration oriented to within 45 degrees of true west, including 45 degrees south of west. For skylights, west also includes any skylight area facing any direction with a pitch of less than 1:12

4. Existing Fenestration Area for All Orientations: Enter the area, in square feet, of the existing fenestration/glazing.

Existing West-Facing Fenestration Area: Enter the area, in square feet, of the existing west-facing fenestration/glazing. If project has no existing west-facing fenestration then enter "0".

5. Maximum Allowed U-factor: Maximum U-factor from Package A or Table 150.1-A. This field will almost always be 0.32 unless the U-factor will be the area weighted average, CF1R-ENV-02, with other higher fenestration windows. For skylights this will be 0.55.
6. Maximum Allowed SHGC: Maximum SHGC from Package A or Table 150.1-A. This field will almost always be either 0.25 or N/A, depending on climate zone. N/A means there is no maximum SHGC required in this climate zone. The SHGC will be the area weighted average, CF1R-ENV-02, with other higher fenestration windows. For skylights this will be 0.30.
7. Comments: Note any special location or comment here.

E. Fenestration/Glazing Proposed Areas and Efficiencies – Add (Section 150.2(b)1A)

1. Tag/ID: A label (if any) from the plans, such as W1.
2. Fenestration Type: Indicate the type of fenestration construction e.g., Fixed Window, Operable Window, or Skylight.

   NOTE: Doors with glazing are counted in one of two ways. A door with 50% or more glazing is counted as the entire door area. A door with less than 50% glazing can be counted as the entire door area or can be calculated as the actual glass area with a 2-inch (0.17 ft^2) frame all around.

3. Frame type: Metal, metal thermal break, or non-metal.
4. Dynamic Glazing: Indicated if the fenestration has integrated shading device, chromogenic glazing or none for no dynamic glazing. Chromogenic glazing shall be considered separately from other fenestration types.
5. Orientation (North, East, South, West). In climate zones where the West-facing glazing is limited, list west-facing individually. The definitions in the Energy Efficiency Standards include these specific details:
   - North is oriented to within 45 degrees of true north, including 45 degrees east of north;
   - East is oriented to within 45 degrees of true east, including 45 degrees south of east;
   - South is oriented to within 45 degrees of true south, including 45 degrees west of south;
   - West is oriented to within 45 degrees of true west, including 45 degrees north of west.

   NOTE: Skylights in a roof pitch greater than 1:12 can be included as facing the same orientation as that portion of the roof angle. If the skylight is in a roof with a pitch less than 1:12, the skylight is assumed to face west.

6. Number of Panes: Indicate the number of panes for each Tag/ID; is it single, double, or triple pane window?
7. Proposed Fenestration Area (ft^2): Indicate the area (in square feet) of each exterior fenestration type, excluding west-facing fenestration.
8. Proposed West Facing Fenestration Area (ft^2): In climate zones 2, 4, 6-16, indicate the area (in square feet) of each exterior west-facing fenestration type separately.

   NOTE: Skylights installed in a roof with pitch less than 1:12 are considered to face west.

9. Proposed U-factor: Enter
   (a) the NFRC U-factor based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.org) certified values, or
   (b) the default value from Table 110.6-A, or
   (c) the NA6.2 alternate default U-factor (for non-rated site-built fenestration only), or
   (d) the Area-weighted Average from CF1R-ENV-02.

If any products (other than skylights) have a higher U-factor than 0.32, first complete a CF1R-ENV-02 to calculate the area-weighted average U-factor, and attach it to the CF1R-ALT-01.

NOTE: Dynamic glazing is a glazing system that changes its performance U-factor and SHGC based on the physical environment. Dynamic glazing includes chromogenic glazing or integrated shading systems (this does not include internally or externally mounted shading devices). If using dynamic glazing, use the lowest tested U-factor and SHGC in Columns 8 and 11.

10. Source: NFRC, Table 100.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the U-factor data for the fenestration product.
11. Proposed SHGC: In climate zones 2, 4, 6-16 enter
    (a) the NFRC-SHGC based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.com) certified values, or
    (b) the default value Table 110.6-B, or
    (c) the NA6.3 alternate default SHGC (for non-rated site-built fenestration only), or
    (d) the Area-weighted Average from CF1R-ENV-02.

    If any products (other than skylights) have a higher SHGC than required by Package A, first complete a form CF1R-ENV-02 to calculate the area-weighted average SHGC and attach it to the CF1R-ALT-01.

12. Source: NFRC, Table 100.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the SHGC data for the fenestration product.
13. Exterior Shading Device: If exterior shading devices are used to meet the SHGC requirement, indicate the type of device (from Table S-1 of CF1R-ENV-03 Solar Heat Gain Coefficient Worksheet) and attach an ENV-03.

NOTES: (1) An exterior shading device is not used for products with an NFRC rated U-factor and SHGC based on a factory integrated shading device.
(2) Chromogenic glazing shall be considered separately from other fenestration.
(3) If using an overhang for south-facing glazing, the glazing must be fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21 (see Residential Manual, Section 3.5.5).

14. Combined SHGC from CF1R-ENV-03: If exterior shading devices are combined with the SHGC value of the fenestration to meet the prescriptive SHGC requirements (as indicated by a value in column E. 13), indicate the SHGC calculated on form CF1R-ENV-03 and attach the form for each window with an exterior shading device.

15.-32. Automatically completed entries; no user input required.

F. Fenestration/Glazing Proposed Areas and Efficiencies – Replace (Section 150.2(b)1B)

1. Tag/ID: A label (if any) from the plans, such as W1.
2. Fenestration Type: Indicate the type of fenestration construction e.g., Fixed Window, Operable Window, or Skylight.

   NOTE: Doors with glazing are counted in one of two ways. A door with 50% or more glazing is counted as the entire door area. A door with less than 50% glazing can be counted as the entire door area or can be calculated as the actual glass area with a 2-inch (0.17 ft^2) frame all around.

3. Frame type: Metal, metal thermal break, or non-metal.
4. Dynamic Glazing: Indicate if the fenestration has integrated shading device, chromogenic glazing or none for no dynamic Glazing. Chromogenic glazing shall be considered separately from other fenestration types.
5. Orientation (North, East, South, West). In climate zones where the West-facing glazing is limited, list west-facing individually. The definitions in the Energy Efficiency Standards include these specific details:
   - North is oriented to within 45 degrees of true north, including 45 degrees east of north;
   - East is oriented to within 45 degrees of true east, including 45 degrees south of east;
   - South is oriented to within 45 degrees of true south, including 45 degrees west of south;
   - West is oriented to within 45 degrees of true west, including 45 degrees north of west.

   NOTE: Skylights in a roof pitch greater than 1:12 can be included as facing the same orientation as that portion of the roof angle. If the skylight is in a roof with a pitch less than 1:12, the skylight is assumed to face west.

6. Area Removed (ft^2): Enter the area, in square feet, of the fenestration/glazing being removed.
7. Area Added (ft^2): Enter the area, in square feet, of the fenestration/glazing being added.
8. Net Added Area (ft^2): The difference between the Area Added and the Area Removed.
9. Proposed U-factor: Enter
   (a) the NFRC U-factor based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.org) certified values, or
   (b) the default value from Table 110.6-A, or
   (c) the NA6.2 alternate default U-factor (for non-rated site-built fenestration only), or
   (d) the Area-weighted Average from CF1R-ENV-02.

   If any products (other than skylights) have a higher U-factor than 0.32, first complete a CF1R-ENV-02 to calculate the area-weighted average U-factor and attach it to the CF1R-ALT-01.

NOTE: Dynamic glazing is a glazing system that changes its performance U-factor and SHGC based on the physical environment. Dynamic glazing includes chromogenic glazing or integrated shading systems (this does not include internally or externally mounted shading devices). If using dynamic glazing, use the lowest tested U-factor and SHGC in Columns 8 and 11.

10. Source: NFRC, Table 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the U-factor data for the fenestration product.
15. Proposed SHGC: In climate zones 2, 4, 6-16 enter
    (e) the NFRC-SHGC based on the proposed brand and type of fenestration using National Fenestration Rating Council (www.nfrc.com) certified values, or
    (f) the default value Table 110.6-B, or
    (g) the NA6.3 alternate default SHGC (for non-rated site-built fenestration only), or
    (h) the Area-weighted Average from CF1R-ENV-02.

    If any products (other than skylights) have a higher SHGC than required by Package A, first complete a form CF1R-ENV-02 to calculate the area-weighted average SHGC and attach it to the CF1R-ALT-01.

11. Source: NFRC, Table 110.6-A and 110.6-B, Equations NA6-1 and NA6-2, or Area-weighted Average Worksheet (ENV-02). The source of the SHGC data for the fenestration product.
12. Exterior Shading Device: If exterior shading devices are used to meet the SHGC requirement, indicate the type of device (from Table S-1 of CF1R-ENV-03 Solar Heat Gain Coefficient Worksheet) and attach an ENV-03.

    NOTES: (1) An exterior shading device is not used for products with an NFRC rated U-factor and SHGC based on a factory integrated shading device.
    (2) Chromogenic glazing shall be considered separately from other fenestration.
    (3) If using an overhang for south-facing glazing, the glazing must be fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21 (see Residential Manual, Section 3.5.5).

13. Combined SHGC from CF1R-ENV-03: If exterior shading devices are combined with the SHGC value of the fenestration to meet the prescriptive SHGC requirements (as indicated by a value in column F. 13), indicate the SHGC calculated on form CF-1R-ENV-03 and attach the form for each window with an exterior shading device.

15.-30. Automatically completed entries; no user input required.

G. Space Conditioning (SC) Systems – Heating/Cooling (Section 150.2(b))

Requirements of the standards apply to a heating and cooling system alteration based on the type of alteration and the system type (Section 150.2(b)1). A completely new system will meet all mandatory and prescriptive requirements, which vary by climate zone (based on Section 150.2(b)1C). [NOTE: Computer performance compliance can be used to trade-off any requirements that are not mandatory.] When parts of a system are replaced, it may trigger some of the same requirements that apply to new systems and duct alterations. A Certificate of Compliance for Alterations to Space Conditioning Systems (CF1R-ALT-02) is required for each dwelling unit with a space conditioning system alteration.

1. Dwelling Unit Name: Name of dwelling unit or any other identifying name.
2. Dwelling Unit Total CFA (ft^2): Conditioned floor area in ft^2, as measured from the outside of exterior walls of the dwelling unit or building being altered.
3. Comments: Any notes regarding location or unique conditions.

H. Water Heating Systems (Section 150.2(b)1G)

Water heating compliance for an alteration is described in Section 150.2(b)1G. For a single dwelling unit, a gas or propane water heater that meets the requirements of 150.1(c)8 can be used. If no natural gas is connected to the building, an electric water heater with an energy factor greater than or equal to the minimal energy factor required under the Appliance Efficiency Regulation, and with storage capacity of less than 60 gallons can be used. Dwelling Unit distribution systems are limited to Standard trunk and branch or demand recirculation for gas or propane water heater. Demand recirculation is not allowed for electric water heater. If there is no natural gas connected to the building, an electric water heater may be replaced with another electric water heater. However, changing from gas to electric is not allowed. Multi-family central systems must use certified equipment as defined under Section 110.1 and 110.3.

1. Water Heating System Identification or Name: Enter a unique name for the Water Heating System.
2. Water Heating System Type: Domestic Hot Water (DHW), Hydronic, Combined Hydronic, or Central. DHW is for domestic hot water, hydronic is a water heating system used for space heating only; combined hydronic are when the water heater will provide both space conditioning and domestic hot water.
3. Water Heater Type: For non-central systems only Small Storage or Small Instantaneous are allowed. For central systems pick from Large Storage, Small Storage, Heat Pump, Boiler, Large Instantaneous, Small Instantaneous or Indirect.
4. Number of Water Heaters in System: In single-family and multi-family with water heaters in each dwelling units the value is 1. For multi-family central systems serving multiple dwelling units enter the total number of water heaters.
5. Water Heater Volume (gal): Tank capacity in gallons. For individual water heaters for a dwelling unit this will be 60 gallons or less. If instantaneous, enter n/a. For multi-family central systems enter the total storage volume.
6. Fuel Type: Gas, Propane, Electric (Only if natural gas is not available)
7. Rated Input Type: Enter the equipment input rating type, for gas or propane fired system the units are Btuh, for electric fired system the units are kW.

8. Rated Input Value: Enter the numeric value of rated input.
9. Heating Efficiency Type: Energy Factor, AFUE, or Thermal Efficiency. From product literature or a California Energy Commission directory.
10. Heating Efficiency Value: Enter the value from product literature or a California Energy Commission directory
11. Standby Loss (percent): Applies only to large storage water heaters. Enter n/a for small storage or instantaneous water heaters.
12. Exterior Insulation R-Value: Enter the R-value if exterior insulation on the storage tank is installed
13. Back-Up Solar Savings Fraction: If compliance requires a back-up solar system, indicate the solar contribution (e.g., 0.30). External calculations are required.
14. Central DHW Distribution System: For multi-family buildings with using a central distribution system a demand recirculation system with at least two distribution loops must be installed. This requirement applies to any building with eight or more units. If the system is non-central or project is individual units enter n/a.
15. Dwelling Unit DHW Distribution Type: For a Central DHW this field shall be Standard. If non-central then pick from Standard, Demand Recirculation – Manual Control, Demand Recirculation – Sensor Control. If non-central electric water heater this must be Standard, no recirculation system shall be installed.

I. Space Conditioning Systems and Water Heating Systems in Multifamily Dwelling Units

Requirements of the standards apply to a heating and cooling system alteration based on the type of alteration and the system type (Section 150.2(b)1). A completely new system will meet all mandatory and prescriptive requirements, which vary by climate zone (based on Section 150.2(b)1C). [NOTE: Computer performance compliance can be used to trade-off any requirements that are not mandatory.] When parts of a system are replaced, it may trigger some of the same requirements that apply to new systems and duct alterations. A Certificate of Compliance for Alterations to Space Conditioning Systems (CF1R-ALT-02) is required for each dwelling unit with a space conditioning system alteration.

1. Dwelling Unit Name: Name of dwelling unit or any other identifying name.
2. Dwelling Unit Total CFA (ft^2): Conditioned floor area in ft^2, as measured from the outside of exterior walls of the dwelling unit or building being altered.
3. Central Water Heating System Identification or Name: Select one of the central DHW system names.
4. Dwelling Unit Water Heating System Identification or Name: Select the applicable water heating system name(s) that were entered in section G or select n/a if no water heating systems are planned to be installed in this dwelling. If more than one water heating system type is needed in the dwelling unit, enter another row of data for the dwelling unit and select the additional water heating system name.
5. Dwelling Unit - Alteration to the Space Conditioning System(s)?: If altering one or more of the Space conditioning systems in the dwelling enter yes, otherwise enter no
6. Comments: Any notes regarding location or unique conditions.

Signatures

1. The person who prepared the CF1R will sign and complete the fields for their name, company (if applicable), address, phone number, certification information (if applicable), date and signature (may be electronic).
2. The person who is assuming responsibility for the project being built to comply with Title 24, Part 6, will complete the fields for their name, company (if applicable), address, phone number, license number (if applicable), date and signature (may be electronic).

Registration

1. The CF1R must be registered with a HERS provider prior to submitting for a building permit. See Residential Manual Section 2.1.1.

CERTIFICATE OF COMPLIANCE	CF1R-ALT-03-E
Alterations - HVAC CZ 1, 3 to 7 and 16 (formerly CF-1R-ALT-HVAC)	(Page 1 of 1)

Site Address:				**Enforcement Agency:**	**Date Prepared:**	**Permit#:**
Equipment Type		Equipment Efficiency		New: Ducting, *Plenums, Lineset* Required R-value	Conditioned Floor Area (sq ft)	Thermostat
☐ Packaged System ☐ Split System ☐ Furnace	☐ Evaporator Coil ☐ Condensing Unit ☐ Lineset	_____AFUE _____SEER ______EER	______COP _____HSPF	☐ R-6 *(CZ 1,3-7)* Ducts ☐ R-8[1] *(CZ 16)* Ducts ☐ R-6 (*all CZ's*) Plenums ☐ R-5 or R7.5 Lineset[3]	Served by system _________sq ft	☐ Setback *(If not already present, must be installed)*

HERS VERIFICATION SUMMARY Installer determines work to be completed and matches to one of the options below. At permit application this form is allowed to be filled out by hand. For final inspection all forms are to be registered (no hand filled forms allowed) and a copy left on site.

☐ **1. HVAC Changeout/Repair** **Can include new ducting**	**Required Compliance Documents to be left on site for Final**:
All Equipment, Condenser Unit, Evaporator Coil, Air Handler/Furnace	CF1R-ALT-02-E CF2R: MECH-01, MECH-20-HERS CF3R: MECH-20-HERS

Installer Requirement: Duct leakage (≤ 15% or, ≤ 10% to outside, or seal all accessible leaks)
Exempted from duct leakage testing if:
☐ 1. Duct system registered with HERS provider as previously sealed, or ☐ 2. There is less than 40 linear feet of duct in unconditioned space, or ☐ 3. Existing duct systems are constructed, insulated or sealed with asbestos (list manufacture date of building ________)

☐ 2. **New HVAC System**	**Required Compliance Documents to be left on site for Final**:
All new equipment and All New Ducts[2]	CF1R-ALT-02-E CF2R-MECH-01, MECH-20-HERS, MECH-22-HERS, MECH-(23 or 24)-HERS CF3R-MECH-20-HERS, MECH-22-HERS, MECH-(23 or 24)-HERS[2]

Installer Requirement: Duct leakage ≤ 6%, Fan Efficacy (.58W/CFM), Air Flow ≥ 350 CFM/ton (or Standards Table 150.0-C / D alternative)

☐ 3. **All New Ducts with Replacement**	**Required Compliance Documents to be left on site for Final**:
Includes replacing or installing All New Ducts[2] and one or more of the following: Condenser Unit, Evaporator Coil, Furnace	CF1R-ALT-02-E CF2R-MECH-01, MECH-20-HERS, MECH-(23 or 24)-HERS CF3R-MECH-20-HERS, MECH-(23 or 24)-HERS

Installer Requirement: Duct leakage ≤ 6%, Air Flow ≥ 350 CFM/ton (or Standards Table 150.0-C / D alternative)
☐ Exempted from duct leakage testing I existing duct systems are constructed, insulated or sealed with asbestos.

☐ 4. **New Ducting over 40 feet**	**Required Compliance Documents to be left on site for Final**:
Adding or replacing ducts in unconditioned space but less than All New Ducts[2]	CF1R-ALT-02-E CF2R: MECH-20-HERS CF3R: MECH-20-HERS

Installer Required to: Duct leakage (≤ 15% or, ≤ 10% to outside, or seal all accessible leaks)
☐ Exempted from duct leakage testing I existing duct systems are constructed, insulated or sealed with asbestos.

[1] All **new** ducting R-8 required when more than 40 ft installed and R-6 when less than 40 ft installed. This includes in walls, between floors etc.
[2] A New Duct system is when the duct system is constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system (e.g., registers, grilles, boots, air handler, plenums, duct material.
[3] R-5 (1" thick insulation) for linesets 1" and less. R-7.5 (1.5" thick insulation) for linesets over 1 inch. Most mfg will require Suction line Diameter with insulation as the following 1.5-2T-2⅝", 2.5-3T-2¾", 3.5 to 4T-2⅞", 5T-4⅛"

Contractor (Documentation Author's /Responsible Designer's Declaration Statement)

I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the California Business and Professions Code to accept responsibility for the information on this document.
3. That the energy features and performance specifications for the design identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California Code of Regulations (CCR).
4. That the energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the CCR.
5. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.

Responsible Designer Name:	Responsible Designer Signature:	Date Signed:	License:
Company :	Address:	City/State/Zip:	Phone:

For assistance or questions regarding the Energy Standards, contact the Energy Hotline at: 1-800-772-3300

CERTIFICATE OF COMPLIANCE	CF1R-ALT-04-E
Alterations - HVAC CZ 2, and 8-15 (formerly CF-1R-ALT-HVAC)	(Page 1 of 1)

Site Address:				**Enforcement Agency:**	**Date Prepared:**	**Permit#:**
Equipment Type		Equipment Efficiency		New Ducting, *Plenums, Lineset:* Required R-value	Conditioned Floor Area (sq ft)	Thermostat
☐ Packaged System ☐ Split System ☐ Mini Split ☐ Furnace	☐ Evaporator Coil ☐ Condensing Unit ☐ Compressor ☐ Lineset ☐ TXV	_____AFUE _____SEER ______EER	_______COP ______HSPF	☐ R-6 *(CZ 2, 8-13)* Ducting ☐ R-8[1] *(CZ 11, 14, 15)* Ducting ☐ R-6 (*all CZ's*) Plenums ☐ R-5 or R7.5) Lineset[4]	Served by system _________sqft	☐ Setback *(If not already present, must be installed)*

HERS VERIFICATION SUMMARY Installer determines work to be completed and matches to one of the options below. At permit application this form is allowed to be filled out by hand. For final inspection all forms are to be registered (no hand filled forms allowed) and a copy left on site.

☐ **1. HVAC Changeout/Repair**	**Required Compliance Documents to be left on site for Final**:
All Equipment, Condenser Unit, Evaporator Coil, Compressor, TXV, Lineset, Air Handler/Furnace[2] **(Can include new ducting)**	CF1R-ALT-02-E CF2R: MECH-01, MECH-20-HERS, MECH-(23 or 24)[2]-HERS, MECH-25-HERS[2] CF3R: MECH-20-HERS, MECH-(23 or 24)-HERS[2], MECH-25-HERS[2]

Installer Requirement: Duct leakage (< 15%, or < 10% to outside, or seal all accessible leaks), Air Flow ≥ 300 CFM/ton, Refrigerant Charge.
Exempted from duct leakage testing if:
☐ 1. Duct system registered with HERS provider as previously sealed, or ☐ 2. There is less than 40 linear feet of duct in unconditioned space, or
☐ 3. Existing duct systems are constructed, insulated or sealed with asbestos (list manufacture date of building ________)

☐ 2. **New HVAC System**	**Required Compliance Documents to be left on site for Final**:
All new equipment and All New Ducts[3] including Mini Split	CF1R-ALT-02-E CF2R: MECH-01, MECH-20-HERS, MECH-22-HERS, MECH-(23 or 24)-HERS[2], MECH-25-HERS[2] CF3R: MECH-20-HERS, MECH-22-HERS, MECH-(23 or 24)-HERS[2], MECH-25-HERS[2] Mini Splits require CF1R-ALT-02-E, CF2R-MECH-01, and (CF2R-CF3R) MECH-25-HERS

Installer Requirement: Duct leakage < 6%, Fan Efficacy (.58W/CFM), Air Flow ≥ 350 CFM/ton (or alternative), Refrigerant Charge

☐ 3. **All New Ducts with Replacement**	**Required Compliance Documents to be left on site for Final**:
All New Ducts[3] and one or more of the following replaced: Condenser Unit, Evaporator Coil, Compressor, TXV, Lineset, Furnace[2]	CF1R-ALT-02-E CF2R: MECH-01, MECH-20-HERS, MECH-(23 or 24)-HERS, MECH-25-HERS CF3R: MECH-20-HERS, MECH-(23 or 24)-HERS, MECH-25-HERS

Installer Requirement: Duct leakage < 6%, Air Flow ≥ 350 CFM/ton (or alternative), Refrigerant Charge
Exempted from duct leakage testing if: ☐ 1. Existing duct systems are constructed, insulated or sealed with asbestos

☐ 4. **New Ducting over 40 feet**	**Required Compliance Documents to be left on site for Final**:
New ducting but less than All New Ducts[3]	CF1R-ALT-02-E, CF2R: MECH-20-HERS, CF3R: MECH-20-HERS

Installer Required to: Duct leakage (< 15% or, < 10% to outside or, or seal all accessible leaks)
☐ EXCEPTION: Existing duct systems constructed, insulated or sealed with asbestos.

[1] All **new** ducting R-8 required when more than 40 ft installed and R-6 when less than 40 ft installed. This includes in walls, between floors etc.
[2] Heating only systems and Air Handler/Furnace changes do not require Air Flow MECH-(23 or 24), or Refrigerant Charge verification MECH-25
[3] All New Ducts is when at least 75 percent of the duct system is new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system (e.g., registers, grilles, boots, air handler, coil, plenums, duct material)
[4] R-5 (1" thick insulation) for linesets 1" and less. R-7.5 (1.5" thick insulation) for linesets over 1 inch. Most mfg will require Suction line Diameter with insulation as the following 1.5-2T-2⅝", 2.5-3T-2¾", 3.5 to 4T-2⅞", 5T-4⅛"

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I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the California Business and Professions Code to accept responsibility for the information on this document.
3. That the energy features and performance specifications for the design identified on this Certificate of Compliance conform to the requirements of Title 24, Parts 1 and 6 of the California Code of Regulations (CCR).
4. That the energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the CCR.
5. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.

Responsible Designer Name:	Responsible Designer Signature:		Date Signed:	License:
Company :	Address:	City/State/Zip:		Phone:

For assistance or questions regarding the Energy Standards, contact the Energy Hotline at: 1-800-772-3300

CF1R

CF3R

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BUILDING LEAKAGE DIAGNOSTIC TEST

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Building Air Leakage – General Information		
01	Test Procedure Used:	
02	Building Air Leakage Target from CF1R	
03	Indoor Temperature During Test (degreeF)	
04	Outdoor Temperature During Test (degreeF)	
05	Blower Door Location	
06	Building Elevation (ft)	
07	Building Volume (ft3)	
08	Date of the Diagnostic Test for this Dwelling	

B. Diagnostic Equipment Information

01	Number of Manometers Used to Measure Home Pressurization	

02	03	04	05	06
Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status

07	Number of Fans Used to Pressurize Home	

08	09	10	11
Fan Make	Fan Model	Fan Serial Number	Fan configuration (rings)

ENV20a - Single Point Air Tightness Test With Manual Meter

C. Envelope Leakage Diagnostic Test		
01	Time Average Period of Meter	
02	Test Methodology	
03	Baseline Building Pressure Reading #1	
04	Baseline Building Pressure Reading #2	
05	Baseline Building Pressure Reading #3	
06	Baseline Building Pressure Reading #4	
07	Baseline Building Pressure Reading #5	
08	Baseline Range	
09	Accuracy Level	
10	Average Baseline Building Pressure Reading	
11	Pre-test baseline building pressure	
12	Unadjusted Building Pressure Target	
13	Unadjusted Building Pressure Measured	
14	Induced Building Pressure Check	
15	Nominal Fan flow at Above Fan Pressure	
16	Nominal CFM50	

D. Altitude and Temperature Correction		
01	Altitude correction factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Accuracy Adjustment		
01	Accuracy Adjustment factor	
02	Adjusted CFM50 (measured air leakage rate)	

F. Compliance Statement	
01	

G. Additional Requirements for Compliance		
01	Open all interior doors and access including those to closets and those between a conditioned basement and attic.	
02	HVAC Supply and return register dampers shall be fully open.	
03	Temporarily sealing of combustion flues and intermittent exhaust fans are not allowed. Some examples are: combustion flues, fresh air intakes, dryer vents, bathroom and kitchen exhaust vents and fire place.	
04	Continuously operated ventilation devices like energy recovery ventilators may be sealed.	
05	Multifamily – Each dwelling unit must be tested individually and shown to meet the leakage requirements. Pressurization of the adjacent dwelling units while conducting this test is not allowed.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-20a-H User Instructions

Section A. Building Air Leakage – General Information

1. Select the appropriate test procedure. This selection will determine which version of this document will be used (a, b, c, d, or e) and therefore which data must be collected. Note that single-point tests can only be used under certain conditions. Note that newer manometers have automatic functions for compensating for baseline (automatic baseline) and compensating for house pressures other than the target (@50 Pa). It is preferable to use these, when available, however if these automatic functions are to be used, they must be used for BOTH automatic baseline and pressure compensation.
2. This number is automatically pulled from the performance approach Certificate of Compliance and is the target maximum that was entered by the documentation author. If this number cannot be achieved, the performance compliance calculations can be redone with a higher number or without the requirement for building air leakage.
3. Enter the indoor temperature measured at the time that the building air leakage test was performed.
4. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
5. Provide a brief description of the location where the blower door was installed for the test. Examples: "front entry door on west side of house", "door between house and garage", "large window in family room".
6. Enter the building elevation use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
8. Enter the date that the building leakage test data was collected.

Section B. Diagnostic Equipment Information

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
3. Enter the model of the manometer used to collect the building air leakage data. Examples: DM-2 Mark II, DG700.
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer's calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.8, above, an error will appear.
7. Enter the number of blower door fan systems required to run simultaneously to pressurize the home for the building air leakage test. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
8. Enter the make (brand) of the fan used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
9. Enter the model of the fan used to collect the building air leakage data. Examples: US1000, Q46, BD3, BD4.
10. Enter the serial number of the fan used to collect the building air leakage data.
11. Enter the fan configuration shown on the meter. This is sometimes referred to as "range configuration", "CONFIG" or "rings". Examples: Open, A, B, C8.

Section C. Envelope Leakage Test (ENV20a)

1. Enter the time average period used on the manometer during the test. Must be at least 10 seconds.
2. Select the type of test being performed: Pressurization (air blowing into house) or Depressurization (air blowing out of house). Note that depressurization is the preferred method.
3. Enter the first of five baseline building pressure readings (Resolution of 0.1 Pa).
4. Enter the second of five baseline building pressure readings (Resolution of 0.1 Pa).
5. Enter the third of five baseline building pressure readings (Resolution of 0.1 Pa).
6. Enter the fourth of five baseline building pressure readings (Resolution of 0.1 Pa).
7. Enter the fifth of five baseline building pressure readings (Resolution of 0.1 Pa).
8. This field is automatically calculated when using the online form. The Baseline Range is the largest value of the five baseline readings minus the smallest value of the five baseline readings.
9. This field is automatically calculated when using the online form. "Standard" is when the baseline range is less than 5 Pa; "Reduced" is when the baseline range is between 5 and 10 Pa (inclusive); c. If the baseline range is greater than 10 you must use a multi-point procedure.
10. This field is automatically calculated when using the online form. Average Baseline Building Pressure Reading is simply the average of the five baseline readings.
11. Enter the Pre-test Baseline Building Pressure. The protocols allow the average to be used or a newly measured number can be used.
12. This field is automatically calculated when using the online form. The Unadjusted Building Pressure Target is the Pre-test Baseline Building Pressure plus the target building pressure (-50 Pa).
13. Enter the Measured Unadjusted Building Pressure straight from the manometer. It should be as close to the Unadjusted Building Pressure Target as possible. All blower door induced pressures for the depressurization tests are to be negative relative to outside.

14. This field is automatically calculated when using the online form. A check is performed to make sure that a pressure of at least -15 pa was achieved. If not, the Single Point Test may not be used.
15. Enter the fan flow from the manometer that corresponds to the Measured Unadjusted Building Pressure. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
16. This field is automatically calculated when using the online form. The Measured Unadjusted Building Pressure is automatically adjusted for a target pressure of -50 Pa.

Section D. Altitude and Temperature Correction

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
    a. If the elevation less than or equal to 5,000 ft, the altitude correction factor is 1 (no adjustment).
    b. If the elevation is greater than 5,000 ft, the altitude correction equation equals 1 + (0.000006 * elevation in feet)
2. Enter the temperature correction factor from Table RA3.8-2 or RA3.8-3 using the indoor and outdoor temperatures entered in Section A.

Table RA3.8-2 *Temperature Correction Factors for Depressurization Testing*- *Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	0.997	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	0.938	0.942	0.950	0.952	0.966	0.974	0.982	0.990	0.998

Table RA3.8-3 ***Temperature Correction Factors for Pressurization Testing****- Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	09.17	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	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	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	0.998	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

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

Section E. Accuracy Adjustment

1. This field is automatically calculated when using the online form.:
   a. If the Accuracy Level from section C is "Standard", the Accuracy Adjustment will be 1 (no adjustment)
   b. If the Accuracy Level from section C is "Reduced", accuracy adjustment equation equals 1+[0.1+(50/Nominal CFM50)]
2. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied times the Accuracy Adjustment. **Note -** This is the number that must be less than or equal to the target building air leakage from the CF1R, shown in Row A.2.

Section F. Compliance Statement

1. This field is automatically calculated when using the online form. A check is performed to make sure that the meter has been properly calibrated and that the measured infiltration is less than the target infiltration.

Section G. Additional Requirements for Compliance

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.

BUILDING LEAKAGE DIAGNOSTIC TEST

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Building Air Leakage – General Information		
01	Test Procedure Used:	
02	Building Air Leakage Target from CF1R	
03	Indoor temperature during test (degreeF)	
04	Outdoor temperature during test (degreeF)	
05	Blower door location	
06	Building Elevation (ft)	
07	Building Volume (ft3)	
08	Date of the diagnostic test for this dwelling	

B. Diagnostic Equipment Information

01	Number of Manometers Used to Measure Home Pressurization	

02	03	04	05	06
Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status

07	Number of Fans Used to Pressurize Home	

08	09	10	11
Fan Make	Fan Model	Fan Serial Number	Fan configuration (rings)

ENV20b - Single Point Air Tightness Test With Automatic Meter

C. Envelope Leakage Diagnostic Test		
01	Time Average Period of Meter	
02	Baseline Building Pressure Reading #1	
03	Baseline Building Pressure Reading #2	
04	Baseline Building Pressure Reading #3	
05	Baseline Building Pressure Reading #4	
06	Baseline Building Pressure Reading #5	
07	Baseline Range	
08	Accuracy Level	
09	Average Baseline Building Pressure Reading	
10	Pre-test Baseline Building Pressure	
11	Induced Building Pressure from Manometer	
12	Induced Building Pressure Check	
13	Nominal CFM50	

D. Altitude and Temperature Correction		
01	Altitude Correction Factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

E. Accuracy Adjustment		
01	Accuracy Adjustment Factor	
02	Adjusted CFM50 (measured air leakage rate)	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

F. Compliance Statement	
01	

G. Additional Requirements for Compliance		
01	Open all interior doors and access including those to closets and those between a conditioned basement and attic.	
02	HVAC Supply and return register dampers shall be fully open.	
03	Temporarily sealing of combustion flues and intermittent exhaust fans are not allowed. Some examples are: combustion flues, fresh air intakes, dryer vents, bathroom and kitchen exhaust vents and fire place.	
04	Continuously operated ventilation devices like energy recovery ventilators may be sealed.	
05	Multifamily – Each dwelling unit must be tested individually and shown to meet the leakage requirements. Pressurization of the adjacent dwelling units while conducting this test is not allowed.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-20b-H User Instructions

Section A. Building Air Leakage – General Information

1. Select the appropriate test procedure. This selection will determine which version of this document will be used (a, b, c, d, or e) and therefore which data must be collected. Note that single-point tests can only be used under certain conditions. Note that newer manometers have automatic functions for compensating for baseline (automatic baseline) and compensating for house pressures other than the target (@50 Pa). It is preferable to use these, when available, however if these automatic functions are to be used, they must be used for BOTH automatic baseline and pressure compensation.
2. This number is automatically pulled from the performance approach Certificate of Compliance and is the target maximum that was entered by the documentation author. If this number cannot be achieved, the performance compliance calculations can be redone with a higher number or without the requirement for building air leakage.
3. Enter the indoor temperature measured at the time that the building air leakage test was performed.
4. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
5. Provide a brief description of the location where the blower door was installed for the test. Examples: “front entry door on west side of house”, “door between house and garage”, “large window in family room”.
6. Enter the building elevation use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
8. Enter the date that the building leakage test data was collected.

Section B. Diagnostic Equipment Information

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
3. Enter the model of the manometer used to collect the building air leakage data. Examples: DM-2 Mark II, DG700.
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer’s calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.8, above, an error will appear.
7. Enter the number of blower door fan systems required to run simultaneously to pressurize the home for the building air leakage test. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
8. Enter the make (brand) of the fan used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
9. Enter the model of the fan used to collect the building air leakage data. Examples: US1000, Q46, BD3, BD4.
10. Enter the serial number of the fan used to collect the building air leakage data.
11. Enter the fan configuration shown on the meter. This is sometimes referred to as “range configuration”, “CONFIG” or “rings”. Examples: Open, A, B, C8.

Section C. Envelope Leakage Test (ENV20b)

1. Enter the time average period used on the manometer during the test. Must be at least 10 seconds.
2. Enter the first of five baseline building pressure readings (Resolution of 0.1 Pa).
3. Enter the second of five baseline building pressure readings (Resolution of 0.1 Pa).
4. Enter the third of five baseline building pressure readings (Resolution of 0.1 Pa).
5. Enter the fourth of five baseline building pressure readings (Resolution of 0.1 Pa).
6. Enter the fifth of five baseline building pressure readings (Resolution of 0.1 Pa).
7. This field is automatically calculated when using the online form. The Baseline Range is the largest value of the five baseline readings minus the smallest value of the five baseline readings.
8. This field is automatically calculated when using the online form. “Standard” is when the baseline range is less than 5 Pa; “Reduced” is when the baseline range is between 5 and 10 Pa (inclusive); c. If the baseline range is greater than 10 you must use a multi-point procedure.
9. This field is automatically calculated when using the online form. Average Baseline Building Pressure Reading is simply the average of the five baseline readings.
10. Enter the Pre-test Baseline Building Pressure. The protocols allow the average to be used or a newly measured number can be used.
11. Enter the Induced Building Pressure straight from the manometer. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
12. This field is automatically calculated when using the online form. A check is performed to make sure that a pressure of at least -15 pa was achieved. If not, the Single Point Test may not be used.
13. Enter the Nominal CFM50 fan flow from the manometer. The meter should be set to automatically adjust to -50 Pa (@50 setting). All blower door induced pressures for the depressurization tests are to be negative relative to outside.

Section D. Altitude and Temperature Correction

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the elevation less than or equal to 5,000 ft, the altitude correction factor is 1 (no adjustment).
   b. If the elevation is greater than 5,000 ft, the altitude correction equation equals 1 + (0.000006 * elevation in feet)
2. Enter the temperature correction factor from Table RA3.8-2 or RA3.8-3 using the indoor and outdoor temperatures entered in Section A.

Table RA3.8-2 ***Temperature Correction Factors for Depressurization Testing****- Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	0.997	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

Table RA3.8-3 ***Temperature Correction Factors for Pressurization Testing***- *Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	09.17	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	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	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	0.998	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

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

Section E. Accuracy Adjustment

1. This field is automatically calculated when using the online form.:
   a. If the Accuracy Level from section C is “Standard”, the Accuracy Adjustment will be 1 (no adjustment)
   b. If the Accuracy Level from section C is “Reduced”, accuracy adjustment equation equals 1+[0.1+(50/Nominal CFM50)]
2. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied times the Accuracy Adjustment. **Note -** This is the number that must be less than or equal to the target building air leakage from the CF1R, shown in Row A.2.

Section F. Compliance Statement

1. This field is automatically calculated when using the online form. A check is performed to make sure that the meter has been properly calibrated and that the measured infiltration is less than the target infiltration.

Section G. Additional Requirements for Compliance

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.
6. *Verification Status:* If this Section does not apply, then select “All n/a”. If the home meets all of the additional requirements for compliance then select “Pass”, otherwise select “Fail”. The latter selection means that the home does not meet the requirements and the home will need to be modified to meet the requirements.
7. *Correction Notes:* If one or more applicable requirements are not met “Fail” will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section H. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

BUILDING LEAKAGE DIAGNOSTIC TEST

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Building Air Leakage – General Information		
01	Test Procedure Used:	
02	Building Air Leakage Target from CF1R	
03	Indoor Temperature During Test (degreeF)	
04	Outdoor Temperature During Test (degreeF)	
05	Blower Door Location	
06	Building Elevation (ft)	
07	Building Volume (ft3)	
08	Date of the Diagnostic Test for this Dwelling	

B. Diagnostic Equipment Information				
01	Number of Manometers Used to Measure Home Pressurization			
02	03	04	05	06
Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status

07	Number of Fans Used to Pressurize Home		
08	09	10	11
Fan Make	Fan Model	Fan Serial Number	Fan configuration (rings)

ENV20c – Multi-Point Air Tightness Test

C. Envelope Leakage Diagnostic Test		
01	Name and version of ASTM E779-10 compliant software used for multi-point test.	
02	Pre-test baseline building pressure	
03	Time average period of meter	
04	Test Methodology	
05	Unadjusted Building Pressure Target	
06	Unadjusted Building Pressure Measured	
07	Induced building pressure	
08	A minimum of eight readings were taken spaced evenly between 15 Pa and 60 Pa (or highest attainable pressure).	
09	Post-test baseline building pressure	
10	Corrected CFM50 (from software)	

D. Altitude and Temperature Correction (not used, performed by blower door software)

E. Accuracy Adjustment		
01	Percent uncertainty @ 95% confidence level (from software)	
02	Accuracy level	
03	Accuracy Adjustment factor	
04	Adjusted CFM50 (measured air leakage rate)	

F. Compliance Statement	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

G. Additional Requirements for Compliance		
01	Open all interior doors and access including those to closets and those between a conditioned basement and attic.	
02	HVAC Supply and return register dampers shall be fully open.	
03	Temporarily sealing of combustion flues and intermittent exhaust fans are not allowed. Some examples are: combustion flues, fresh air intakes, dryer vents, bathroom and kitchen exhaust vents and fire place.	
04	Continuously operated ventilation devices like energy recovery ventilators may be sealed.	
05	Multifamily – Each dwelling unit must be tested individually and shown to meet the leakage requirements. Pressurization of the adjacent dwelling units while conducting this test is not allowed.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance	
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-20c-H User Instructions

Section A. Building Air Leakage – General Information

1. Select the appropriate test procedure. This selection will determine which version of this document will be used (a, b, c, d, or e) and therefore which data must be collected. Note that single-point tests can only be used under certain conditions. Note that newer manometers have automatic functions for compensating for baseline (automatic baseline) and compensating for house pressures other than the target (@50 Pa). It is preferable to use these, when available, however if these automatic functions are to be used, they must be used for BOTH automatic baseline and pressure compensation.
2. This number is automatically pulled from the performance approach Certificate of Compliance and is the target maximum that was entered by the documentation author. If this number cannot be achieved, the performance compliance calculations can be redone with a higher number or without the requirement for building air leakage.
3. Enter the indoor temperature measured at the time that the building air leakage test was performed.
4. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
5. Provide a brief description of the location where the blower door was installed for the test. Examples: “front entry door on west side of house”, “door between house and garage”, “large window in family room”.
6. Enter the building elevation use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
8. Enter the date that the building leakage test data was collected.

Section B. Diagnostic Equipment Information

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
3. Enter the model of the manometer used to collect the building air leakage data. Examples: DM-2 Mark II, DG700.
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer’s calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.8, above, an error will appear.
7. Enter the number of blower door fan systems required to run simultaneously to pressurize the home for the building air leakage test. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
8. Enter the make (brand) of the fan used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
9. Enter the model of the fan used to collect the building air leakage data. Examples: US1000, Q46, BD3, BD4.
10. Enter the serial number of the fan used to collect the building air leakage data.
11. Enter the fan configuration shown on the meter. This is sometimes referred to as “range configuration”, “CONFIG” or “rings”. Examples: Open, A, B, C8.

Section C. Envelope Leakage Test (ENV20c)

1. This version of the MCH-24 requires the use of an ASTM E779-10 compliant software, typically provided by the blower door manufacturer. Confirm with the software vendor that it is compliant. Enter the name and version here.
2. Enter the Pre-test Baseline Building Pressure.
3. Enter the time average period used on the manometer during the test. Must be at least 10 seconds.
4. Select the type of test being performed: Pressurization (air blowing into house) or Depressurization (air blowing out of house). Note that depressurization is the preferred method.
5. This field is automatically calculated when using the online form. The Unadjusted Building Pressure Target is the Pre-test Baseline Building Pressure plus the target building pressure (-60 Pa).
6. Enter the Measured Unadjusted Building Pressure straight from the manometer. It should be as close to the Unadjusted Building Pressure Target as possible. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
7. Enter the Induced Building Pressure straight from the manometer. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
8. When using the software for a multi-point test, a minimum of eight measurements must be taken over a range of pressures. This is where the user acknowledges that this was done.
9. Enter the Post Test Baseline Building Pressure from the manometer.
10. Enter the final Corrected CFM50 reading from the software.

Section D. Altitude and Temperature Correction (not used)

Section E. Accuracy Adjustment

1. The software will provide a "Percent Uncertainty" value based on the readings taken. Enter that value here
2. This field is automatically calculated when using the online form . If the Percent Uncertainty level is 10% or less, the Accuracy Level is "Standard". If the Percent Uncertainty level is greater than 10%, the Accuracy Level is "Reduced".
3. This field is automatically calculated when using the online form:
   a. If the Accuracy Level is "Standard", the Extending Factor will be 1 (no adjustment)
   b. If the Accuracy Level is "Reduced", the Extending Factor will be adjusted by the Percent Uncertainty.
4. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied by the Extending Factor.

Section F. Compliance Statement

1. This field is automatically calculated when using the online form. A check is performed to make sure that the meter has been properly calibrated and that the measured infiltration is less than the target infiltration.

Section G. Additional Requirements for Compliance

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.
6. *Verification Status:* If this Section does not apply, then select "All n/a".. If the home meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the home does not meet the requirements and the home will need to be modified to meet the requirements.
7. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section H. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

BUILDING LEAKAGE DIAGNOSTIC TEST

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Building Air Leakage – General Information		
01	Test Procedure Used:	
02	Building Air Leakage Target from CF1R	
03	Indoor Temperature During Test (degreeF)	
04	Outdoor Temperature During Test (degreeF)	
05	Blower Door Location	
06	Building Elevation (ft)	
07	Building Volume (ft3)	
08	Date of the Diagnostic Test for this Dwelling	

B. Diagnostic Equipment Information				
01	Number of Manometers Used to Measure Home Pressurization			
02	03	04	05	06
Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status

07	Number of Fans Used to Pressurize Home		
08	09	10	11
Fan Make	Fan Model	Fan Serial Number	Fan configuration (rings) Note: fan configuration must be the same for all data points

ENV20d – Repeated Single Point Air Tightness Test With Manual Meter

C. Envelope Leakage Diagnostic Test				
01	Time Average Period of Meter			
02	Blower Door Software used for calculations?			
03	Test Methodology			
04	05	06	07	08
Baseline Building Pressure Reading	Unadjusted building pressure	Nominal fan flow	Induced Building Pressure	Nominal CFM50
09	Average Nominal CFM50			

D. Altitude and Temperature Correction		
01	Altitude Correction Factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Accuracy Adjustment		
01	Standard deviation of nominal CFM 50 values above	
02	Percent uncertainty	
03	Accuracy level	
04	Accuracy Adjustment factor	
05	Adjusted CFM50 (measured air leakage rate)	
06	Corrected CFM50 (from software)	
07	Percent uncertainty @ 95% confidence level (from software)	

F. Compliance Statement	
01	

G. Additional Requirements for Compliance		
01	Open all interior doors and access including those to closets and those between a conditioned basement and attic.	
02	HVAC Supply and return register dampers shall be fully open.	
03	Temporarily sealing of combustion flues and intermittent exhaust fans are not allowed. Some examples are: combustion flues, fresh air intakes, dryer vents, bathroom and kitchen exhaust vents and fire place.	
04	Continuously operated ventilation devices like energy recovery ventilators may be sealed.	
05	Multifamily – Each dwelling unit must be tested individually and shown to meet the leakage requirements. Pressurization of the adjacent dwelling units while conducting this test is not allowed.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-20d-H User Instructions

Section A. Building Air Leakage – General Information

1. Select the appropriate test procedure. This selection will determine which version of this document will be used (a, b, c, d, or e) and therefore which data must be collected. Note that single-point tests can only be used under certain conditions. Note that newer manometers have automatic functions for compensating for baseline (automatic baseline) and compensating for house pressures other than the target (@50 Pa). It is preferable to use these, when available, however if these automatic functions are to be used, they must be used for BOTH automatic baseline and pressure compensation.
2. This number is automatically pulled from the performance approach Certificate of Compliance and is the target maximum that was entered by the documentation author. If this number cannot be achieved, the performance compliance calculations can be redone with a higher number or without the requirement for building air leakage.
3. Enter the indoor temperature measured at the time that the building air leakage test was performed.
4. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
5. Provide a brief description of the location where the blower door was installed for the test. Examples: "front entry door on west side of house", "door between house and garage", "large window in family room".
6. Enter the building elevation use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
8. Enter the date that the building leakage test data was collected.

Section B. Diagnostic Equipment Information

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
3. Enter the model of the manometer used to collect the building air leakage data. Examples: DM-2 Mark II, DG700.
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer's calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.8, above, an error will appear.
7. Enter the number of blower door fan systems required to run simultaneously to pressurize the home for the building air leakage test. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
8. Enter the make (brand) of the fan used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
9. Enter the model of the fan used to collect the building air leakage data. Examples: US1000, Q46, BD3, BD4.
10. Enter the serial number of the fan used to collect the building air leakage data.
11. Enter the fan configuration shown on the meter. This is sometimes referred to as "range configuration", "CONFIG" or "rings". Examples: Open, A, B, C8.

Section C. Envelope Leakage Test (ENV20d)

1. Enter the time average period used on the manometer during the test. Must be at least 10 seconds.
2. This version of the MCH-24 can be used with an ASTM E779-10 compliant software, typically provided by the blower door manufacturer. Confirm with the software vendor that it is compliant.
3. Select the type of test being performed: Pressurization (air blowing into house) or Depressurization (air blowing out of house). Note that depressurization is the preferred method.
4. Enter five to nine baseline building pressure readings (Resolution of 0.1 Pa).
5. Enter five to nine Unadjusted Building Pressure numbers straight from the manometer. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
6. Enter five to nine Nominal fan flows from the manometer that corresponds to the Unadjusted Building Pressure values. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
7. This field is automatically calculated when using the online form. The Induced Building Pressure is the difference between the Unadjusted Building Pressure and the Baseline Building pressure.
8. This field is automatically calculated when using the online form. The Nominal Fan Flow at the Induced Building Pressure is adjusted mathematically for a target pressure of -50 Pa.
9. This field is automatically calculated when using the online form. It is the average of the Nominal CFM50 values for the 5-9 repeated single point tests.

Section D. Altitude and Temperature Correction

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the elevation less than or equal to 5,000 ft, the altitude correction factor is 1 (no adjustment).
   b. If the elevation is greater than 5,000 ft, the altitude correction equation equals 1 + (0.000006 * elevation in feet)
2. Enter the temperature correction factor from Table RA3.8-2 or RA3.8-3 using the indoor and outdoor temperatures entered in Section A.

Table RA3.8-2 ***Temperature Correction Factors for Depressurization Testing****- Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	0.997	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

Table RA3.8-3 ***Temperature Correction Factors for Pressurization Testing****- Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	09.17	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	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	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	0.998	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

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

Section E. Accuracy Adjustment (If Row C.2 = No)

1. This field is automatically calculated when using the online form. It is the standard deviation of the Nominal CFM50 values from the 5 to 9 repeated single point tests.
2. This field is automatically calculated when using the online form. It is the percent uncertainty and the equation used to calculate this value in the field equals {[(C.1/ square root N for the number of tests)x t-statistic look up from table RA 3.8-1]/D.3 corrected CFM50} = percent uncertainty

Table 3.8-1 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

3. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the percent uncertainty in E.2 ≤ 10, then enter "standard" as accuracy level in box E. 3
   b. If the percent uncertainty in E.2 > 10, then enter "reduced" as accuracy level in box E. 3
4. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the accuracy level E.3 = Standard, then enter 1 as extending factor in box E.4
   b. If the accuracy level E.3 = Reduced, extending factor equation equals 1+(E.2/100)
5. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals the D.3 * E.4 = Adjusted CFM50

Section E. Accuracy Adjustment (If Row C.2 = Yes)

6. Enter the corrected CFM50 from manometer software.
7. Enter the percent uncertainty from manometer software.

Section F. Compliance Statement

1. This field is automatically calculated when using the online form. A check is performed to make sure that the meter has been properly calibrated and that the measured infiltration is less than the target infiltration.

Section G. Additional Requirements for Compliance

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.
6. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the home does not meet the requirements and the home will need to be modified to meet the requirements.
7. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section H. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

BUILDING LEAKAGE DIAGNOSTIC TEST

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Building Air Leakage – General Information		
01	Test Procedure Used:	
02	Building Air Leakage Target from CF1R	
03	Indoor temperature during test (degreeF)	
04	Outdoor temperature during test (degreeF)	
05	Blower door location	
06	Building Elevation (ft)	
07	Building Volume (ft3)	
08	Date of the diagnostic test for this dwelling	

B. Diagnostic Equipment Information				
01	Number of Manometers Used to Measure Home Pressurization			
02	03	04	05	06
Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status

07	Number of Fans Used to Pressurize Home		
08	09	10	11
Fan Make	Fan Model	Fan Serial Number	Fan configuration (rings)

ENV20e – Repeated Single Point Air Tightness Test With Automatic Meter

C. Envelope Leakage Diagnostic Test		
01	Time average period of meter	
02	Blower Door Software used for calculations?	
03		04
Induced Building Pressure		Nominal CFM50
05	Average Nominal CFM50	

D. Altitude and Temperature Correction		
01	Altitude Correction Factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Accuracy Adjustment		
01	Standard Deviation of Nominal CFM 50 Values Above	
02	Percent Uncertainty	
03	Accuracy Level	
04	Accuracy Adjustment Factor	
05	Adjusted CFM50 (measured air leakage rate)	
06	Corrected CFM50 (from software)	
07	Percent Uncertainty @ 95% Confidence Level (from software)	

F. Compliance Statement	
01	

G. Additional Requirements for Compliance		
01	Open all interior doors and access including those to closets and those between a conditioned basement and attic.	
02	HVAC Supply and return register dampers shall be fully open.	
03	Temporarily sealing of combustion flues and intermittent exhaust fans are not allowed. Some examples are: combustion flues, fresh air intakes, dryer vents, bathroom and kitchen exhaust vents and fire place.	
04	Continuously operated ventilation devices like energy recovery ventilators may be sealed.	
05	Multifamily – Each dwelling unit must be tested individually and shown to meet the leakage requirements. Pressurization of the adjacent dwelling units while conducting this test is not allowed.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
Building Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-20e-H User Instructions

Section A. Building Air Leakage – General Information

1. Select the appropriate test procedure. This selection will determine which version of this document will be used (a, b, c, d, or e) and therefore which data must be collected. Note that single-point tests can only be used under certain conditions. Note that newer manometers have automatic functions for compensating for baseline (automatic baseline) and compensating for house pressures other than the target (@50 Pa). It is preferable to use these, when available, however if these automatic functions are to be used, they must be used for BOTH automatic baseline and pressure compensation.
2. This number is automatically pulled from the performance approach Certificate of Compliance and is the target maximum that was entered by the documentation author. If this number cannot be achieved, the performance compliance calculations can be redone with a higher number or without the requirement for building air leakage.
3. Enter the indoor temperature measured at the time that the building air leakage test was performed.
4. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
5. Provide a brief description of the location where the blower door was installed for the test. Examples: "front entry door on west side of house", "door between house and garage", "large window in family room".
6. Enter the building elevation use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
8. Enter the date that the building leakage test data was collected.

Section B. Diagnostic Equipment Information

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
3. Enter the model of the manometer used to collect the building air leakage data. Examples: DM-2 Mark II, DG700.
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer's calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.8, above, an error will appear.
7. Enter the number of blower door fan systems required to run simultaneously to pressurize the home for the building air leakage test. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
8. Enter the make (brand) of the fan used to collect the building air leakage data. Examples: Retrotec, Energy Conservatory.
9. Enter the model of the fan used to collect the building air leakage data. Examples: US1000, Q46, BD3, BD4.
10. Enter the serial number of the fan used to collect the building air leakage data.
11. Enter the fan configuration shown on the meter. This is sometimes referred to as "range configuration", "CONFIG" or "rings". Examples: Open, A, B, C8.

Section C. Envelope Leakage Test (ENV20e)

1. Enter the time average period used on the manometer during the DEPRESSURIZATION test. Must be at least 10 seconds.
2. This version of the MCH-24 can be used with an ASTM E779-10 compliant software, typically provided by the blower door manufacturer. Confirm with the software vendor that it is compliant.
3. Enter five to nine Induced Building Pressure numbers straight from the manometer. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
4. Enter five to nine Nominal CFM50 values from the manometer that corresponds to the Induced Building Pressure values.
5. This field is automatically calculated when using the online form. It is the average of the Nominal CFM50 values for the 5-9 repeated single point tests.

Section D. Altitude and Temperature Correction

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
    a. If the elevation less than or equal to 5,000 ft, the altitude correction factor is 1 (no adjustment).
    b. If the elevation is greater than 5,000 ft, the altitude correction equation equals 1 + (0.000006 * elevation in feet)
2. Enter the temperature correction factor from Table RA3.8-2 or RA3.8-3 using the indoor and outdoor temperatures entered in Section A.

Table RA3.8-2 ***Temperature Correction Factors for Depressurization Testing***- *Calculated according to ASTM E779-10*

		Inside Temperature (F)								
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**
Outside Temp (F)	**-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	0.997	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

Table RA3.8-3 ***Temperature Correction Factors for Pressurization Testing***- *Calculated according to ASTM E779-10*

		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	09.17	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	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
Outside Temp (F)	**45**	0.978	0.974	0.961	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	0.998	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

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

Section E. Accuracy Adjustment (If Row C.2 = No)

1. This field is automatically calculated when using the online form. It is the standard deviation of the Nominal CFM50 values from the 5 to 9 repeated single point tests
2. This field is automatically calculated when using the online form. It is the percent uncertainty and the equation used to calculate this value in the field equals {[(C.1/ square root N or the number of tests)x t-statistic look up from table RA 3.8-1]/D.3 corrected CFM50} = percent uncertainty

Table 3.8-1 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

3. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the percent uncertainty in E.2 ≤ 10, then enter "standard" as accuracy level in box E. 3
   b. If the percent uncertainty in E.2 > 10, then enter "reduced" as accuracy level in box E. 3
4. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
   a. If the accuracy level E.3 = Standard, then enter 1 as extending factor in box E.4
   b. If the accuracy level E.3 = Reduced, extending factor equation equals 1+(E.2/100)
5. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals the D.3 * E.4 = Adjusted CFM50

Section E. Accuracy Adjustment (If Row C.2 = Yes)

6. Enter the corrected CFM50 from manometer software.
7. Enter the percent uncertainty from manometer software.

Section F. Compliance Statement

1. This field is automatically calculated when using the online form. A check is performed to make sure that the meter has been properly calibrated and that the measured infiltration is less than the target infiltration.

Section G. Additional Requirements for Compliance

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.
6. *Verification Status:* If this Section does not apply, then select "All n/a". If the home meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the home does not meet the requirements and the home will need to be modified to meet the requirements.
7. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section H. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

AIR INFILTRATION SEALING – FRAMING STAGE FOR BATT, LOOSE FILL, AND SPF

CERTIFICATE OF VERIFICATION		CF3R-ENV-21-H
Quality Insulation Installation (QII) –Air Infiltration Sealing - Framing Stage for Batt, Loose Fill, and SPF		(Page 1 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Air Infiltration and Insulation Installation (QII) - Framing Stage		
01	The requirements below cover the required air sealing and installation of insulation that must occur in the framing stage.	
02	Spray Polyurethane Foam (SPF) insulation can be considered an air barrier when SPF covers the possible leakage area to a thickness of 5.5 inches for open cell SPF (ocSPF) and 2.0 inches for closed cell SPF (ccSPF).	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
04	Correction Notes:	
The responsible person’s signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

B. Raised Floor Air Barrier		
01	All gaps in the raised floor are sealed.	
02	All chases sealed at floor level using a hard cover and the hard cover is sealed.	
03	All plumbing and electrical wires that penetrate the floor are sealed.	
04	Subfloor sheathing is glued or sealed at all exterior panel edges to create a continuous air tight subfloor.	
05	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
06	Correction Notes:	
The responsible person’s signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

C. Walls/Knee Wall Air Barrier		
01	All penetrations through the exterior wall air barrier are sealed to provide an air-tight envelope to unconditioned spaces such as the outdoors, attic, garage, and crawl space.	
02	Exterior wall air barrier is sealed to the top plate and bottom plate in each stud bay.	
03	All electrical boxes including knockouts that penetrate the air barrier to unconditioned space are sealed.	
04	All openings in the top and bottom plate, including all interior and exterior walls, to unconditioned space are sealed; such as holes drilled for electrical and plumbing.	
05	Exterior bottom plates (all stories) are sealed to the floor using the appropriate sealing method.	
06	All gaps around windows and doors are sealed. The sealant used follows window manufacturer specifications.	
07	Rim joists gaps/openings are fully sealed.	
08	Fan exhaust ducts that run between conditioned floors to exterior walls including damper at the exterior wall.	
09	Metal tie downs are insulated between exterior framing and tie down.	
10	Hard to access wall stud cavities, such as corner channels or wall intersections, are insulated to the proper R-value prior to the installation of exterior sheathing or exterior stucco lath.	
11	Insulation is installed behind tub, shower, or fireplace enclosures, and exterior stairwells to the R-value listed on the CF1R when located against exterior walls. Insulation is installed before tub, shower, and fireplace are installed.	
12	A solid air barrier is installed, from floor to ceiling, on the inside of exterior walls directly adjacent to tub, shower, or fireplace enclosures. Insulation shall contact all six sides of the air barrier on exterior walls.	
13	All window and door headers shall be insulated to a minimum of R-2 Using continuous rigid insulation sheathing, or SIP headers, or Two-member headers with insulation in between, or Single-member headers with insulation to the exterior.	
14	Knee walls have solid and sealed blocking at the bottom, top, left and right sides.	
15	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
16	Correction Notes:	
The responsible person’s signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-21-H
Quality Insulation Installation (QII) –Air Infiltration Sealing - Framing Stage for Batt, Loose Fill, and SPF		(Page 2 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Ceiling/Attic Air Barrier		
01	For vented attics much of the ceiling air barrier is verified after the ceiling drywall is installed using the ENV-22.	
02	For unvented attics ensure all penetrations through the roof deck and gable ends are sealed and airtight.	
03	All eave/soffits vents are covered with a rigid ventilation baffle that maintains the net free ventilation area.	
04	All dropped ceilings are covered with hard covers and sealed to framing.	
05	All chases are covered with hard covers and sealed to framing.	
06	Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.	
07	Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.	
08	All eave/soffit baffles are installed to stop air movement around the baffle and into insulation. Net free-ventilation of the eave/soffit shall be maintained.	
09	Double walls that open to the attic are covered with an air barrier and cover has an air tight seal to the framing.	
10	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
11	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

E. Conditioned Space Above or Adjacent to Garage Air Barrier		
01	All penetrations in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements above.	
02	Infiltration between the space above the garage and subfloor is prevented by one of the following methods: • Seal all edges of the garage ceiling (typically drywall) at the perimeter of the garage to create a continuous air tight surface between the garage and adjacent conditioned envelope. Seal all plumbing, electrical, and mechanical penetrations between the garage and adjacent conditioned space. For an open-web truss, airtight blocking is added on four sides of the garage perimeter. Insulation can be placed on the garage ceiling. • Seal the band joist above the wall at the garage to conditioned space transition. Seal all subfloor seams and penetrations between the garage and adjacent conditioned space. Insulation must be placed in contact with the subfloor below the conditioned space.	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. Walls for Attached Porch, Attic, Double Wall Air Barrier		
01	All walls that separate conditioned and unconditioned space include a continuous air barrier on the interior and exterior wall.	
02	An exterior wall air barrier is required at the intersection of the porch and exterior wall when there is conditioned space on the other side. The exterior wall includes an air barrier where the attic attaches to the conditioned space.	
03	Truss framing blocking is used at the top and bottom of each wall/roof section.	
04	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-21-H
Quality Insulation Installation (QII) –Air Infiltration Sealing - Framing Stage for Batt, Loose Fill, and SPF		(Page 3 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

G. Cantilevered Floor Air Barrier		
01	Airtight blocking is installed between joists where the wall rim joist would have been located in the absence of a cantilever.	
02	Exterior sheathing is installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R value as would be required for the subfloor prior to closing.	
03	Any gaps, cracks or penetrations in the air barrier of the cantilever are sealed. Can lights in the cantilever are IC and AT rated and properly sealed to sheathing.	
04	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Multifamily Air Barrier		
01	Multifamily buildings must meet all air sealing requirements for single family buildings listed above.	
02	Each dwelling unit must be air sealed to stop air movement from one unit to another.	
03	Floor AND Ceiling of each dwelling unit – all penetrations through the floor and ceiling of each unit are sealed, including electric and gas utilities, water pipes, drain pipes, fire protection service pipes, and communication wiring.	
04	Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, and plumbing stacks are all sealed to reduce air transfer from attached spaces.	
05	Common Walls – the bottom plate between units is sealed to the subfloor. All penetrations in the common walls are sealed, including electrical boxes, wiring, and plumbing penetrations. Perpendicular interior walls that open into the common walls are sealed.	
06	Vertical Chases for garbage chutes, elevator shafts, and HVAC ducting plumbing must be sealed to the floor and ceiling of each unit to stop air movement up and around the chase due to stack effect.	
07	Vertical chases such as garbage chutes, elevator shafts, HVAC ducting, plumbing, wiring, etc. must be sealed to stop air movement through the chase to the surrounding spaces.	
08	Common hallways – penetrations between dwelling units and common hallways are sealed, including doors to dwelling units which shall be gasketed or made substantially airtight.	
09	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☑ All N/A - This entire table is not applicable.
10	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-21-H
Quality Insulation Installation (QII) –Air Infiltration Sealing - Framing Stage for Batt, Loose Fill, and SPF		(Page 4 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF2R-ENV21-H User Instructions

A. Air Infiltration and Insulation Installation (QII) - Framing Stage

3. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
4. Correction Notes, Rater must enter reason for failure.

B. Raised Floor Air Barrier

5. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
6. Correction Notes, Rater must enter reason for failure.

C. Walls/Knee Wall Air Barrier

15. HERS Rater to select from list:
    a. Pass - all applicable requirements are met.
    b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
16. Correction Notes, Rater must enter reason for failure.

D. Ceiling/Attic Air Barrier

10. HERS Rater to select from list:
    a. Pass - all applicable requirements are met.
    b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
11. Correction Notes, Rater must enter reason for failure.

E. Conditioned Space Above or Adjacent to Garage Air Barrier

5. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
6. Correction Notes, Rater must enter reason for failure.

F. Walls for Attached Porch, Attic, Double Wall Air Barrier

4. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

G. Cantilevered Floor Air Barrier

4. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

H. Multifamily Air Barrier

9. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
10. Correction Notes, Rater must enter reason for failure.

STATE OF CALIFORNIA

AIR INFILTRATION SEALING – CEILING/ROOF DECK

CEC-CF3R-ENV-22-H (Revised 03/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-ENV-22-H
Quality Insulation Installation (QII) - Air Infiltration Sealing - Ceiling/Roof Deck		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

For typical vented attics where the insulation is at the roof deck/ceiling the air barrier must be verified after the ceiling drywall is installed and before attic insulation is installed. If spray polyurethane foam (SPF) will be used in the attic this can be considered the air barrier. Soffits and chases must be covered, and chimneys and flues require metal flashing. Buildings with an unvented attic – all air sealing requirements appropriate for the roof must be verified.

A. Ceiling Inspection – Vented Attics		
01	There is a continuous air barrier at the ceiling level. All opening into walls, drops, chasses, or double walls are sealed. Examples are below.	
02	Chimneys and flues require sheet metal flashing. The flashing shall be sealed to the chimney/flue with fire rated caulk. The flashing shall be sealed to the surrounding framing.	
03	All penetrations through the top plate of interior and exterior walls are sealed.	
04	Electrical boxes, fire alarm boxes, and fire sprinklers cut into ceilings are sealed to the surrounding drywall. If it is not possible to seal the fixture directly, a secondary air barrier shall be created around the fixture.	
05	All installed recessed light fixtures that penetrate the ceiling to unconditioned space are rated to be Insulation Contact and Airtight (IC and AT) which allows direct contact with insulation. The housing is sealed to the drywall.	
06	Exhaust fan housing is sealed to the surrounding drywall and all holes and seams in the housing are sealed.	
07	All soffits and chases are covered with a hard cover that is sealed to the framing with caulk or foam.	
08	Double walls that open to the attic are covered and the cover is sealed to the framing.	
09	Attic access forms an airtight seal between conditioned space and unconditioned space. Vertical attic access requires mechanical compression using screws or latches.	
10	Knee walls require solid and sealed blocking at the bottom, top, left, and right sides. When the knee wall is placed on top of a subfloor the open cavity between the subfloor and the ceiling below is sealed.	
11	Where HVAC ducts travel down a chase, the chase is sealed at the ceiling level.	
12	HVAC boots that penetrate the ceiling are sealed to the surrounding drywall.	
13	All top plates of interior and exterior walls are sealed to drywall.	
14	Attic access must be surrounded with a dam at least the same depth as the insulation to prevent loss of ceiling insulation.	
15	There must be a dam placed at the exterior edge of all knee walls and at all edges of insulation to stop air movement through the insulation.	
16	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
17	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

B. Roof Inspection – Unvented attics		
01	There is a continuous air barrier at the roof deck and gable ends.	
02	Chimneys and flues require sheet metal flashing at the roof deck. The flashing is sealed to the chimney/flue with fire rated caulk. The flashing is sealed to the surrounding framing.	
03	All penetrations for plumbing, electrical, etc. in the roof deck and gable ends are sealed.	
04	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-22-H
Quality Insulation Installation (QII) - Air Infiltration Sealing - Ceiling/Roof Deck		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

C. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-22-H
Quality Insulation Installation (QII) - Air Infiltration Sealing - Ceiling/Roof Deck		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-22-H User Instructions

A. Ceiling Inspection – Vented Attics

16. HERS Rater to select from list:
    a. Pass - all applicable requirements are met.
    b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
    c. All n/a - This entire table is not applicable.
17. Correction Notes, Rater must enter reason for failure.

B. Roof Inspection – Unvented attics

4. HERS Rater to select from list:
    a. Pass - all applicable requirements are met.
    b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
    c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

CERTIFICATE OF VERIFICATION	CF3R-ENV-23-H
Quality Insulation Installation (QII) - Insulation Installation	(Page 1 of 5)

Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. QUALITY INSULATION INSTALLATION (QII) PREPARATION FOR INSULATION		
01	Air barrier installation and preparation for insulation was done and verified at framing stage prior to insulation being installed. Where applicable, CF3R-ENV21a, 21b and 22 forms have been signed off.	
02	All structural framing areas shall be insulated in a manner that resists thermal bridging of the assembly separating conditioned from unconditioned space. Structural bracing, tie-downs, and framing of steel, or specialized framing used to meet structural requirements of the CBC are allowed and must be insulated. These areas shall be called out on the building plans with diagrams and/or specific design drawings indicating the R-value of insulation and fastening method to be used. It is recommended that spray foam be use.	
03	All insulation was installed to the manufactures insulation installation instructions.	
04	Verification Status:	☐ <u>Pass</u> - all applicable requirements are met; or ☐ <u>Fail</u> - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ <u>All N/A</u> - This entire table is not applicable
05	Correction Notes:	
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B. QUALITY OF ALL INSTALLED INSULATION		
01	Installed insulation R-values is the same or greater than specified on the CF1R.	
02	No gaps or voids between the insulation and framing.	
03	Gaps between studs shall be filled with insulation.	
04	Batt - ensure the ends are cut so there are no gaps.	
05	Batt - Insulation is cut around obstructions like electrical boxes and no gaps exist.	
06	Batt - insulation is not compressed (no stuffing of the insulation into the cavity).	
07	Batt insulation is delaminated around all plumbing and electrical lines in ceilings, walls and floors.	
08	An air barrier is installed at all exposed edge faces of batt, loose fill and SFP insulation.	
09	Loose-fill insulation installed to the minimum installed weight per square foot per the manufacturer's labeled R-value specification.	
10	SPF insulation shall be spray-applied to fully adhere to structural assembly framing, floor and ceiling joists, and other framing surfaces within the construction cavity.	
11	SPF - with multiple layers applied, each foam lift (i.e. spray application) adheres to the substrate and foam interfaces.	
12	SPF - if values other than R-5.8 per inch for closed-cell SPF (ccSPF) and R-3.6 per inch for open-cell SFP (ocSPF) are used, the ICC Evaluation Service Report (ESR) number (e.g. ESR-xxxx) will be documented on the CF2R-ENV-03.	
13	ccSPF - in areas where an air barrier is required the foam is at least two inches thick.	
14	ocSPF depressions in the foam insulation surface are not greater than 1-inch of the required thickness provided these depressions do not exceed 10% of the surface area being insulated.	
15	ocSPF insulation does completely fill cavities of 2x4 inch framing or less.	
16	ocSPF cavities greater than 2x4 inch framing are filled to the thickness that meets the required R-value used for compliance.	
17	SPF installed as an air barrier is sprayed at a minimum of 5.5 inches in thickness for open cell and 2.0 inches for closed cell.	
18	The insulation installer provided a CF2R-ENV-03 and CF2R-ENV-23. Labels or specification/data sheets are attached to the CF2R-ENV-03 for each insulating material. The material datasheet for the installed material meets the performance specifications of the required R-Values. Blown in material also includes insulation material bag labels or coverage charts.	
19	Verification Status:	☐ <u>Pass</u> - all applicable requirements are met; or ☐ <u>Fail</u> - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ <u>All N/A</u> - This entire table is not applicable
20	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-23-H
Quality Insulation Installation (QII) - Insulation Installation		(Page 2 of 5)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

C. CEILING/ROOF INSULATION		
01	Insulation extends to the outside edge of the exterior top plates and is flush against any ventilation dams/baffles.	
02	Insulation is in direct contact with ceiling so there are no gaps between the ceiling and the insulation.	
03	Chimneys and flues (except for zero clearance) require sheet metal collar around the stack. The collar must be at least as tall as the depth of the insulation. The collar shall be 1" from the chimney/flue for double wall vent, and 6" from the chimney/flue for single wall vent" unless manufacturer requires otherwise. The collar must be sealed to the ceiling with high temperature sealant to prevent air leakage. The insulation is in contact with the sheet metal collar.	
04	Required eave ventilation shall not be obstructed - the net free-ventilation area of the eave vent is maintained	
05	Eave vent baffles are installed to prevent air movement under or into the ceiling insulation	
06	Recessed downlights are covered with insulation. If they are not covered to the same depth as required by the CF1R for ceiling insulation then an area weighted calculation is required. Recessed downlights are AT and IC rated.	
07	SPF insulation shall not be applied directly to recessed lighting fixtures. Recessed downlights where SPF insulation is installed shall: (a) be covered with a minimum of 1.5 inches of mineral fiber insulation, or (b) be enclosed in a box fabricated from 1/4 inch plywood, 18 gauge metal, 3/8 inch hard board or gypboard. Hard board or gypboard do not cause a recessed downlights to meet the zero clearance insulation contact requirements.	
08	Walkways and mechanical platforms are insulated to the same R-value as required by the CF1R for ceiling insulation. If not an area weighted calculation is completed and turned in with this form.	
09	Soffits, chasses, drops have a sealed hard cover and the insulation is in direct contact with the hard cover.	
10	Knee walls – an air dam the full depth of the ceiling insulation is added to the exterior edge of the knee wall so the ceiling insulation overlaps the knee wall to the full depth of the ceiling insulation.	
11	Attic access doors are insulated to the same R-value required by the CF1R for roof insulation and the insulation is permanently attached using adhesive or mechanical fasteners. Preferred method is rigid insulation.	
12	Attic Access forms airtight seal from conditioned space to unconditioned space. Vertical attic access requires mechanical compression using screws, or latches.	
13	Attic access must have a dam around the access to at least the same depth as the insulation.	
14	Insulation batts must be cut to fit around cross bracings and truss webs.	
15	Attic rulers appropriate to the material are installed and evenly distributed throughout the attic to verify Depth (one ruler for every 250 square feet) The rulers are clearly readable from the attic access and scaled to read inches of insulation and the R-value installed.	
16	Loose fill and SPF insulation a HERS rater shall measure the installed thickness (include low and high areas) and density of insulation in at least 6 random locations on walls, roof/ceilings and floors to ensure minimum thickness levels and the installed density meets the R-value specified on the Certificate of Compliance, and are consistent with the manufacturer's coverage chart.	
17	Steel-framed kneewalls, skylight shafts, and gable ends, external surfaces of steel studs are covered with insulation	
18	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
19	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-23-H
Quality Insulation Installation (QII) - Insulation Installation		(Page 3 of 5)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. WALL INSULATION		
01	**Batts, loose fill mineral fiber, mineral and natural wool, and cellulose:** fills cavity and is in contact with air barrier on six sides.	
02	**ocSPF:** completely fill cavities of 2x4 inch framing or less. Not required to fill cavities greater than 2x4 inch framing unless required to meet R-value.	
03	**ccSPF:** insulation is not required to fill the cavities of framed assemblies unless required to meet R-value.	
04	**Double walls and bump-outs** - insulation fills the cavity, or additional air barrier is installed so the insulation fills the cavity and is in contact with the insulation on all six sides unless SPF is used. Insulation shall be installed on the exterior of the double walls/bump-outs.	
05	Low expanding foam used around windows and doors, if allowed by the manufacturer. If not allowed fill cavity with insulation. Batts are not allowed to be stuffed into space.	
06	Electrical panel in exterior insulated wall the panel is air tight and insulation is installed behind the panel.	
07	Skylight shafts and attic knee wall insulation must meet all the requirements for walls and is in contact with the air barrier on six sides unless SPF is used.	
08	Skylight shafts and attic kneewalls insulation shall be in full contact with the drywall or other interior wall finish. Batt insulation must be cut to fit around 2x4's that are laid flat.	
09	Skylight shafts and attic kneewalls shall be completely enclosed by vertical and horizontal framing, including horizontal plates at top and bottom of the insulation.	
10	Band/Rim joists are insulated to the same R-value as the wall.	
11	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
12	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

E. RAISED FLOOR INSULATION QUALITY		
01	Insulation is in full contact with subfloor.	
02	Insulation hangers are spaced at 18 inches or less, insulation hangers do not compress insulation.	
03	Netting or mesh can be used if the cavity under the floor is filled and in contact with the subfloor.	
04	When daylight basements are adjacent to crawlspaces, if the basement is conditioned the walls adjacent to the crawlspace are insulated to the R-value listed on the CF-1R. This includes framed stem walls, and vertical concrete retaining walls.	
05	If access to the crawlspace is from the conditioned area the raised floor includes an airtight insulated access hatch. Where possible locate crawl space access from the exterior.	
06	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

F. FLOOR ABOVE GARAGE INSULATION QUALITY		
01	Insulation must be in full contact with subfloor if the air barrier is at the band joist at the garage house wall.	
02	Insulation hangers spaced at 18 inches or less, insulation hangers must not compress insulation.	
03	Netting or mesh can be used if the cavity under the floor is filled and in contact with the subfloor.	
04	If air barrier is at the perimeter of the garage below the conditioned subfloor then the insulation may be placed on the garage ceiling. Perimeter of subfloor must also be insulated.	
05	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
06	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

G. CANTILEVERED FLOOR INSULATION QUALITY		
01	Insulation is in full contact with cantilevered subfloor. Insulation hangers are spaced at 18 inches or less, insulation hangers do not compress insulation. Netting or mesh can be used if the cavity under the floor is filled and in contact with the subfloor.	
02	Sealed Blocking shall be installed between joists where the wall rim joist would have been located in the absence of a cantilever. Insulation shall be placed on both sides of this block.	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. ATTACHED PORCH ROOF INSULATION QUALITY		
01	Exterior wall at the intersection of the porch roof is fully insulated above, below and behind the roof line.	
02	Where truss framing is used, airtight blocking is used at the top and bottom of each wall/roof section and insulated.	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

I. DETERMINATION OF HERS VERIFICATION COMPLIANCE	
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-ENV-23-H
Quality Insulation Installation (QII) - Insulation Installation		(Page 5 of 5)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENF-23-H User Instructions

A. QUALITY INSULATION INSTALLATION (QII) INSULATION STAGE

6. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
7. Correction Notes, Rater must enter reason for failure.

B. QUALITY OF ALL INSTALLED INSULATION

20. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
21. Correction Notes, Rater must enter reason for failure.

C. CEILING/ROOF INSULATION

18. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
19. Correction Notes, Rater must enter reason for failure.

D. WALLS INSULATION

11. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
12. Correction Notes, Rater must enter reason for failure.

E. RAISED FLOOR INSULATION QUALITY

6. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
7. Correction Notes, Rater must enter reason for failure.

F. FLOOR ABOVE GARAGE INSULATION QUALITY

5. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
6. Correction Notes, Rater must enter reason for failure.

G. CANTILEVERED FLOOR INSULATION QUALITY

3. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
4. Correction Notes, Rater must enter reason for failure.

H. ATTACHED PORCH ROOF INSULATION QUALITY

3. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
4. Correction Notes, Rater must enter reason for failure.

AIR INFILTRATION SEALING – FRAMING STAGE FOR SIP and ICF

CERTIFICATE OF VERIFICATION		CF3R-ENV-24-H
Quality Insulation Installation (QII) – Air Infiltration Sealing - Framing Stage for SIP and ICF		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

If there are any traditional stick built exterior walls use the CF3R-ENV-21. For traditional stick built roof/ceiling use the CF3R-ENV-22 and 23.

A. INSTALLATION		
01	The R-value of all SIP/ICF products is the same or better than listed on the CF1R.	
02	If modeled on the CF-1R the density of the installed product is the same as installed.	
03	SIP/ICF products have been installed per manufacturer installation instructions.	
04	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

B. RAISED FLOOR		
01	All gaps in the raised floor are sealed.	
02	All chases sealed at floor level using a hard cover and the hard covers are sealed.	
03	All Plumbing and electrical wires that penetrate the floor must be sealed.	
04	Subfloor sheathing is glued or sealed at all exterior panel edges, to create a continuous air tight subfloor.	
05	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
06	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

C. WALLS/KNEE WALLS		
01	Exterior walls are sealed to every floor on every story.	
02	All gaps around windows and doors are sealed. Proper sealant used was as specified by window manufacturer.	
03	All gaps around windows and doors are filled with insulation. Batt insulation is not allowed to be stuffed into gap.	
04	All plumbing and wiring penetrations through the top and bottom of panels, and electrical boxes that penetrate the wall are sealed.	
05	All SIP panel joints sealed at the interior of the wall and the exterior of each panel.	
06	Fan exhaust ducts that run between conditioned floors to exterior walls must include a damper at the exterior wall.	
07	Header sealed to wall with continues foam or caulk per manufacturer directions.	
08	Knee walls have solid and sealed blocking at the bottom, top, left side and right side of the knee wall.	
09	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
10	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

D. SIP CEILING		
01	For vented attics use the CF3R-ENV-22.	
02	For non-vented attics ensure all penetrations through the roof deck and gable ends are sealed and air tight.	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-ENV-24-H
Quality Insulation Installation (QII) – Air Infiltration Sealing - Framing Stage for SIP and ICF		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. CONDITIONED SPACE ABOVE OR ADJACENT TO GARAGE AIR BARRIER		
01	All penetration in the subfloor above the garage into conditioned space must follow the raised floor air barrier requirements above.	
02	Infiltration between the space above the garage and subfloor is prevented by one of the two following methods: • Seal all edges of garage ceiling (typical drywall) at the perimeter of the garage to create a continuous air tight surface between the garage and adjacent conditioned envelope. Seal all plumbing, electric and mechanical penetrations between the garage and the adjacent conditioned space on. For an open-web truss, airtight blocking must be added on four sides of the garage perimeter. Insulation can be placed on the garage ceiling. • Seal band joist above the wall at the garage to conditioned space transition. Seal all subfloor seams and penetrations between the conditioned space and the garage. Insulation must be placed in contact of subfloor below conditioned space.	
03	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table..		

F. CANTILEVERED FLOOR AIR BARRIER		
01	Airtight blocking shall be installed between joists where the wall rim joist would have been located in the absence of a cantilever.	
02	Exterior sheathing shall be installed to the bottom of the cantilever so that there is a continuous air and weather barrier for the cantilever. The cantilevered joist must be insulated to the same R-value as for the subfloor.	
03	Any gaps, cracks or penetrations in the air barrier of the cantilever shall be sealed. Recessed down lights in the cantilever is IC and AT rated and properly sealed to sheathing.	
04	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table..		

G. MULTIFAMILY AIR BARRIER		
01	Multifamily buildings require all the above plus each unit must control air movement across envelope components separating each dwelling.	
02	Floor AND Ceiling of each Dwelling Unit – All penetrations through the floor and ceiling of each unit must be sealed including, electric and gas utilities, water pipes, drain pipes, fire protection service pipes, communication wiring etc.	
03	Elevator penthouse, mechanical penthouse, stairwell doors, roof access hatch, plumbing stacks etc. sealed to reduce air transfer from attached spaces.	
04	Common Walls – Bottom plate between units must be sealed to the subfloor. All penetration in the common walls is sealed. Interior walls that open into the common walls must be sealed.	
05	Vertical Chases – All vertical chases are sealed at the floor and ceiling of each unit so air cannot transfer from first floor to second floor around chase.	
06	Vertical Chases –The chases such as garbage chutes, elevator shafts, and HVAC ducting are sealed to stop air movement through the chase to surrounding spaces.	
07	Common Hallways – Penetrations between dwelling unit and common hallways are sealed including doors to the dwelling unit are gasketed or made substantially airtight.	
08	Verification Status:	☐ Pass - all applicable requirements are met; or ☐ Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or ☐ All N/A - This entire table is not applicable.
09	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table..		

CERTIFICATE OF VERIFICATION		CF3R-ENV-24-H
Quality Insulation Installation (QII) – Air Infiltration Sealing - Framing Stage for SIP and ICF		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-ENV-24-H User Instructions

A. INSTALLATION

4. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

B. RAISED FLOOR

5. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
6. Correction Notes, Rater must enter reason for failure.

C. WALLS

8. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
9. Correction Notes, Rater must enter reason for failure.

D. SIP CEILING

3. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
4. Correction Notes, Rater must enter reason for failure.

E. CONDITIONED SPACE ABOVE OR ADJACENT TO GARAGE AIR BARRIER

4. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

F. CANTILEVERED FLOOR AIR BARRIER

4. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
5. Correction Notes, Rater must enter reason for failure.

G. MULTIFAMILY AIR BARRIER

6. HERS Rater to select from list:
   a. Pass - all applicable requirements are met.
   b. Fail - one or more applicable requirements are not met. Rater must enter reason for failure in corrections notes field below.
   c. All n/a - This entire table is not applicable.
7. Correction Notes, Rater must enter reason for failure.

CERTIFICATE OF VERIFICATION	CF3R-EXC-20-H
Existing Conditions for Residential Alterations	(Page 1 of 4)
Project Name:	CF1R-PRF Calculation Date/Time:
CF1R-PRF Calculation Description:	CF1R-PRF Input File Name:

A. General Information					
01	Project Name:				
02	Calculation Description:				
03	Project Location:				
04	CA City:		05	Standard Version:	
06	Zip code:		07	Compliance Manager Version:	
08	Climate Zone:		09	Software Version:	
10	Building Type:		11	Building Front Orientation (deg)	
12	Project Scope:		13	Number of Dwelling Units:	
14	Total Conditioned Floor Area(ft^2):		15	Number of Zones:	
16	Slab Area (ft^2):		17	Number of Stories in Building:	
18	Addition Conditioned Floor Area (ft^2):		19	Natural Gas Available? (Yes/No):	
20	Addition Slab Area (ft^2):		21	Glazing Percentage (%):	

B. Opaque Surfaces							
01	02	03	04	05	06	07	08
Name	Zone	Existing Conditions	Surface Type	Azimuth	Orientation	Total Cavity R-value	Verification
09	Verification Status:						
10	Correction Notes:						

C. Attic							
01	02	03	04	05	06	07	08
Name	Construction	Roof Rise	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof	Verification
09	Verification Status:						
10	Correction Notes:						

D. Windows							
01	02	03	04	05	06	07	08
Name	Azimuth	Multiplier	Area (ft²)	U-factor	SHGC	Exterior Shading	Verification
09	Verification Status:						
10	Correction Notes:						

E. Doors				
01	02	03	04	05
Name	Azimuth	Area (ft²)	U-factor	Verification
06	Verification Status:			
07	Correction Notes:			

F. Overhangs & Fins														
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
	Overhang					Left Fin				Right Fin				
Window	Overhang Depth	Dist. Up	Left Ext.	Right Ext.	Flap Ht	Depth	Top Up	Dist (Left)	Bottom Up	Depth	Top Up	Dist (Right)	Depth	Verification
16	Verification Status:													
17	Correction Notes:													

G. Water Heaters								
01	02	03	04	05	06	07	08	09
Name	Heater Element Type	Tank Type	Tank Volume (gal)	Energy Factor or Efficiency	Input Rating	Tank Exterior Insulation R-value	Standby Loss (Fraction)	Verification
10	Verification Status:							
11	Correction Notes:							

H. Water Heating				
01	02	03	04	05
Name	Distribution Type	Number of Heaters	Solar Savings Fraction	Verification
06	Verification Status:			
07	Correction Notes:			

I. HVAC – Heating Systems			
01	02	03	04
Name	Type	Efficiency	Verification
05	Verification Status:		
06	Correction Notes:		

J. HVAC – Cooling Systems				
01	02	03	04	05
Name	System Type	EER	SEER	Verification
06	Verification Status:			
07	Correction Notes:			

K. HVAC Distribution				
01	02	03	04	05
Name	Duct R-Value	Supply Duct Location	Return Duct Location	Verification
06	Verification Status:			
07	Correction Notes:			

L. Determination of HERS Verification Compliance	
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. I field inspected the existing building features, materials, components, manufactured devices, or system performance characteristics proposed for compliance credit for energy efficiency improvement identified on this Certificate of Verification and determined these existing building features, materials, components, manufactured devices, or system performance characteristics qualify for the proposed existing conditions compliance credit unless reported as not qualified in verification status and correction notes fields on this Certificate of Verification.
4. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider:	Date Signed:

CF3R-EXC-20-H User Instructions

A. General Information
Rater should verify this information to the best of their ability. Any questions or deviations should be indicated in the Verification Status row.

B. Opaque Surfaces
Existing roof type, R-value above deck and R-value below deck should all be verified.

C. Attic
Existing dwelling unit, frame type, area, u-factor, and R-values should all be verified.

D. Windows
Existing dwelling unit, surface type, frame type, area, u-factor, and R-values should all be verified.

E. Doors
Existing wall type, frame type, area, u-factor and R-values, should all be verified.

F. Overhangs & Fins
All columns of this section should be verified.

G. Water Heaters
All columns of this section should be verified.

H. Water Heating
All columns of this section should be verified.

I. HVAC – Heating Systems
All columns of this section should be verified.

J. HVAC – Cooling Systems
All columns of this section should be verified.

K. HVAC Distribution
All columns of this section should be verified

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
01	Space Conditioning System Identification or Name:	
02	Space Conditioning System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS) Credit from CF1R?	
05	Verified Low Leakage Air-handling Unit Credit from CF1R?	
06	Duct System Compliance Category:	

MCH-20a - Completely New Duct System

B. Duct Leakage Diagnostic Test		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor	
07	Air-Handling Unit Airflow (AHU Airflow) Determination Method	
08	Measured AHU Airflow (cfm)	
09	Calculated Target Allowable Duct Leakage Rate (cfm)	
10	Actual Duct Leakage Rate from Leakage Test Measurement (cfm)	
11	Compliance Statement:	
12	Correction Notes:	

C. Additional Requirements for Compliance		
01	System was tested in its normal operation condition. No temporary taping allowed.	
02	Outside air (OA) ducts for Central Fan Integrated (CFI) ventilation systems, shall not be sealed/taped off during duct leakage testing. CFI OA ducts that utilize controlled motorized dampers, that open only when OA ventilation is required to meet ASHRAE Standard 62.2, and close when OA ventilation is not required, may be configured to the closed position during duct leakage testing.	
03	All supply and return register boots were sealed to the drywall.	
04	Building cavities were not used as plenums or platform returns in lieu of ducts.	
05	If cloth backed tape was used it was covered with Mastic and draw bands.	
06	All connection points between the air handler and the supply and return plenums are completely sealed.	
Visual Inspection at Final Construction Stage (applicable if system was tested at rough-in) After installing the interior finishing wall and verifying that the above rough-in tests was completed, the following procedure must be performed:		
07	For all supply and return registers, verify that the spaces between the register boot and the interior finishing wall are properly sealed.	
08	If the house rough-in duct leakage test was conducted without an air handler installed, inspect the connection points between the air handler and the supply and return plenums to verify that the connection points are properly sealed.	
09	Inspect all joints to ensure that no cloth backed rubber adhesive duct tape is used.	
10	Verification Status:	
11	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Determination of HERS Verification Compliance

All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-20a-H User Instructions

Section A. System Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
2. *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
3. *Building Type*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
4. *Verified Low Leakage Ducts in Conditioned Space (VLLDCS)*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
5. *Verified Low Leakage Air-handling Unit (VLLAHU) Credit:* This field is filled out automatically. It is referenced from the CF2R-MCH-20.
Duct System Compliance Category: This field is filled out automatically. It is referenced from the CF2R-MCH-20.

Section B. Duct Leakage Diagnostic Test - MCH-20a - Completely New Duct System

1. *Condenser Nominal Cooling Capacity (ton)*: Same data given on MCH-01. Should be consistent with CF2R-MCH-20 for this system.
2. *Heating Capacity (kBtu/h)*: Same data given on MCH-01. Should be consistent with CF2R-MCH-20 for this system.
3. *Conditioned Floor Area Served by this HVAC System(ft^2)*: User must input CFA for the space. Should be consistent with CF2R-MCH-20 for this system.
4. *Duct Leakage Test Conditions*: *Test Final* is the only option for raters.
5. *Duct Leakage Test Method*: Select from the following options: Leakage to the Outside (house is pressurized simultaneously with the ducts such that only leakage going outside of the pressurized conditioned shell is measured, see RA3.2.4.3.4), or Total Leakage.
6. *Leakage Factor*: This field is automatically filled out based on choices in previous fields.
7. *Air-Handling Unit Airflow (AHUAirflow) Determination Method*: User will select from the following options:
    a. <u>Default Airflow Method:</u> The Default Airflow Method may only be used for homes where the duct system is being tested before the conditioning and heating system is installed and the equipment specification is not known (See Section RA3.1.4.2.1 of the 2013 Reference Appendices).
    b. <u>Cooling System Method:</u> For systems with air conditioning, this selection must be made, and the nominal air handler airflow shall be 400 CFM per nominal ton of condensing unit cooling capacity as specified by the manufacturer (Note: the heating only value may be used, if higher, See Section RA3.1.4.2.2 of the 2013 Reference Appendices).
    c. <u>Heating System Method:</u> For heating only systems the nominal air handler airflow shall be 21.7 CFM per kBtu/hr of rated heating output capacity.
    d. <u>Measured Airflow Method:</u> The measured system airflow can be used as the air handler airflow for the purpose of establishing duct leakage percentage (See Section RA3.1.4.2.3 of the 2013 Reference Appendices).
8. *Measured AHU Airflow (CFM)*: If "Measured Airflow Method" is selected as the *Air-Handling Unit Airflow (AHUAirflow) Determination Method*, user must input measured airflow.
9. *Calculated Target Allowable Duct Leakage Rate (cfm)*: This value will be automatically calculated based on values entered in previous fields.
10. *Actual Duct Leakage Rate from Leakage Test Measurement (cfm)*: Input the duct leakage rate taken from actual test measurements.
11. *Compliance Statement*: If Actual Duct Leakage Rate from leakage test (B10) is less than or equal to Calculated Target Allowable Duct Leakage Rate, "System passes leakage test" will automatically populate. If not, "System fails leakage test" will automatically populate.
12. *Notes*: This field is automatically filled out. The values in B01, B02 and B03 are checked against the values in the same rows of the CF2R-MCH-20 for this system. If they do not match an error message will appear here.

Section C Additional Requirements for Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. This field must be a true statement (or not applicable) for the system to comply
7. This field must be a true statement (or not applicable) for the system to comply
8. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
9. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section D. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

A. System Information		
01	Space Conditioning System Identification or Name:	
02	Space Conditioning System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS) Credit from CF1R?	
05	Verified Low Leakage Air-handling Unit Credit from CF1R?	
06	Duct System Compliance Category:	

MCH-20b - Low Leakage Ducts in Conditioned Space

B. Duct Leakage Diagnostic Test		
01	System compliance with visual inspection per RA3.1.4.1.3?	
02	Duct Leakage Test Conditions	
03	Duct Leakage Test Method	
04	Target Allowable Duct Leakage Rate (cfm)	
05	Actual duct leakage rate from leakage test measurement (cfm)	
06	Compliance statement:	

C. Additional Requirements for Compliance		
01	System was tested in its normal operation condition. No temporary taping allowed.	
02	Outside air (OA) ducts for Central Fan Integrated (CFI) ventilation systems, shall not be sealed/taped off during duct leakage testing. CFI OA ducts that utilize controlled motorized dampers, that open only when OA ventilation is required to meet ASHRAE Standard 62.2, and close when OA ventilation is not required, may be configured to the closed position during duct leakage testing.	
03	All supply and return register boots were sealed to the drywall.	
04	Building cavities were not used as plenums or platform returns in lieu of ducts.	
05	If cloth backed tape was used it was covered with Mastic and draw bands.	
06	All connection points between the air handler and the supply and return plenums are completely sealed.	
07	Verification Status:	
08	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

D. Determination of HERS Verification Compliance

All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:

HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable):

HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider:	Date Signed:

CF3R-MCH-20b-H User Instructions

Section A. System Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
2. *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
3. *Building Type*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
4. *Verified Low Leakage Ducts in Conditioned Space (VLLDCS)*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
5. *Verified Low Leakage Air-handling Unit (VLLAHU) Credit:* This field is filled out automatically. It is referenced from the CF2R-MCH-20.
Duct System Compliance Category: This field is filled out automatically. It is referenced from the CF2R-MCH-20.

Section B. – Duct Leakage Diagnostic Test

1. *System compliance with visual inspection per RA3.1.4.1.2? (registered MCH-21 is required)*: This field will be automatically filled. A MCH-21 must be registered to certify that a visual inspection confirms the space conditioning system is located entirely in conditioned space in accordance with RA3.1.4.1.3. If any part of the duct system is outside of conditioned space, the system does not pass.
2. *Duct Leakage Test Conditions*: This field will be automatically filled. The entire duct system shall be included in the total leakage test. The air handler, supply and return plenums and all the connectors, transition pieces, duct boots and registers must be installed and tested to total system leakage. All supply registers shall be taped so that the tape goes over the grills and attaches to the surrounding drywall. All return grilles except for one large centrally located return grille or the air handler cabinet access panel shall be taped up.
3. *Duct Leakage Test Method*: This field will be automatically filled. Leakage to outside shall be verified by pressurizing the dwelling and the ducts to 25 Pa (0.1 inches of water) **with respect to outside**. A full description of these procedures can be found in RA3.1.4.3.4.
4. *Target Allowable Duct Leakage Rate (cfm)*: This field will be automatically filled. In order to pass this test duct leakage must be equal to or less than 25 cfm when the dwelling and ducts are pressurized to 25 Pa with respect to outside. NOTE: The 25 cfm leakage value will be difficult to reach unless the ducts are located in conditioned space.
5. *Actual Duct Leakage Rate from Leakage Test Measurement (cfm)*: Input the duct leakage rater taken from actual test measurements.
1. *Compliance statement:* This field will be automatically filled. The test passes if actual leakage rate is less than or equal to 25 cfm and a MCH-21 has been registered.

Section C Additional Requirements for Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. This field must be a true statement (or not applicable) for the system to comply
7. This field must be a true statement (or not applicable) for the system to comply
8. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
9. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section D. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

STATE OF CALIFORNIA

DUCT LEAKAGE DIAGNOSTIC TEST

CEC-CF3R-MCH-20-H (Revised 03/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

A. System Information		
01	Space Conditioning System Identification or Name:	
02	Space Conditioning System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS) Credit from CF1R?	
05	Verified Low Leakage Air-handling Unit Credit from CF1R?	
06	Duct System Compliance Category:	

MCH-20c - Low Leakage Air-Handling Unit (LLAHU)

B. Duct Leakage Diagnostic Test		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft^2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor	
07	Air-Handling Unit Airflow (AHU Airflow) Determination Method	
08	Measured AHU Airflow (cfm)	
09	Calculated Target Allowable Duct Leakage Rate (cfm)	
10	Actual Duct Leakage Rate from Leakage Test Measurement (cfm)	
11	Air-Handling Unit Manufacturer Name	
12	Air-Handling Unit Model Number	
13	Compliance statement:	
14	Notes:	

C. Additional Requirements for Compliance		
01	The Low-Leakage Air-handling Unit Model identified on this compliance document is included in the list of certified Low Leakage Air-Handling Units published on the Energy Commission Website at: http://www.energy.ca.gov/title24/equipment_cert/llahu/low_leakage_air_handling_units.pdf	
02	System was tested in its normal operation condition. No temporary taping allowed.	
03	Outside air (OA) ducts for Central Fan Integrated (CFI) ventilation systems, shall not be sealed/taped off during duct leakage testing. CFI OA ducts that utilize controlled motorized dampers, that open only when OA ventilation is required to meet ASHRAE Standard 62.2, and close when OA ventilation is not required, may be configured to the closed position during duct leakage testing.	
04	All supply and return register boots were sealed to the drywall.	
05	Building cavities were not used as plenums or platform returns in lieu of ducts.	
06	If cloth backed tape was used it was covered with Mastic and draw bands.	
07	All connection points between the air handler and the supply and return plenums are completely sealed.	
08	Verification Status:	
09	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

D. Determination of HERS Verification Compliance
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable):
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider:	Date Signed:

CF3R-MCH-20c-H User Instructions

Section A. System Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
2. *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
3. *Building Type*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
4. *Verified Low Leakage Ducts in Conditioned Space (VLLDCS)*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
5. *Verified Low Leakage Air-handling Unit (VLLAHU) Credit:* This field is filled out automatically. It is referenced from the CF2R-MCH-20.
   Duct System Compliance Category: This field is filled out automatically. It is referenced from the CF2R-MCH-20.

Section B. Duct Leakage Diagnostic Test - MCH-20c - Low Leakage Air-Handling Unit (LLAHU)

1. *Condenser Nominal Cooling Capacity (ton)*: Same data given on MCH-01.
2. *Heating Capacity (kBtu/h)*: Same data given on MCH-01;
3. *Conditioned Floor Area Served by this HVAC System (ft2)*: User will input CFA for zone which should be consistent with the value from the CF1R. User will have the option to leave this field blank because the zone CFA is only required for the default airflow calculation.
4. *Duct Leakage Test Conditions*: User must select from the following options:
   a. Test Final: Test conducted at final inspection (testing at rough is not an option with this test. See Section RA3.1.4.3.1 of the 2013 Reference Appendices).
5. *Duct Leakage Test Method?*: User will select from the following options: Total Leakage.
6. *LeakageFactor*: value will be automatically populated from in CF1R.
7. *Air-Handling Unit Airflow (AHU Airflow) Determination Method*: User will select from the following options:
   a. Cooling System Method: For systems with cooling, this selection must be made, and the nominal air handler airflow shall be 400 CFM per nominal ton of condensing unit cooling capacity as specified by the manufacturer or the heating only value, whichever is greater (See Section RA3.1.4.2.2 of the 2013 Reference Appendices).
   b. Heating System Method: For heating only systems the nominal air handler airflow shall be 21.7 CFM per kBtu/hr of rated heating output capacity.
   c. Measured Airflow Method: The system airflow can be used as the air handler airflow for the purpose of establishing duct leakage percentage (See Section RA3.1.4.2.3 of the 2013 Reference Appendices).
8. *Measured AHU Airflow (cfm)*: If "Measured Airflow Method" is selected in row 7, user must input measured airflow.
9. *Calculated Target Allowable Duct Leakage Rate (cfm)*: This value will be automatically populated depending on values in B6, B7, and B8.
10. *Actual Duct Leakage Rate from Leakage Test Measurement (cfm)*: User will input this value from actual measurements from leakage test.
11. *Air-Handling Unit Manufacturer Name*: This will be automatically populated from information entered in the MCH-01.
12. *Air-Handling Unit Model Number*: This will be automatically populated from information entered in the MCH-01.
13. *Compliance Statement*: If Actual Duct Leakage Rate from leakage test (B10) is less than or equal to Calculated Target Allowable Duct Leakage Rate (B9), "System passes leakage test" will automatically populate. If not, "System fails leakage test will automatically populate.
14. *Notes*: This field is automatically filled out. The values in B01, B02, B03, B11 and B12 are checked against the values in the same rows of the CF2R-MCH-20 for this system. If they do not match an error message will appear here.

Section C Additional Requirements for Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. This field must be a true statement (or not applicable) for the system to comply
7. This field must be a true statement (or not applicable) for the system to comply
8. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
9. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section D. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
01	Space Conditioning System Identification or Name:	
02	Space Conditioning System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS) Credit from CF1R?	
05	Verified Low Leakage Air-handling Unit Credit from CF1R?	
06	Duct System Compliance Category:	

MCH-20d - Complete Replacement or Altered Duct System

B. Duct Leakage Diagnostic Test		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method?	
06	LeakageFactor ( )	
07	Air-Handler Unit Airflow (AHUAirflow) Determination Method	
08	Measured AHUAirflow (cfm)	
09	Calculated Target Allowable Duct Leakage Rate (cfm)	
10	Actual duct leakage rate from leakage test measurement (cfm)	
11	Compliance statement:	
12	Notes:	

C. ADDITIONAL REQUIREMENTS FOR COMPLIANCE		
01	System was tested in its normal operation condition. No temporary taping allowed.	
02	Outside air (OA) ducts for Central Fan Integrated (CFI) ventilation systems, shall not be sealed/taped off during duct leakage testing. CFI OA ducts that utilize controlled motorized dampers, that open only when OA ventilation is required to meet ASHRAE Standard 62.2, and close when OA ventilation is not required, may be configured to the closed position during duct leakage testing.	
03	If a complete replacement, all supply and return register boots were sealed to the drywall.	
04	Building cavities were not used as plenums or platform returns in lieu of ducts.	
05	If cloth backed tape was used it was covered with Mastic and draw bands.	
06	All connection points between the air handler and the supply and return plenums are completely sealed.	
07	If the system complies using the Smoke Test method, the smoke test was conducted in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.6. Systems that comply using smoke test shall not be included in sample groups for HERS verification.	
08	Verification Status:	
09	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Determination of HERS Verification Compliance	
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

User instructions CF3R-MCH-20d.

Section A. System Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
2. *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
3. *Building Type*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
4. *Verified Low Leakage Ducts in Conditioned Space (VLLDCS)*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
5. *Verified Low Leakage Air-handling Unit (VLLAHU) Credit:* This field is filled out automatically. It is referenced from the CF2R-MCH-20.
   Duct System Compliance Category: This field is filled out automatically. It is referenced from the CF2R-MCH-20.

Section B. Duct Leakage Diagnostic Test - MCH-20d - Complete Replacement or Altered Duct System

1. *Condenser Nominal Cooling Capacity (ton)*: Same data given on MCH-01.
2. *Heating Capacity (kBtu/h)*: Same data given on MCH-01;
3. *Conditioned Floor Area Served by this HVAC System(ft^2)*: User must input CFA for the space. Should be consistent with the CF1R input value.
4. *Duct Leakage Test Conditions*: Select from the following options:
   a. <u>Test Rough-in AHU</u>: Installers may determine duct leakage in new construction by using diagnostic measurements at rough-in building construction stage prior to installation of interior finishing (See Section RA3.1.4.3.2 of the 2013 Reference Appendices). In this case the air handling unit (AHU) is installed at the time of test.
   b. <u>Test Rough-in No AHU</u>: Same as “Test Rough-in” except air handling unit is not yet installed (See Section RA3.1.4.3.2 of the 2013 Reference Appendices).
   c. <u>Test Final</u>: Test conducted at “final”, i.e. all equipment, ducts, and registers are installed and the system is essentially in its final operating condition. (rough-in no longer an option. See Section RA3.1.4.3.1 of the 2013 Reference Appendices).
5. *Duct Leakage Test Method*: Select from the following options: Leakage to the Outside (house is pressurized simultaneously with the ducts such that only leakage going outside of the pressurized conditioned shell is measured, see RA3.2.4.3.4), or Total Leakage.
6. *Leakage Factor*: This field is automatically filled out based on choices in previous fields.
7. *Air-Handling Unit Airflow (AHUAirflow) Determination Method*: User will select from the following options:
   a. <u>Default Airflow Method:</u> The Default Airflow Method may only be used for homes where the duct system is being tested before the conditioning and heating system is installed and the equipment specification is not known (See Section RA3.1.4.2.1 of the 2013 Reference Appendices).
   b. <u>Cooling System Method:</u> For systems with air conditioning, this selection must be made, and the nominal air handler airflow shall be 400 CFM per nominal ton of condensing unit cooling capacity as specified by the manufacturer (Note: the heating only value may be used, if higher, See Section RA3.1.4.2.2 of the 2013 Reference Appendices).
   c. <u>Heating System Method:</u> For heating only systems the nominal air handler airflow shall be 21.7 CFM per kBtu/hr of rated heating output capacity.
   d. <u>Measured Airflow Method:</u> The measured system airflow can be used as the air handler airflow for the purpose of establishing duct leakage percentage (See Section RA3.1.4.2.3 of the 2013 Reference Appendices).
8. *Measured AHU Airflow (CFM)*: If “Measured Airflow Method” is selected as the *Air-Handling Unit Airflow (AHUAirflow) Determination Method*, user must input measured airflow.
9. *Calculated Target Allowable Duct Leakage Rate (cfm)*: This value will be automatically calculated based on values entered in previous fields.
10. *Actual Duct Leakage Rate from Leakage Test Measurement (cfm)*: Input the duct leakage rater taken from actual test measurements.
11. *Compliance Statement*: If Actual Duct Leakage Rate from leakage test (B10) is less than or equal to Calculated Target Allowable Duct Leakage Rate, “System passes leakage test” will automatically populate. If not, “System fails leakage test” will automatically populate..
12. *Notes*: This field is automatically filled out. The values in B01, B02 and B03 are checked against the values in the same rows of the CF2R-MCH-20 for this system. If they do not match an error message will appear here.

Section C Additional Requirements For Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. This field must be a true statement (or not applicable) for the system to comply
7. This field must be a true statement (or not applicable) for the system to comply

8. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets all of the additional requirements for compliance then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
9. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section D. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
01	Space Conditioning System Identification or Name:	
02	Space Conditioning System Location or Area Served:	
03	Building Type from CF1R	
04	Verified Low Leakage Ducts in Conditioned Space (VLLDCS) Credit from CF1R?	
05	Verified Low Leakage Air-handling Unit Credit from CF1R?	
06	Duct System Compliance Category:	

MCH-20e - Sealing All Accessible Leaks using Smoke Test

B. Duct Leakage Diagnostic Test		
01	Condenser Nominal Cooling Capacity (ton)	
02	Heating Capacity (kBtu/h)	
03	Conditioned Floor Area Served by this HVAC System (ft2)	
04	Duct Leakage Test Conditions	
05	Duct Leakage Test Method	
06	Leakage Factor	
07	Air-Handling Unit Airflow (AHU Airflow) Determination Method	
08	Measured AHU Airflow (cfm)	
09	Calculated Target Allowable Duct Leakage Rate (cfm)	
10	Actual Duct Leakage Rate from Leakage Test Measurement (cfm)	
11	Compliance statement:	
12	Correction Notes:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

C. Additional Requirements for Compliance		
01	System was tested in its normal operation condition. No temporary taping allowed.	
02	Outside air (OA) ducts for Central Fan Integrated (CFI) ventilation systems, shall not be sealed/taped off during duct leakage testing. CFI OA ducts that utilize controlled motorized dampers, that open only when OA ventilation is required to meet ASHRAE Standard 62.2, and close when OA ventilation is not required, may be configured to the closed position during duct leakage testing.	
03	All supply and return register boots were sealed to the drywall.	
04	Building cavities were not used as plenums or platform returns in lieu of ducts.	
05	If cloth backed tape was used it was covered with Mastic and draw bands.	
06	All connection points between the air handler and the supply and return plenums are completely sealed.	
07	If the system complies using the Smoke Test method, the smoke test was conducted in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.6. Systems that comply using smoke test shall not be included in sample groups for HERS verification compliance.	
08	Verification Status:	
09	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

D. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-20-H
Duct Leakage Diagnostic Test		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-20e-H User Instructions

Section A. System Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
2. *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
3. *Building Type*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
4. *Verified Low Leakage Ducts in Conditioned Space (VLLDCS)*: This field is filled out automatically. It is referenced from the CF2R-MCH-20.
5. *Verified Low Leakage Air-handling Unit (VLLAHU) Credit:* This field is filled out automatically. It is referenced from the CF2R-MCH-20.
   Duct System Compliance Category: This field is filled out automatically. It is referenced from the CF2R-MCH-20.

B. Duct Leakage Diagnostic Test - MCH-20e - Sealing All Accessible Leaks using Smoke Test

1. *Condenser Nominal Cooling Capacity (ton)*: Same data given on MCH-01.
2. *Heating Capacity (kBtu/h)*: Same data given on MCH-01;
3. *Conditioned Floor Area Served by this HVAC System(ft^2)*: User must input CFA for the space. Should be consistent with the CF1R input value.
4. *Duct Leakage Test Conditions*: Select from the following options:
   a. Test Rough-in AHU: Installers may determine duct leakage in new construction by using diagnostic measurements at rough-in building construction stage prior to installation of interior finishing (See Section RA3.1.4.3.2 of the 2013 Reference Appendices). In this case the air handling unit (AHU) is installed at the time of test.
   b. Test Rough-in No AHU: Same as “Test Rough-in” except air handling unit is not yet installed (See Section RA3.1.4.3.2 of the 2013 Reference Appendices).
   c. Test Final: Test conducted at “final”, i.e. all equipment, ducts, and registers are installed and the system is essentially in its final operating condition. (rough-in no longer an option. (See Section RA3.1.4.3.1 of the 2013 Reference Appendices).
5. *Duct Leakage Test Method*: Select from the following options: Leakage to the Outside (house is pressurized simultaneously with the ducts such that only leakage going outside of the pressurized conditioned shell is measured, see RA3.2.4.3.4), or Total Leakage.
6. *Leakage Factor*: This field is automatically filled out based on choices in previous fields.
7. *Air-Handling Unit Airflow (AHU Airflow) Determination Method*: User will select from the following options:
   a. Default Airflow Method: The Default Airflow Method may only be used for homes where the duct system is being tested before the conditioning and heating system is installed and the equipment specification is not known (See Section RA3.1.4.2.1 of the 2013 Reference Appendices).
   b. Cooling System Method: For systems with air conditioning, this selection must be made, and the nominal air handler airflow shall be 400 CFM per nominal ton of condensing unit cooling capacity as specified by the manufacturer (Note: the heating only value may be used, if higher, See Section RA3.1.4.2.2 of the 2013 Reference Appendices).
   c. Heating System Method: For heating only systems the nominal air handler airflow shall be 21.7 CFM per kBtu/hr of rated heating output capacity.
   d. Measured Airflow Method: The measured system airflow can be used as the air handler airflow for the purpose of establishing duct leakage percentage (See Section RA3.1.4.2.3 of the 2013 Reference Appendices).
8. *Measured AHU Airflow (CFM)*: If “Measured Airflow Method” is selected as the *Air-Handling Unit Airflow (AHU Airflow) Determination Method*, user must input measured airflow.
9. *Calculated Target Allowable Duct Leakage Rate (cfm)*: This value will be automatically calculated based on values entered in previous fields.
10. *Actual Duct Leakage Rate from Leakage Test Measurement (cfm)*: Input the duct leakage rater taken from actual test measurements.
11. *Compliance Statement*: If measured leakage (B10) is less than or equal to allowable duct leakage rate (B9), “system passes - system complies with Allowable Duct Leakage Rate Criterion” will automatically populate.
    If measured leakage is greater than allowable duct leakage rate, then the following will automatically populate:
    “System passes using smoke test of an altered HVAC system in an existing building
    - No visible smoke exits the accessible portions of the duct system.
    - Smoke is only emanating from air handler unit (AHU cabinet and non-accessible portions of the duct system.
12. *Notes*: This field is automatically filled out. The values in B01, B02 and B03 are checked against the values in the same rows of the CF2R-MCH-20 for this system. If they do not match an error message will appear here.

Section C Additional Requirements for Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. This field must be a true statement (or not applicable) for the system to comply
7. This field must be a true statement (or not applicable) for the system to comply
8. *Verification Status:* If this Section does not apply, then select “All n/a”. If the system meets all of the additional requirements for compliance then select “Pass”, otherwise select “Fail”. The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
9. *Correction Notes:* If one or more applicable requirements are not met “Fail” will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section D. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

CERTIFICATE OF INSTALLATION		CF3R-MCH-21-H
Duct Location		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. General Information
Note: Submit one Installation Certificate for each duct system that is taking credit for duct location.

01	SC System Identification or Name	
02	SC System Location or Area Served	
03	Status - Less than 12 ft Ducts in Conditioned Space Performance Credit:	
04	Status - Ducts Located In Conditioned Space Performance Credit:	
05	Status – All Ducts Entirely in Directly Conditioned Space R-value Exception	

B. 12 Linear Feet or Less of Supply Duct Located Outside of Conditioned Space - RA3.1.4.1.2

01	A visual inspection shall confirm space conditioning systems with air handlers located outside the conditioned space have 12 linear feet or less of duct located outside the conditioned space including air handler and plenum.	
02	Verification Status:	
03	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

C. Ducts Located In Conditioned Space - RA3.1.4.1.3

01	A visual inspection shall confirm the space conditioning system is located entirely in conditioned space.
02	Verification Status:
03	Correction Notes:

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

D. All Ducts Located Entirely in Directly Conditioned Space R-Value Exception - RA3.1.4.3.8

01	A visual inspection shall confirm the space conditioning distribution system location:	
02	Actual system duct leakage rate (cfm) measured using RA3.1.4.3.4 Duct Leakage to Outside from Fan Pressurization of Ducts	
03	Compliance Statement:	

E. Determination of HERS Verification Compliance
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF INSTALLATION		CF3R-MCH-21-H
Duct Location		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-21-H User Instructions

Section A. General Information

1 *HVAC System Identification or Name*: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

2 *HVAC System Location or Area Served*: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

3 *Status – Less than 12 ft Ducts in Conditioned Space Performance Credit:* This field is automatically filled based on the information given on the CF1R. If "True" appears here, it means that this credit was taken in the performance calculations, is required for compliance and must be field verified.

4 *Status – Ducts Located in Conditioned Space Performance Credit:* This field is automatically filled based on the information given on the CF1R. If "True" appears here, it means that this credit was taken in the performance calculations, is required for compliance and must be field verified.

5 *Status – All Ducts Located Entirely in Directly Conditioned Space R-Value Exception:* This field is automatically filled based on the information given on the CF1R. If "True" appears here, it means that this credit was taken in the performance calculations, is required for compliance and must be field verified.

Section B. 12 Linear Feet or Less of Supply Duct Located Outside of Conditioned Space

1 This field is informational and pertains to the following fields.

2 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *12 Linear Feet or Less of Supply Duct Located Outside of Conditioned Space* credit then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.

3 This field is automatically filled.

Section C. Ducts Located in Conditioned Space.

1 This field is informational and pertains to the following fields.

2 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *Ducts Located in Conditioned Space* credit then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.

3 This field is automatically filled.

Section D. All Ducts Located Entirely in Directly Conditioned Space R-Value Exception

1 A Visual Inspection Shall Confirm the Distribution System is in Conditioned Space: Select from the list one of the following "entirely in conditioned space" or "Not entirely in conditioned space".

2 Actual System Duct Leakage Rate (cfm) Measured using RA3.1.4.3.4 Duct Leakage to Outside from Fan Pressurization of Ducts: Enter the measured duct leakage rate (cfm) using the procedures found in RA3.1.4.3.4.

3 Compliance Statement: This field is automatically filled.

SPACE CONDITIONING SYSTEM FAN EFFICACY

CERTIFICATE OF VERIFICATION		CF3R-MCH-22-H
Space Conditioning System Fan Efficacy		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol utilized	

B. Fan Watt Measurement Apparatus and Procedure Information

Instrument Specifications are given in RA3.3.1, and system fan watt measurement apparatus information is given in RA3.3.2.2.

01	Fan Watt Verification Device Used.	

MCH-22a Forced Air System Fan Watt Measurement – Newly Installed Non-Zoned Systems or Zoned Multi-Speed Compressor

C. Forced Air System Fan Efficacy Measurement

The procedures for System Fan Watt Verification are specified in Reference Residential Appendix RA3.

01	Actual Tested Watts	
02	Actual Tested Airflow from MCH-23 (cfm)	
03	Required Fan Efficacy (watts/cfm)	
04	Actual Fan Efficacy (watts/cfm)	
05	Compliance Statement:	

D. Additional Requirements

01	All registers were fully open during the diagnostic test.	
02	System fan was set at maximum speed during the diagnostic test.	
03	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
04	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the Fan Efficacy tested value.	
05	Multi-speed compressor space cooling systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) with system operating in cooling mode at the maximum compressor speed and the maximum air handler fan speed.	
06	Zoned cooling air distribution systems with single speed compressors shall meet both the airflow (cfm/ton) and fan efficacy (Watt/cfm) criteria in every zonal control mode.	
07	Verification Status:	
08	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

E. Determination of HERS Verification Compliance

All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-22-H
Space Conditioning System Fan Efficacy		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-22a-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
3 *System Installation Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
7 *Central Fan Integrated (CFI) Ventilation System Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
9 *Date of System Airflow Rate Measurement:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
10 *Airflow Rate Protocol utilized:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.

Section B. Fan Watt Measurement Apparatus and Procedure Information

1 *Fan Watt Verification Device Used:* If the device used to measure fan watts was a portable watt meter then select "Portable Watt Meter". This can include plug-in devices such as a "Watts-Up" meter, or a "Kill-a-Watt" meter, or a clamp-on type meter that reads true power watts directly (must account for power factor – multiplying amps x volts is not adequate).

Section C. Forced Air System Fan Efficacy Measurement

1 *Actual Tested Watts:* Enter the number of watts tested using the device specified in section B.
2 *Actual Tested Airflow from MCH-23 (cfm):* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
3 *Required Fan Efficacy (watts/cfm):* This field is filled out automatically. If a value other than 0.58 watts/cfm was claimed in the performance calculations, it will be referenced from the CF1R, otherwise the target is 0.58 watts/cfm.
4 *Actual Fan Efficacy (watts/cfm):* This field is filled out automatically. It is calculated by dividing the actual tested watts by the actual tested airflow.
5 *Compliance Statement:* This field is filled out automatically based on whether or not the actual fan efficacy meets the required fan efficacy.

Section D. Additional Requirements

1 This field must be a true statement (or not applicable) for the system to comply.
2 This field must be a true statement (or not applicable) for the system to comply.
3 This field must be a true statement (or not applicable) for the system to comply.
4 This field must be a true statement (or not applicable) for the system to comply.
5 This field must be a true statement (or not applicable) for the system to comply.
6 This field must be a true statement (or not applicable) for the system to comply.
7 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *Ducts Located in Conditioned Space* credit then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
8 *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

CERTIFICATE OF VERIFICATION		CF3R-MCH-22-H
Space Conditioning System Fan Efficacy		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol utilized	

B. Fan Watt Measurement Apparatus and Procedure Information
Instrument Specifications are given in RA3.3.1, and system fan watt measurement apparatus information is given in RA3.3.2.2.

01	Fan Watt Verification Device Used.	

MCH-22b Forced Air System Fan Efficacy Measurement – Newly Installed Zoned Single-Speed-Compressor Systems

C. Forced Air System Fan Efficacy Measurement – All Zones Calling
The procedures for System Fan Watt Verification are specified in Reference Residential Appendix RA3.3.3.2

01	Actual Tested Watts	
02	Actual Tested Airflow from MCH-23 (cfm)	
03	Required Fan Efficacy (watts/cfm)	
04	Actual Fan Efficacy (watts/cfm)	
05	Compliance Statement:	

D. Forced Air System Fan Efficacy Measurement – All Zonal Control Modes
The procedures for System Fan Efficacy Verification are specified in Reference Residential Appendix RA3.3.
Note: For compliance with verification in all zonal control modes, it is sufficient to verify fan efficacy for operation of each individual zone when the individual zone is the sole zone calling for conditioning. It is not necessary to verify fan efficacy for combinations of 2 or more zones that are less than all zones calling (e.g., 2 out of three zones calling).

01	Number of independently controlled zones (i.e., number of thermostats or temperature sensors that independently control one or more dampers.)	
02	Required Fan Efficacy in all Zonal Control Modes(watt/cfm)	

03	04	05	06	07	08
Zone Name	Zone Description	Measured Watt Draw with all other zones off	Measured Airflow with all other zones off (cfm)	Calculated Fan Efficacy (W/cfm)	Zone Compliance Status

09	Compliance Statement:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-22-H
Space Conditioning System Fan Efficacy		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Additional Requirements		
01	All registers were fully open during the diagnostic test.	
02	System fan was set at maximum speed during the diagnostic test.	
03	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
04	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the fan efficacy tested value.	
05	Multi-speed compressor space cooling systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) with system operating in cooling mode at the maximum compressor speed and the maximum air handler fan speed.	
06	Zoned cooling air distribution systems with single speed compressors shall meet both the airflow (cfm/ton) and fan efficacy (Watt/cfm) criteria in every zonal control mode.	
07	Portable Watt meters used for measurements of air handler Watt draws shall be true power measurement systems (i.e., sensor plus data acquisition system) having an accuracy of ± 2% of reading or ± 10 watts whichever is greater	
08	Verification Status:	
09	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. Determination of HERS Verification Compliance	
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-22-H
Space Conditioning System Fan Efficacy		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-22b-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
3 *System Installation Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
7 *Central Fan Integrated (CFI) Ventilation System Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
9 *Date of System Airflow Rate Measurement:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
10 *Airflow Rate Protocol utilized:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.

Section B. Fan Watt Measurement Apparatus and Procedure Information

1 *Fan Watt Verification Device Used:* If the device used to measure fan watts was a portable watt meter then select "Portable Watt Meter". This can include plug-in devices such as a "Watts-Up" meter, or a "Kill-a-Watt" meter, or a clamp-on type meter that reads true power watts directly (must account for power factor – multiplying amps x volts is not adequate).

Section C. Forced Air System Fan Efficacy Measurement – All Zones Calling

1 *Actual Tested Watts:* Enter the number of watts tested using the device specified in section B and tested with all zones calling for cooling simultaneously.
2 *Actual Tested Airflow from MCH-23 (cfm):* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
3 *Required Fan Efficacy (watts/cfm):* This field is filled out automatically. If a value other than 0.58 watts/cfm was claimed in the performance calculations, it will be referenced from the CF1R, otherwise the target is 0.58 watts/cfm.
4 *Actual Fan Efficacy (watts/cfm):* This field is filled out automatically. It is calculated by dividing the actual tested watts by the actual tested airflow.
5 *Compliance Statement:* This field is filled out automatically. The result is based on whether or not the actual fan efficacy meets the required fan efficacy.

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol Utilized	

B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum
Procedures for installing HSPP or PSPP are specified in RA3.3.1.1.

01	Method Used to Demonstrate Compliance with the HSPP/PSPP Requirement	

C. Airflow Rate Measurement Apparatus and Procedure Information
Instrument Specifications are given in RA3.3.1.1, and system airflow rate measurement apparatus information is given in RA3.3.2.

01	Airflow Rate Measurement Type Used for this Airflow Rate Verification	
02	Manufacturer of Airflow Measurement Apparatus	
03	Model Number of Airflow Measurement Apparatus	
04	Certification Status of the Airflow Measurement Apparatus Accuracy	

MCH-23a Forced Air System Airflow Rate Measurement – Newly Installed Non-Zoned Systems or Zoned Multi-Speed Compressor

D. Forced Air System Airflow Rate Measurement
The procedures for System Airflow Rate Verification are specified in Reference Residential Appendix RA3.3.

01	Required Minimum System Airflow Rate (cfm/ton)	
02	Required Minimum System Airflow Target (cfm)	
03	Actual System Airflow Rate Measurement (cfm) -	
04	Compliance Statement:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Additional Requirements		
01	Air filters that meet the applicable requirements of Standards Section 150.0(m)12 or 150.0(m)13 were properly installed in the system during system air flow rate measurement identified on this Certificate of Verification.	
02	The airflow rate measurement apparatus used to perform the airflow rate measurement identified on this Certificate of Verification was calibrated in accordance with the apparatus manufacturer's specifications and conforms to the instrumentation specifications given in RA3.3.1.	
03	A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used on newly constructed zonally controlled systems unless the Performance Certificate of Compliance indicates an allowance for use of a bypass duct. When a bypass duct is accounted for on the Performance Certificate of Compliance, the airflow rate shall conform to the specifications listed on the Certificate of Compliance.	
04	All registers were fully open during the diagnostic test.	
05	System fan was set at maximum speed during the diagnostic test.	
06	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
07	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the Fan Efficacy tested value.	
08	Multi-speed compressor space cooling systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) with system operating in cooling mode at the maximum compressor speed and the maximum air handler fan speed.	
09	Verification Status:	
10	Correction Notes:	
The responsible person’s signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-23a-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

3 *System Installation Type:* Select the appropriate System Installation Type from the following choices:

a. New: Use this choice for newly constructed buildings, additions with all-new systems dedicated to the addition, or new systems installed in existing homes where the equipment and ducts are all newly installed (aka, "Cut-in").

b. Replacement: Use this choice if the system is a complete replacement space-conditioning system installed as part of an alteration, and includes all the system heating or cooling equipment plus a replacement duct system (150.2(b)1Diia) where the ducts are at least 75 percent or more newly installed duct material (up to 25 percent of the finished system may consist of reused parts from the dwelling unit's previously existing duct system, such as registers, grilles, boots, air handler, coil, plenums, duct material); plus a replacement air handler.

c. Alteration: Use this choice for existing buildings where any of the following are newly installed or replaced as part of the project and the system does not meet one of the other compliance categories above:

i. 40 feet or more of space-conditioning system ducts are installed in unconditioned space or indirectly conditioned space.

ii. Air conditioning or heat pump condenser

iii. Heating or cooling coil

iv. Air handler (e.g., furnace, fan coil, package unit)

4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

7 *Central Fan Integrated (CFI) Ventilation System Status:* If the system has Central Fan Integrated System, then select "CFI System", otherwise select "Not a CFI system".

8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

9 *Date of System Airflow Rate Measurement:* Enter the date that the airflow test was performed.

10 *Airflow Rate Protocol Utilized:* If the system installation type is "New" or "Replacement" then only the RA3.3 airflow methods may be used. If the system installation type is "Alteration", the RA3.3 airflow methods may be used, but the Alternative to Compliance with Minimum System Airflow Requirements ("Best I Can Do" airflow) is an option for existing systems that may require substantial modification to improve the airflow.

Section B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum

1 A hole for a static pressure probe (HSPP) or a permanent static pressure probe (PSPP) is required when system airflow verification is required, whether the airflow test method used requires one or not. Select the appropriate choice from the following options using a dropdown box, the Static Pressure Measurement Method:

A. If an Hole Static Pressure Probe is installed then select "HSPP Installed"

B. If a Permanent Static Pressure Probe is installed then select "PSPP Installed"

C. If the system is configured such that an HSPP nor PSPP can be installed, an alternate location that provides access for making supply plenum pressure measurement may be used. Select "An alternative location has been provided and clearly labeled."

D. If the system is such that an HSPP or PSPP is not applicable, select "HSPP/PSPP are not applicable to this system".

Section C. Airflow Rate Measurement Apparatus and Procedure Information

1. *Airflow Rate Measurement Type Used for this Airflow Rate Verification:* Select the appropriate airflow test procedure from the following options for the method used to determine actual fan air flow*:*
   a. Diagnostic Fan Flow Using Fan Flow Meter (aka Plenum Pressure Matching) according to the procedures in RA3.3.3.1.1
   b. Diagnostic Fan Flow Using Flow Grid Measurement according to the procedures in RA3.3.3.1.2
   c. Diagnostic Fan Flow Using Powered Flow Capture Hood according to the procedures in RA3.3.3.1.3
   d. Diagnostic Fan Flow Using Traditional Flow Capture Hood according to the procedures in RA3.3.3.1.4
2. *Manufacturer of Airflow Measurement Apparatus:* Enter the name of the manufacturer of the airflow measurement tool used to measure the airflow for this test.
3. *Model number of Airflow Measurement Apparatus:* Enter the model number of the airflow measurement tool used to measure the airflow for this test.
4. *Certification Status of the Airflow Measurement Apparatus Accuracy:* The measurement apparatus used to perform airflow verification measurements must appear on the CEC list of approved devices found at http://www.energy.ca.gov/title24/equipment_cert/ama_fas/index.html, if this is true, select "Certified", otherwise select "Not Certified". The latter choice will not allow the system to pass until a certified device is used.

Section D. Forced Air System Airflow Rate Measurement

1. *Required Minimum System Airflow Rate (cfm/ton):* This field is filled automatically. The target is based on whether the system is new or altered and whether a value was specified on the CF2R-MCH-01.
2. *Required Minimum System Airflow Target (cfm):* This field is calculated automatically. It is the product of the minimum airflow rate per ton and the tonnage of the system condenser.
3. *Actual System Airflow Rate Measurement (cfm):* Enter the actual tested value of the airflow measured using the apparatus specified above.
4. *Compliance Statement:* This field is filled automatically. Compliance requires that the measured airflow meets the minimum airflow target.

Section E. Additional Requirements

1 This field must be a true statement (or not applicable) for the system to comply.
2 This field must be a true statement (or not applicable) for the system to comply.
3 This field must be a true statement (or not applicable) for the system to comply.
4 This field must be a true statement (or not applicable) for the system to comply.
5 This field must be a true statement (or not applicable) for the system to comply.
6 This field must be a true statement (or not applicable) for the system to comply.
7 This field must be a true statement (or not applicable) for the system to comply.
8 This field must be a true statement (or not applicable) for the system to comply.
9 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the airflow criteria then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
10 *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol Utilized	

B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum
Procedures for installing HSPP or PSPP are specified in RA3.3.1.1.

01	Method used to demonstrate compliance with the HSPP/PSPP requirement	

C. Airflow Rate Measurement Apparatus and Procedure Information
Instrument Specifications are given in RA3.3.1.1, and system airflow rate measurement apparatus information is given in RA3.3.2.

01	Airflow Rate Measurement Type Used for this Airflow Rate Verification.	
02	Manufacturer of Airflow Measurement Apparatus	
03	Model Number of Airflow Measurement Apparatus	
04	Certification Status of the Airflow Measurement Apparatus Accuracy	

MCH-23b Forced Air System Airflow Rate Measurement – Newly Installed Zoned Single-Speed Compressor Systems

D. Forced Air System Airflow Rate Measurement – All Zones Calling
The procedures for System Airflow Rate Verification are specified in Reference Residential Appendix RA3.3.

01	Required All Zones Calling Minimum System Airflow Rate (cfm/ton)	
02	Required All Zones Calling Minimum System Airflow Target (cfm)	
03	Actual System Airflow Rate Measurement (cfm)	
04	Compliance Statement:	

E. Forced Air System Airflow Rate Measurement – All Other Zonal Control Modes
The procedures for System Airflow Rate Verification are specified in Reference Residential Appendix RA3.3.
For compliance with verification in all zonal control modes, it is sufficient to verify airflow rate for operation of each individual zone when the individual zone is the sole zone calling for conditioning. It is not necessary to verify airflow rate for combinations of 2 or more zones that are less than all zones calling (e.g., 2 out of three zones calling).

01	Number of independently controlled zones (i.e., number of thermostats or temperature sensors that independently control one or more dampers.)	
02	Required Minimum Cooling System Airflow Rate (cfm/ton)	
03	Required Minimum Airflow in all Zonal Control Modes (cfm)	

04	05	06	07
Zone Name	Zone Description	Measured Airflow with all other zones off (CFM)	Zone Compliance Status

08	Compliance Statement:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
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Dwelling Address:	City	Zip Code

F. Additional Requirements		
01	Air filters that meet the applicable requirements of Standards Section 150.0(m)12 or 150.0(m)13 were properly installed in the system during system air flow rate measurement identified on this Certificate of Verification.	
02	The airflow rate measurement apparatus used to perform the airflow rate measurement identified on this Certificate of Verification was calibrated in accordance with the apparatus manufacturer's specifications and conforms to the instrumentation specifications given in RA3.3.1.	
03	A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used on newly constructed zonally controlled systems unless the Performance Certificate of Compliance indicates an allowance for use of a bypass duct. When a bypass duct is accounted for on the Performance Certificate of Compliance, the airflow rate shall conform to the specifications listed on the Certificate of Compliance.	
04	All registers were fully open during the diagnostic test.	
05	System fan was set at maximum speed during the diagnostic test.	
06	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
07	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the Fan Efficacy tested value.	
08	Multi-speed compressor space cooling systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) with system operating in cooling mode at the maximum compressor speed and the maximum air handler fan speed.	
09	Verification Status:	
10	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

G. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
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Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-23b-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
3 *System Installation Type:* Select the appropriate System Installation Type from the following choices:
   a. New: Use this choice for newly constructed buildings, additions with all-new systems dedicated to the addition, or new systems installed in existing homes where the equipment and ducts are all newly installed (aka, "Cut-in").
   b. Replacement: Use this choice if the system is a complete replacement space-conditioning system installed as part of an alteration, and includes all the system heating or cooling equipment plus a replacement duct system (150.2(b)1Diia) where the ducts are at least 75 percent or more newly installed duct material (up to 25 percent of the finished system may consist of reused parts from the dwelling unit's previously existing duct system, such as registers, grilles, boots, air handler, coil, plenums, duct material); plus a replacement air handler.
   c. Alteration: Use this choice for existing buildings where any of the following are newly installed or replaced as part of the project and the system does not meet one of the other compliance categories above:
      i. 40 feet or more of space-conditioning system ducts are installed in unconditioned space or indirectly conditioned space.
      ii. Air conditioning or heat pump condenser
      iii. Heating or cooling coil
      iv. Air handler (e.g., furnace, fan coil, package unit)
4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
7 *Central Fan Integrated (CFI) Ventilation System Status:* If the system has Central Fan Integrated System, then select "CFI System", otherwise select "Not a CFI system".
8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
9 *Date of System Airflow Rate Measurement:* Enter the date that the airflow test was performed.
10 *Airflow Rate Protocol Utilized:* If the system installation type is "New" or "Replacement" then only the RA3.3 airflow methods may be used. If the system installation type is "Alteration", the RA3.3 airflow methods may be used, but the Alternative to Compliance with Minimum System Airflow Requirements ("Best I Can Do" airflow) is an option for existing systems that may require substantial modification to improve the airflow.

Section B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum

1 A hole for a static pressure probe (HSPP) or a permanent static pressure probe (PSPP) is required when system airflow verification is required, whether the airflow test method used requires one or not. Select the appropriate choice from the following options using a dropdown box, the Static Pressure Measurement Method:
   A. If an Hole Static Pressure Probe is installed then select "HSPP Installed"
   B. If a Permanent Static Pressure Probe is installed then select "PSPP Installed"
   C. If the system is configured such that an HSPP nor PSPP can be installed, an alternate location that provides access for making supply plenum pressure measurement may be used. Select "An alternative location has been provided and clearly labeled."
   D. If the system is such that an HSPP or PSPP is not applicable, select "HSPP/PSPP are not applicable to this system".

Section C. Airflow Rate Measurement Apparatus and Procedure Information

1. *Airflow Rate Measurement Type Used for this Airflow Rate Verification:* Select the appropriate airflow test procedure from the following options for the method used to determine actual fan air flow*:*
   a. Diagnostic Fan Flow Using Fan Flow Meter (aka Plenum Pressure Matching) according to the procedures in RA3.3.3.1.1
   b. Diagnostic Fan Flow Using Flow Grid Measurement according to the procedures in RA3.3.3.1.2
   c. Diagnostic Fan Flow Using Powered Flow Capture Hood according to the procedures in RA3.3.3.1.3
   d. Diagnostic Fan Flow Using Traditional Flow Capture Hood according to the procedures in RA3.3.3.1.4
2. *Manufacturer of Airflow Measurement Apparatus:* Enter the name of the manufacturer of the airflow measurement tool used to measure the airflow for this test.
3. *Model number of Airflow Measurement Apparatus:* Enter the model number of the airflow measurement tool used to measure the airflow for this test.
4. *Certification Status of the Airflow Measurement Apparatus Accuracy:* The measurement apparatus used to perform airflow verification measurements must appear on the CEC list of approved devices found at http://www.energy.ca.gov/title24/equipment_cert/ama_fas/index.html, if this is true, select "Certified", otherwise select "Not Certified". The latter choice will not allow the system to pass until a certified device is used.

Section D. Forced Air System Airflow Rate Measurement – All Zones Calling

1. *Required All Zones Calling Minimum System Airflow Rate (cfm/ton):* This field is filled automatically. The target is based on whether the system is new or altered and whether a value was specified on the CF2R-MCH-01.
2. *Required All Zones Calling Minimum System Airflow target (cfm):* This field is calculated automatically. It is the product of the minimum airflow rate per ton and the tonnage of the system condenser.
3. *Actual System Airflow Rate Measurement (cfm):* Enter the actual tested value of the airflow measured using the apparatus specified above.
4. *Compliance Statement:* This field is filled automatically. Compliance requires that the measures airflow meets the minimum airflow target.

Section E. Forced Air System Airflow Rate Measurement – All Other Zonal Control Modes

1. *Number of Independently Controlled Zones:* Enter the number of zones in this system that are independently controlled, i.e., that can call for cooling while other zones can be fully or mostly shut off from system airflow. This usually corresponds to the number of thermostats or zone sensors.
2. *Required Minimum Airflow in all Zonal Control Modes (cfm):* This field is filled out automatically. If a value other than 350 cfm was claimed in the performance calculations, it will be referenced from the CF1R, otherwise the target is 350 cfm.
3. *Zone Name:* Enter a unique name for each zone on this system. Examples: Zone 1, Z1, Zone A, etc.
4. *Zone Description:* Enter a brief description of each zone that is detailed enough allow someone to distinguish it from the others in the field. Examples: upstairs, first floor, east wing, bedrooms only, (list rooms served), etc.
5. *Measured Airflow with all other zones off:* This test must be performed with only one independently controlled zone calling for cooling (Note: if fan watt verification is required, it must be performed simultaneously to the corresponding airflow from this test). All other zones must not be calling during this test. The zone dampers for the other zones must be in their normal closed position. Enter the airflow value measured for the zone that is calling. This test must be performed for each and every independently controlled zone.
6. *Zone Compliance Status:* This field is filled out automatically. The result is based on whether or not the actual airflow meets the required airflow for this zone.
7. *Compliance Statement:* This field is filled out automatically. The result is based on whether or not the actual airflow meets the required airflow for all zones

Section F. Additional Requirements

1 This field must be a true statement (or not applicable) for the system to comply.
2 This field must be a true statement (or not applicable) for the system to comply.
3 This field must be a true statement (or not applicable) for the system to comply.
4 This field must be a true statement (or not applicable) for the system to comply.
5 This field must be a true statement (or not applicable) for the system to comply.
6 This field must be a true statement (or not applicable) for the system to comply.
7 This field must be a true statement (or not applicable) for the system to comply.
8 This field must be a true statement (or not applicable) for the system to comply.
9 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the airflow criteria then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
10 *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

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Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol Utilized	

B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum Procedures for installing HSPP or PSPP are specified in RA3.3.1.1.		
01	Method Used to Demonstrate Compliance with the HSPP/PSPP Requirement	

C. Airflow Rate Measurement Apparatus and Procedure Information Instrument Specifications are given in RA3.3.1.1, and system airflow rate measurement apparatus information is given in RA3.3.2.		
01	Airflow Rate Measurement Type Used for this Airflow Rate Verification	
02	Manufacturer of Airflow Measurement Apparatus	
03	Model Number of Airflow Measurement Apparatus	
04	Certification Status of the Airflow Measurement Apparatus Accuracy	

MCH-23c Forced Air System Airflow Rate Measurement - Alternative to Compliance with Minimum System Airflow Requirements for Altered Systems

D. Alternative to Compliance with Minimum System Airflow Requirements for Altered Systems The installer shall attempt to correct non-compliant system airflow rates by performing the following remedial actions as specified in RA3.2.2.7.3		
01	Determine that the air filter media is clean. If the air filter media is dirty, then replace it with clean filter media.	
02	Open all registers and dampers and remove any obstructions.	
03	Replace/Repair all accessible crushed, blocked, restricted, remove excess length, and sharp bends in ducts. Supported every 4 ft max. with a max. 2 in sag.	
04	Clean the evaporator coil according to the manufacturer and ensure the coil is not obstructed.	
05	Air handler fan speed set to high and blower wheel and motor are operating properly.	
06	If determined to be too small, replace the return duct with a larger one and/or add a second return duct.	
07	If determined to be too small, replace the return grille with a larger area grille.	
08	Verification Status:	
09	Correction Notes:	
10	Optional Notes: additional information not relevant to correction for responses given in Rows 01 through 07 in this section:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Forced Air System Airflow Rate Measurement - Best Airflow Rate Attainable
The procedures for System Airflow Rate Verification are specified in Reference Residential Appendix RA3.3.

01	Required Minimum System Airflow Rate (cfm/ton)	
02	Required Minimum System Airflow Target (cfm)	
03	Actual System Airflow Rate Measurement (cfm)	
04	Compliance Statement:	
05	HERS Sample Group Eligibility	

F. Additional Requirements

01	Air filters that meet the applicable requirements of Standards Section 150.0(m)12 or 150.0(m)13 were properly installed in the system during system air flow rate measurement identified on this Certificate of Verification.	
02	The airflow rate measurement apparatus used to perform the airflow rate measurement identified on this Certificate of Verification was calibrated in accordance with the apparatus manufacturer's specifications and conforms to the instrumentation specifications given in RA3.3.1.	
03	A visual inspection shall confirm that bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow are not used on newly constructed zonally controlled systems unless the Performance Certificate of Compliance indicates an allowance for use of a bypass duct. When a bypass duct is accounted for on the Performance Certificate of Compliance, the airflow rate shall conform to the specifications listed on the Certificate of Compliance.	
04	All registers were fully open during the diagnostic test.	
05	System fan was set at maximum speed during the diagnostic test.	
06	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
07	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the Fan Efficacy tested value.	
08	Multi-speed compressor space cooling systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) with system operating in cooling mode at the maximum compressor speed and the maximum air handler fan speed.	
09	For altered systems that do not comply with the minimum 300 cfm per ton airflow rate requirement but opt to comply using the remedial actions on this MCH-23 compliance document according to Section RA3.2.2.7.3, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5 and shall be capable of receiving and responding to Demand Response Signals prior to final approval of the building permit by the enforcing agency (Section 150.2(b)1Fia).	
10	Verification Status:	
11	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

G. Determination of HERS Verification Compliance
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-23c-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

3 *System Installation Type:* Select the appropriate System Installation Type from the following choices:

- a. New: Use this choice for newly constructed buildings, additions with all-new systems dedicated to the addition, or new systems installed in existing homes where the equipment and ducts are all newly installed (aka, "Cut-in").
- b. Replacement: Use this choice if the system is a complete replacement space-conditioning system installed as part of an alteration, and includes all the system heating or cooling equipment plus a replacement duct system (150.2(b)1Diia) where the ducts are at least 75 percent or more newly installed duct material (up to 25 percent of the finished system may consist of reused parts from the dwelling unit's previously existing duct system, such as registers, grilles, boots, air handler, coil, plenums, duct material); plus a replacement air handler.
- c. Alteration: Use this choice for existing buildings where any of the following are newly installed or replaced as part of the project and the system does not meet one of the other compliance categories above:
  - i. 40 feet or more of space-conditioning system ducts are installed in unconditioned space or indirectly conditioned space.
  - ii. Air conditioning or heat pump condenser
  - iii. Heating or cooling coil
  - iv. Air handler (e.g., furnace, fan coil, package unit)

4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

7 *Central Fan Integrated (CFI) Ventilation System Status:* If the system has Central Fan Integrated System, then select "CFI System", otherwise select "Not a CFI system".

8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

9 *Date of System Airflow Rate Measurement:* Enter the date that the airflow test was performed.

10 *Airflow Rate Protocol Utilized:* If the system installation type is "New" or "Replacement" then only the RA3.3 airflow methods may be used. If the system installation type is "Alteration", the RA3.3 airflow methods may be used, but the Alternative to Compliance with Minimum System Airflow Requirements ("Best I Can Do" airflow) is an option for existing systems that may require substantial modification to improve the airflow.

Section B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum

1 A hole for a static pressure probe (HSPP) or a permanent static pressure probe (PSPP) is required when system airflow verification is required, whether the airflow test method used requires one or not. Select the appropriate choice from the following options using a dropdown box, the Static Pressure Measurement Method:

- A. If an Hole Static Pressure Probe is installed then select "HSPP Installed"
- B. If a Permanent Static Pressure Probe is installed then select "PSPP Installed"
- C. If the system is configured such that an HSPP nor PSPP can be installed, an alternate location that provides access for making supply plenum pressure measurement may be used. Select "An alternative location has been provided and clearly labeled."
- D. If the system is such that an HSPP or PSPP is not applicable, select "HSPP/PSPP are not applicable to this system".

Section C. Airflow Rate Measurement Apparatus and Procedure Information

1. *Airflow Rate Measurement Type Used for this Airflow Rate Verification:* Select the appropriate airflow test procedure from the following options for the method used to determine actual fan air flow*:*
   a. Diagnostic Fan Flow Using Fan Flow Meter (aka Plenum Pressure Matching) according to the procedures in RA3.3.3.1.1
   b. Diagnostic Fan Flow Using Flow Grid Measurement according to the procedures in RA3.3.3.1.2
   c. Diagnostic Fan Flow Using Powered Flow Capture Hood according to the procedures in RA3.3.3.1.3
   d. Diagnostic Fan Flow Using Traditional Flow Capture Hood according to the procedures in RA3.3.3.1.4
2. *Manufacturer of Airflow Measurement Apparatus:* Enter the name of the manufacturer of the airflow measurement tool used to measure the airflow for this test.
3. *Model number of Airflow Measurement Apparatus:* Enter the model number of the airflow measurement tool used to measure the airflow for this test.
4. *Certification Status of the Airflow Measurement Apparatus Accuracy:* The measurement apparatus used to perform airflow verification measurements must appear on the CEC list of approved devices found at http://www.energy.ca.gov/title24/equipment_cert/ama_fas/index.html, if this is true, select "Certified", otherwise select "Not Certified". The latter choice will not allow the system to pass until a certified device is used.
5. *(not visible to user)*

Section D. Alternative to Compliance with Minimum System Airflow Requirements for Altered Systems

1. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
2. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
3. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
4. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
5. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
6. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
7. Refer to section *RA3.2.2.7.* for details on this item. Indicate whether completed or not.
8. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the airflow criteria then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
9. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.
10. If any of the above items could not be completed due to inaccessibility or significant cost, provide additional explanation here.

Section E. Forced Air System Airflow Rate Measurement - Best Airflow Rate Attainable

1. *Required Minimum System Airflow Rate (cfm/ton):* This field is filled automatically. The target is always 300 cfm/ton for this option.
2. *Required Minimum System Airflow Target (cfm):* This field is calculated automatically. It is the product of the minimum airflow rate per ton and the tonnage of the system condenser.
3. *Actual System Airflow Rate Measurement (cfm):* Enter the actual tested value of the airflow measured using the apparatus specified above.
4. *Compliance Statement:* This field is filled automatically. Compliance requires that the measured airflow meets the minimum airflow target, however if the criteria of *RA3.2.2.7* is met the best attainable airflow rate will suffice.
5. *HERS Sample Group Eligibility:* This field is filled out automatically. If the minimum airflow rate cannot be met and the criteria of *RA3.2.2.7* is used, the system cannot be included in a HERS sample group.

Section F. Additional Requirements

1 This field must be a true statement (or not applicable) for the system to comply.
2 This field must be a true statement (or not applicable) for the system to comply.
3 This field must be a true statement (or not applicable) for the system to comply.
4 This field must be a true statement (or not applicable) for the system to comply.
5 This field must be a true statement (or not applicable) for the system to comply.
6 This field must be a true statement (or not applicable) for the system to comply.
7 This field must be a true statement (or not applicable) for the system to comply.
8 This field must be a true statement (or not applicable) for the system to comply.
9 *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the airflow criteria then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
10 *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Ducted Cooling System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	System Installation Type	
04	Nominal Cooling Capacity (tons) of Condenser	
05	Condenser Speed Type	
06	Cooling System Zonal Control Type	
07	Central Fan Integrated (CFI) Ventilation System Status	
08	System Bypass Duct Status	
09	Date of System Airflow Rate Measurement	
10	Airflow Rate Protocol Utilized	

B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum Procedures for installing HSPP or PSPP are specified in RA3.3.1.1.		
01	Method Used to Demonstrate Compliance with the HSPP/PSPP Requirement	

C. Airflow Rate Measurement Apparatus and Procedure Information Instrument Specifications are given in RA3.3.1.1, and system airflow rate measurement apparatus information is given in RA3.3.2.		
01	Airflow Rate Measurement Type Used for this Airflow Rate Verification	
02	Manufacturer of Airflow Measurement Apparatus	
03	Model Number of Airflow Measurement Apparatus	
04	Certification Status of the Airflow Measurement Apparatus Accuracy	

MCH-23d Forced Air System Airflow Rate Measurement – Newly Installed Heating Only Non-Zoned Systems Measurement Only – No Minimum Target Requirement

D. Forced Air System Airflow Rate Measurement The procedures for System Airflow Rate Verification are specified in Reference Residential Appendix RA3.3.		
01	Actual System Airflow Rate Measurement (cfm)	

E. Additional Requirements		
01	Air filters that meet the applicable requirements of Standards Section 150.0(m)12 or 150.0(m)13 were properly installed in the system during system air flow rate measurement identified on this Certificate of Verification.	
02	The airflow rate measurement apparatus used to perform the airflow rate measurement identified on this Certificate of Verification was calibrated in accordance with the apparatus manufacturer's specifications and conforms to the instrumentation specifications given in RA3.3.1.	
03	All registers were fully open during the diagnostic test.	
04	System fan was set at maximum speed during the diagnostic test.	
05	If fresh air duct is part of the HVAC system it was not closed during the diagnostic test.	
06	Airflow rate and fan watt draw shall be simultaneous measurements when used to calculate the Fan Efficacy tested value.	
07	Verification Status:	
08	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-23-H
Space Conditioning System Airflow Rate		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-23d-H User Instructions

Section A. Ducted Cooling System Information

1 *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

2 *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

3 *System Installation Type:* Select the appropriate System Installation Type from the following choices:

a. New: Use this choice for newly constructed buildings, additions with all-new systems dedicated to the addition, or new systems installed in existing homes where the equipment and ducts are all newly installed (aka, "Cut-in").

b. Replacement: Use this choice if the system is a complete replacement space-conditioning system installed as part of an alteration, and includes all the system heating or cooling equipment plus a replacement duct system (150.2(b)1Diia) where the ducts are at least 75 percent or more newly installed duct material (up to 25 percent of the finished system may consist of reused parts from the dwelling unit's previously existing duct system, such as registers, grilles, boots, air handler, coil, plenums, duct material); plus a replacement air handler.

c. Alteration: Use this choice for existing buildings where any of the following are newly installed or replaced as part of the project and the system does not meet one of the other compliance categories above:

i. 40 feet or more of space-conditioning system ducts are installed in unconditioned space or indirectly conditioned space.

ii. Air conditioning or heat pump condenser

iii. Heating or cooling coil

iv. Air handler (e.g., furnace, fan coil, package unit)

v. Air handler (e.g., furnace, fan coil, package unit)

4 *Nominal Cooling Capacity (tons) of Condenser:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

5 *Condenser Speed Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

6 *Cooling System Zonal Control Type:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

7 *Central Fan Integrated (CFI) Ventilation System Status:* If the system has Central Fan Integrated System, then select "CFI System", otherwise select "Not a CFI system".

8 *System Bypass Duct Status:* This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.

9 *Date of System Airflow Rate Measurement:* Enter the date that the airflow test was performed.

10 *Airflow Rate Protocol Utilized:* If the system installation type is "New" or "Replacement" then only the RA3.3 airflow methods may be used. If the system installation type is "Alteration", the RA3.3 airflow methods may be used, but the Alternative to Compliance with Minimum System Airflow Requirements ("Best I Can Do" airflow) is an option for existing systems that may require substantial modification to improve the airflow.

Section B. Hole for the Placement of a Static Pressure Probe (HSPP), and Permanently Installed Static Pressure Probe (PSPP) in the Supply Plenum

1 A hole for a static pressure probe (HSPP) or a permanent static pressure probe (PSPP) is required when system airflow verification is required, whether the airflow test method used requires one or not. Select the appropriate choice from the following options using a dropdown box, the Static Pressure Measurement Method:

A. If an Hole Static Pressure Probe is installed then select "HSPP Installed"

B. If a Permanent Static Pressure Probe is installed then select "PSPP Installed"

C. If the system is configured such that an HSPP nor PSPP can be installed, an alternate location that provides access for making supply plenum pressure measurement may be used. Select "An alternative location has been provided and clearly labeled."

D. If the system is such that an HSPP or PSPP is not applicable, select "HSPP/PSPP are not applicable to this system".

Section C. Airflow Rate Measurement Apparatus and Procedure Information

1. *Airflow Rate Measurement Type Used for this Airflow Rate Verification:* Select the appropriate airflow test procedure from the following options for the method used to determine actual fan air flow:
    a. Diagnostic Fan Flow Using Fan Flow Meter (aka Plenum Pressure Matching) according to the procedures in RA3.3.3.1.1
    b. Diagnostic Fan Flow Using Flow Grid Measurement according to the procedures in RA3.3.3.1.2
    c. Diagnostic Fan Flow Using Powered Flow Capture Hood according to the procedures in RA3.3.3.1.3
    d. Diagnostic Fan Flow Using Traditional Flow Capture Hood according to the procedures in RA3.3.3.1.4
2. *Manufacturer of Airflow Measurement Apparatus:* Enter the name of the manufacturer of the airflow measurement tool used to measure the airflow for this test.
3. *Model number of Airflow Measurement Apparatus:* Enter the model number of the airflow measurement tool used to measure the airflow for this test.
4. *Certification Status of the Airflow Measurement Apparatus Accuracy:* The measurement apparatus used to perform an airflow verification measurements must appear on the CEC list of approved devices found at http://www.energy.ca.gov/title24/equipment_cert/ama_fas/index.html, if this is true, select "Certified", otherwise select "Not Certified". The latter choice will not allow the system to pass until a certified device is used.

Section D. Forced Air System Airflow Rate Measurement

1. *Actual System Airflow Rate Measurement (cfm):* Enter the actual tested value of the airflow measured using the apparatus specified above.

Section E. Additional Requirements

1 This field must be a true statement (or not applicable) for the system to comply.
2 This field must be a true statement (or not applicable) for the system to comply.
3 This field must be a true statement (or not applicable) for the system to comply.
4 This field must be a true statement (or not applicable) for the system to comply.
5 This field must be a true statement (or not applicable) for the system to comply.
6 This field must be a true statement (or not applicable) for the system to comply.

STATE OF CALIFORNIA

REFRIGERANT CHARGE VERIFICATION

CEC-CF3R-MCH-25-H (Revised 09/15)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-MCH-25
Refrigerant Charge Verification		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information HERS Rater to field-verify all system information, discrepancies to be noted by overwriting entry.		
01	System Identification or Name	
02	System Location or Area Served	
03	Condenser (or package unit) make or brand	
04	Condenser (or package unit) model number	
05	Nominal Cooling Capacity (tons) of Condenser	
06	Condenser (or package unit) serial number	
07	Refrigerant Type	
08	Other Refrigerant Type (if applicable)	
09	System Installation Type	
10	Charge Indicator Display (CID) Status (Note: Even systems with a CID must have refrigerant charge verified by installer)	
11	Is the system of a type that the minimum airflow can be verified using an approved measurement procedure (RA3.3 or RA3.2.2.7)?	
12	Is the system of a type that approved refrigerant charge verification procedures can be used to verify compliance with the refrigerant charge verification requirements when temperatures are ≥ 55°F (RA3.2.2, or RA1)?	
13	Date of HERS Rater Refrigerant Charge Verification for this system	
14	Refrigerant charge verification method used by installer.	
15	Person who performed the Refrigerant Charge Verification reported on the Certificate of Installation:	
16	HERS Verification Compliance Requirement Status	
17	Refrigerant charge verification method used by HERS Rater.	

Standard Charge Verification Procedure – CF3R-MCH-25a - Superheat Method

B. Metering Device Verification – HERS Rater is required to visually field verify all information from CF2R Superheat Method can only be used on systems that do not have a variable metering device.		
01	Refrigerant metering device	
02	Superheat Method applicability status	

C. Instrument Calibration – HERS Raters are required to calibrate their diagnostic tools. Procedures for instrument calibration are given in Reference Residential Appendix RA3.2.2 and RA3.2.2.2		
01	Date of Digital Refrigerant Gauge Calibration	
02	Date of Digital Thermocouple Calibration	
03	Digital Refrigerant Gauge Calibration Status	
04	Digital Thermocouple Calibration Status	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25
Refrigerant Charge Verification		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Measurement Access Hole (MAH) Verification – HERS Raters are required to visually field verify MAH
Procedures for installing MAH are specified in Reference Residential Appendix RA3.2.2.3

01	Method used to demonstrate compliance with the Measurement Access Hole (MAH) requirement	

E. Minimum System Airflow Rate Verification
Procedures for verifying minimum system airflow are specified in Reference Residential Appendix RA3.2.2.7.

01	Minimum Required System Airflow Rate (cfm)	
02	System Airflow Rate Verification Status	

F. Data Collection – HERS Rater must independently collect all data in this section.
Procedures for determining Refrigerant Charge using the Standard Charge Verification Procedure are given in Reference Residential Appendix RA3.2.2 and RA3.2.2.2

01	Lowest return air dry bulb temperature that occurred during the refrigerant charge verification procedure (degreeF)	
02	Measured Condenser air entering dry-bulb temperature ($T_{condenser, db}$) (degreeF)	
03	Outdoor Temperature Qualification Status	
04	Measured Return (evaporator entering) air dry-bulb temperature ($T_{return, db}$) (degreeF)	
05	Measured Return (evaporator entering) air wet-bulb temperature ($T_{return, wb}$) (degreeF)	
06	Measured Suction line temperature ($T_{suction}$) (degreeF)	
07	Measured Suction line pressure ($P_{suction}$, psig)	
08	Evaporator saturation temperature ($T_{evaporator, sat}$) from digital gauge or P-T Table using Line F07 (degreeF)	
09	Measured Superheat (Line F06 – Line F08) (degreeF)	
10	Target Superheat (from Table RA3.2-2, using F02 and F05) (degreeF)	
11	Compliance Statement:	

G. Determination of HERS Verification Compliance
All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25
Refrigerant Charge Verification		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

Instructions MCH-25a:

Section A. System Information

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
4. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
5. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
6. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
7. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Choose the type of refrigerant used by the system being verified. R-22 and R-410A are the most common, but other types may occasionally be encountered.
8. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If “Other” is chosen in Row A07, then installer will indicate the type of refrigerant being used. If R-22 or R-410A is being used (regardless of trade name, Puron, Genetron, etc.) it should be indicated in Row A07, not here. This row is only for refrigerants other than R-22 and R-410a. Documentation of other refrigerants should be requested. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
9. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). These are defined in detail the Residential Compliance Manual. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Indicate whether the HVAC system is Completely New, Replacement or an Alteration.
10. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to select the appropriate choice regarding whether this system has a Charge Indicator Display (CID). Qualifying CID’s may exempt a system from HERS refrigerant charge verification. CID’s are described in Joint Appendix JA6.1. Qualfying CID’s must appear on a list of approved devices kept by the Commission. If installed system does not match the description here, it fails. Note: Installation of a CID does not exempt the installer from proper refrigerant charge verification. It may only exempt the need for third party refrigerant charge verification. Third party verification of the CID is required. Other requirements may also be triggered.
11. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that minimum airflow can be verified using an approved measurement procedure. Examples of systems that do not meet this description are ductless systems. Selecting “No” here may subject the project to additional scrutiny by enforcement personnel.
12. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) Most ducted split systems and package systems are of the type that approved refrigerant charge verification procedures detailed in Residential Appendix RA3.2.2 or RA1 can be used (i.e., Standard Charge Verification or Winter Setup Verification procedures). Examples of systems that may not meet this description are “mini splits” or variable refrigerant flow systems that may only be charged using weigh-in procedures. Selecting “No” here may subject the project to additional scrutiny.
13. HERS rater to input date of their refrigerant charge verification.
14. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer is to have selected the refrigerant charge verification method used from the choices provided:
    - Superheat (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with fixed orifice refrigerant metering devices (non-variable metering devices). This method is detailed in Reference Appendix RA3.2.2.6.1. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25a.
    - Subcooling (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with variable metering devices (TXV or EXV). This method is detailed in Reference Appendix RA3.2.2.6.2. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25b.
    - Weigh-in; This verification method can be used by the installer at any outdoor temperature allowed by the equipment manufacturer. This method is detailed in Reference Appendix RA3.2.3. Systems verified using this method are NOT eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25c.
    - Winter Setup (applicable when outdoor temperature is < 55 degF); The Winter Setup verification method is a special version of the Subcooling method. It can be used when the outdoor temperature is between 37 and 55 degF. It can only be used on equipment where the manufacturer has specifically approved it for the equipment being tested. The Winter Setup procedure is details in Residential Appendix RA1.2. Choosing this option will generate a CF2R-MCH-25e.

- New Package Unit Factory Charge; The installer should choose this option when a new package unit is being installed that has an AHRI rating. This helps ensure that the unit was properly charged at the factory. HERS verification of refrigerant charge may not be required in this case. Choosing this option will generate a CF2R-MCH-25f.

15. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer (or rater) is to have identified who performed the verification that is documented on the Certificate of Installation. Note that HERS verification compliance by Group Sampling requires that the installer perform their own refrigerant charge verification as part of the installation of the equipment prior to the system being put into a sample group for possible selection by a HERS rater for verification. If Group Sampling is not intended, the HERS Rater may perform the refrigerant charge verification on behalf of the Installing Contractor (applies to any method but Weigh-In) and the Rater will enter same results on both the CF2R and CF3R.
16. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The Group Sampling status is automatically displayed based on the input results of Row A14 and Row A15 on the CF2R. Group Sampling procedures are detailed in Residential Appendix RA2.3.
17. Specify the refrigerant charge verification used by the HERS rater. Choices vary depending on what method was specified in Row A10, A11, and A14.

Section B. Metering Device Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have selected the correct metering device used on the system being verified. This will check against the refrigerant charge verification method selected in Row A14. An error message will appear in Row B02 if the wrong verification method may has been selected. Superheat verification can only be used on systems with fixed orifice and Subcool verification can only be used on systems with variable metering devices (TXV or EXV). This entry must match installed system to pass.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Superheat verification can only be used on systems with fixed orifice and Subcool verification can only be used on systems with variable metering devices (TXV or EXV).

Section C. Instrument Calibration

1. Enter the date of most recent Digital Refrigerant Gauge Calibration Field Check by rater. Analog gauges are not allowed for verification purposes under the 2013 Standards. Specification for pressure gauges is found in Residential Appendix RA3.2.2.2.3. Procedures for the field check procedure are detailed in RA3.2.2.4.2. Calibration field check must happen at least once every 30 days.
2. Enter the date of the most recent Digital Thermocouple Calibration by rater. Specifications for thermocouples and temperature sensors can be found in Residential Appendix RA3.2.2.2.2. Procedures for calibration are detailed in RA3.2.2.4.1. Calibration must happen at least once every 30 days.
3. Digital Refrigerant Gauge Calibration status will appear automatically. If the date entered in Row C01 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.
4. Digital Thermocouple Calibration status will appear automatically. If the date entered in Row C02 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.

Section D. Measurement Access Hole (MAH) Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have indicated the method used to demonstrate compliance with the MAH requirement by selecting the appropriate method from the drop down list. Procedures for installing MAH's are detailed in RA3.2.2.3. Selecting that the MAH cannot be installed consistent with Figure 3.2-1 may result in additional scrutiny by enforcement personnel.) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.

Section E. Minimum System Airflow Rate Verification

1. This information is automatically calculated based on the information given in line A09. This is the target minimum system airflow required for the system being verified.
2. This information is automatically calculated based on either the CF3R-MCH-23, or CF3R-MCH-28, which documents the rater's measured airflow of the system being verified (or alternative method). If the measured airflow is not adequate it will not comply with the airflow requirements and refrigerant charge verification cannot be performed.

Section F. Superheat Charge Verification Method – Data Collection

1. The Rater must independently collect this data. Measure and record the lowest return air dry-bulb temperature that occurred during the refrigerant charge procedure in degrees F. This temperature must remain above 70 degF during the verification procedure. This requirement is detailed in Residential Appendix RA3.2.2.5.
2. The Rater must independently collect this data. Measure and record the condenser air dry-bulb temperature ($T_{condenser}$) in degrees F. This value is used to determine the target superheat from table RA3.2-2. This value must be at least 55 degF and no more than 115 degF to use the Superheat Charge Verification Method.
3. If a value less than 55 degF or greater than 115 degF is entered in Row F02 the Superheat Method cannot be used.

4. The Rater must independently collect this data. Measure and record the return air dry-bulb temperature ($T_{return,db}$) in degrees F. This measurement is taken at the MAH (or alternate location specified in Row F01. This procedure is detailed in RA3.2.2.5.
5. The Rater must independently collect this data. Measure and record the return air wet-bulb temperature ($T_{return,wb}$) in degrees F. This measurement is taken at the MAH (or alternate location specified in Row F01. This procedure is detailed in RA3.2.2.5. This value is used to determine the target superheat from table RA3.2-2.
6. The Rater must independently collect this data. Measure and record the suction line temperature ($T_{suction}$) in degrees F. This procedure is detailed in RA3.2.2.5. This value is used to calculate the measured superheat.
7. The Rater must independently report this data. This procedure is detailed in RA3.2.2.5. This value is used to determine the evaporator saturation temperature ($T_{evaporator,sat}$) from a pressure temperature chart for the appropriate refrigerant (can be internal to a digital gauge), which is entered into Row F08.
8. The Rater must independently collect this data. Enter the evaporator saturation temperature ($T_{evaporator,sat}$) from the digital gauge or a separate pressure-temperature chart that corresponds to the suction line pressure entered in Row F07, in degrees F.
9. Measured superheat is automatically calculated as the difference between the suction line temperature (Row F06) and the evaporator saturation temperature (Row F08)
10. The Rater must independently report this data. Enter target superheat from Table RA3.2-2. This table requires values for the condenser air dry bulb temperature (Row F02) and the return air wet bulb temperature (Row F05)
11. System passes superheat method when Row F10 is within plus or minus 8 degrees of Row F09. Note that the target for the installer, on the CF2R-MCH-25a is plus or minus 5 degrees.

REFRIGERANT CHARGE VERIFICATION

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information HERS Rater to field-verify all system information, discrepancies to be noted by overwriting entry.		
01	System Identification or Name	
02	System Location or Area Served	
03	Condenser (or package unit) make or brand	
04	Condenser (or package unit) model number	
05	Nominal Cooling Capacity (tons) of Condenser	
06	Condenser (or package unit) serial number	
07	Refrigerant Type	
08	Other Refrigerant Type (if applicable)	
09	System Installation Type	
10	Charge Indicator Display (CID) Status (Note: Even systems with a CID must have refrigerant charge verified by installer)	
11	Is the system of a type that the minimum airflow can be verified using an approved measurement procedure (RA3.3 or RA3.2.2.7)?	
12	Is the system of a type that approved refrigerant charge verification procedures can be used to verify compliance with the refrigerant charge verification requirements when temperatures are ≥ 55°F (RA3.2.2, or RA1)?	
13	Date of HERS Rater Refrigerant Charge Verification for this system	
14	Refrigerant charge verification method used by installer.	
15	Person who performed the Refrigerant Charge Verification reported on the Certificate of Installation:	
16	HERS Verification Compliance Requirement Status	
17	Refrigerant charge verification method used by HERS Rater	

Standard Charge Verification Procedure - MCH25b - Subcooling Method

B. Metering Device Verification – HERS Rater is required to visually field verify all information from C2R Subcooling Method can only be used on systems that have a variable metering device.		
01	Refrigerant metering device	
02	Subcooling Method applicability status	

C. Instrument Calibration – HERS Raters are required to calibrate their diagnostic tools. Procedures for instrument calibration are given in Reference Residential Appendix RA3.2.2 and RA3.2.2.2		
01	Date of Digital Refrigerant Gauge Calibration	
02	Date of Digital Thermocouple Calibration	
03	Digital Refrigerant Gauge Calibration Status	
04	Digital Thermocouple Calibration Status	

D. Measurement Access Hole (MAH) Verification – HERS Raters are required to visually field verify MAH *Procedures for installing MAH are specified in Reference Residential Appendix RA3.2.2.3*		
01	Method used to demonstrate compliance with the Measurement Access Hole (MAH) requirement	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Minimum System Airflow Rate Verification Procedures for verifying minimum system airflow are specified in Reference Residential Appendix RA3.2.2.7.		
01	Minimum Required System Airflow Rate (cfm)	
02	System Airflow Rate Verification Status	

F. Data Collection and Calculations – HERS Rater must independently collect all data in this section. Procedures for Refrigerant Charge using the Standard Charge Verification Procedure are given in Reference Residential Appendix RA3.2.2.		
01	Lowest return air dry bulb temperature that occurred during the refrigerant charge verification procedure (degreeF)	
02	Measured Condenser air entering dry-bulb temperature ($T_{condenser, db}$)	
03	Outdoor Temperature Qualification Status	
04	Measured Liquid Line Temperature (T_{liquid}) (degreeF)	
05	Measured Liquid Line Pressure (P_{liquid}) (psig)	
06	Condenser saturation temperature ($T_{condensor, sat}$) from digital gauge or P-T Table using Line F05 (degreeF)	
07	Measured Subcooling (Line F06 – Line F04) (degreeF)	
08	Target Subcooling from Manufacturer (degreeF)	
09	Compliance Statement:	

G. Metering Device Verification– HERS Rater must independently collect all data in this section. Procedures for the verification of proper metering device operation are specified in RA3.2.2.6.2		
01	Measured Suction line temperature ($T_{suction}$) (degreeF)	
02	Measured Suction line pressure ($P_{suction}$) (psig)	
03	Evaporator saturation temperature ($T_{evaporator, sat}$) from digital gauge or P-T Table using line G02 (degreeF)	
04	Measured Superheat (Line G01 – Line G03) (degreeF)	
05	Measured Superheat (Line G04) is between 3 and 26 deg F (inclusive)	
06	Measured Superheat (Line G04) is within manufacturer's specifications, if known.	
07	Compliance Statement:	

G. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this certificate of verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

Instructions MCH-25b:

Section A. System Information

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
4. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
5. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
6. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
7. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Choose the type of refrigerant used by the system being verified. R-22 and R-410A are the most common, but other types may occasionally be encountered.
8. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If "Other" is chosen in Row A07, then installer will indicate the type of refrigerant being used. If R-22 or R-410A is being used (regardless of trade name, Puron, Genetron, etc.) it should be indicated in Row A07, not here. This row is only for refrigerants other than R-22 and R-410a. Documentation of other refrigerants should be requested. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
9. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). These are defined in detail the Residential Compliance Manual. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Indicate whether the HVAC system is Completely New, Replacement or an Alteration.
10. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to select the appropriate choice regarding whether this system has a Charge Indicator Display (CID). Qualifying CID's may exempt a system from HERS refrigerant charge verification. CID's are described in Joint Appendix JA6.1. Qualfying CID's must appear on a list of approved devices kept by the Commission. If installed system does not match the description here, it fails. Note: Installation of a CID does not exempt the installer from proper refrigerant charge verification. It may only exempt the need for third party refrigerant charge verification. Third party verification of the CID is required. Other requirements may also be triggered.
11. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that minimum airflow can be verified using an approved measurement procedure. Examples of systems that do not meet this description are ductless systems. Selecting "No" here may subject the project to additional scrutiny by enforcement personnel.
12. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) Most ducted split systems and package systems are of the type that approved refrigerant charge verification procedures detailed in Residential Appendix RA3.2.2 or RA1 can be used (i.e., Standard Charge Verification or Winter Setup Verification procedures). Examples of systems that may not meet this description are "mini splits" or variable refrigerant flow systems that may only be charged using weigh-in procedures. Selecting "No" here may subject the project to additional scrutiny.
13. HERS rater to input date of their refrigerant charge verification.
14. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer is to have selected the refrigerant charge verification method used from the choices provided:
    - Superheat (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with fixed orifice refrigerant metering devices (non-variable metering devices). This method is detailed in Reference Appendix RA3.2.2.6.1. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25a.
    - Subcooling (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with variable metering devices (TXV or EXV). This method is detailed in Reference Appendix RA3.2.2.6.2. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25b.
    - Weigh-in; This verification method can be used by the installer at any outdoor temperature allowed by the equipment manufacturer. This method is detailed in Reference Appendix RA3.2.3. Systems verified using this method are NOT eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25c.
    - Winter Setup (applicable when outdoor temperature is < 55 degF); The Winter Setup verification method is a special version of the Subcooling method. It can be used when the outdoor temperature is between 37 and 55 degF. It can only be used on equipment where the manufacturer has specifically approved it for the equipment being tested. The Winter Setup procedure is details in Residential Appendix RA1.2. Choosing this option will generate a CF2R-MCH-25e.

- New Package Unit Factory Charge; The installer should choose this option when a new package unit is being installed that has an AHRI rating. This helps ensure that the unit was properly charged at the factory. HERS verification of refrigerant charge may not be required in this case. Choosing this option will generate a CF2R-MCH-25f.

15. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer (or rater) is to have identified who performed the verification that is documented on the Certificate of Installation. Note that HERS verification compliance by Group Sampling requires that the installer perform their own refrigerant charge verification as part of the installation of the equipment prior to the system being put into a sample group for possible selection by a HERS rater for verification. If Group Sampling is not intended, the HERS Rater may perform the refrigerant charge verification on behalf of the Installing Contractor (applies to any method but Weigh-In) and the Rater will enter same results on both the CF2R and CF3R.
16. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The Group Sampling status is automatically displayed based on the input results of Row A14 and Row A15 on the CF2R. Group Sampling procedures are detailed in Residential Appendix RA2.3.
17. Specify the refrigerant charge verification used by the HERS rater. Choices vary depending on what method was specified in Row A10, A11, and A14.

Section B. Metering Device Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have selected the correct metering device used on the system being verified. This will check against the refrigerant charge verification method selected in Row A14. An error message will appear in Row B02 if the wrong verification method may has been selected. Superheat verification can only be used on systems with fixed orifice and Subcool verification can only be used on systems with variable metering devices (TXV or EXV). This entry must match installed system to pass.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Superheat verification can only be used on systems with fixed orifice and Subcool verification can only be used on systems with variable metering devices (TXV or EXV).

Section C. Instrument Calibration

1. Enter the date of most recent Digital Refrigerant Gauge Calibration Field Check by rater. Analog gauges are not allowed for verification purposes under the 2013 Standards. Specification for pressure gauges is found in Residential Appendix RA3.2.2.2.3. Procedures for the field check procedure are detailed in RA3.2.2.4.2. Calibration field check must happen at least once every 30 days.
2. Enter the date of the most recent Digital Thermocouple Calibration by rater. Specifications for thermocouples and temperature sensors can be found in Residential Appendix RA3.2.2.2.2. Procedures for calibration are detailed in RA3.2.2.4.1. Calibration must happen at least once every 30 days.
3. Digital Refrigerant Gauge Calibration status will appear automatically. If the date entered in Row C01 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.
4. Digital Thermocouple Calibration status will appear automatically. If the date entered in Row C02 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.

Section D. Measurement Access Hole (MAH) Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have indicated the method used to demonstrate compliance with the MAH requirement by selecting the appropriate method from the drop down list. Procedures for installing MAH's are detailed in RA3.2.2.3. Selecting that the MAH cannot be installed consistent with Figure 3.2-1 may result in additional scrutiny by enforcement personnel.) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.

Section E. Minimum System Airflow Rate Verification

1. This information is automatically calculated based on the information given in line A09. This is the target minimum system airflow required for the system being verified.
2. This information is automatically calculated based on either the CF3R-MCH-23, or CF3R-MCH-28, which documents the rater's measured airflow of the system being verified (or alternative method). If the measured airflow is not adequate it will not comply with the airflow requirements and refrigerant charge verification cannot be performed.

Section F. Subcooling Charge Verification Method – Data Collection

1. The Rater must independently collect this data. Measure and record the lowest return air dry-bulb temperature that occurred during the refrigerant charge procedure in degrees F. This temperature must remain above 70 degF during the verification procedure. This requirement is detailed in Residential Appendix RA3.2.2.5.
2. The Rater must independently collect this data. Measure and record the condenser air dry-bulb temperature ($T_{condenser}$) in degrees F. This value must be at least 55 degF and no more than 115 degF to use the Subcooling Charge Verification Method.
3. If a value less than 55 degF or greater than 115 degF is entered in Row F02 the Subcooling Method cannot be used.
4. The Rater must independently collect this data. Measure and record the liquid line temperature (T_{liquid}) in degrees F. This procedure is detailed in RA3.2.2.5. This value is used to calculate the measured subcool temperature.

5. The Rater must independently collect this data. Measure and record the liquid line pressure (P_{liquid}) in psig. This procedure is detailed in RA3.2.2.5. This value is used to determine the condenser saturation temperature ($T_{condenser,sat}$) from a pressure temperature chart for the appropriate refrigerant (can be internal to a digital gauge), which is entered into Row F06.
6. Enter the condenser saturation temperature ($T_{condenser,sat}$) from the digital gauge or a separate pressure-temperature chart that corresponds to the liquid line pressure entered in Row F05, in degrees F.
7. Measured Subcooling is automatically calculated as the difference between the liquid line temperature (Row F04) and the condenser saturation temperature (Row F06)
8. The Rater must independently collect this data. Enter target subcooling from manufacturer. This may be a challenge to find for older equipment. Internet searches can sometimes result in archived equipment specifications for the equipment in question, or sometimes a very similar model. If the manufacturer's target cannot be found the Commission's Executive Director may provide additional guidance for compliance.
9. System passes Subcooling method when Row F08 is within plus or minus 6 degrees of Row F07. Note that the target for the installer, on the CF2R, is plus or minus 3 degrees.

Section G. Metering Device Verification

1. The Rater must independently collect this data. Measure and record the suction line temperature ($T_{suction}$) in degrees F. This procedure is detailed in RA3.2.2.5. This value is used to calculate the measured superheat.
2. The Rater must independently collect this data. Measure and record the suction line pressure ($P_{suction}$) in psig. This procedure is detailed in RA3.2.2.5. This value is used to determine the evaporator saturation temperature ($T_{evaporator,sat}$) from a pressure temperature chart for the appropriate refrigerant (can be internal to a digital gauge), which is entered into Row G03.
3. Enter the evaporator saturation temperature ($T_{evaporator,sat}$) from the digital gauge or a separate pressure-temperature chart that corresponds to the suction line pressure entered in Row G02, in degrees F.
4. Measured superheat is automatically calculated as the difference between the suction line temperature (Row G01) and the evaporator saturation temperature (Row G03)
5. There are two possible criteria for passing. If the manufacturer's specification is known it should be used, otherwise the CEC requirement is that the superheat be between 4 and 25 degF, inclusive. This row checks the CEC requirement.
6. If the manufacturer's target superheat for ensuring proper metering device operation is known, it supersedes the CEC requirement of being between 4 and 25 degF. If "Yes, documentation to be provided upon request." is selected, the installer should be prepared to provide documentation for the target values used.
7. There are two possible criteria for passing. If the manufacturer's specification is known it should be used, otherwise the CEC requirement is that the superheat be between 4 and 25 degF, inclusive. If "Yes, documentation to be provided upon request." is selected in Row G06, the installer should be prepared to provide documentation for the target values used.

REFRIGERANT CHARGE VERIFICATION

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 1 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information
HERS Rater to field-verify all system information, discrepancies to be noted by overwriting entry.

01	System Identification or Name	
02	System Location or Area Served	
03	Condenser (or package unit) make or brand	
04	Condenser (or package unit) model number	
05	Nominal Cooling Capacity (tons) of Condenser	
06	Condenser (or package unit) serial number	
07	Refrigerant Type	
08	Other Refrigerant Type (if applicable)	
09	System Installation Type	
10	Charge Indicator Display (CID) Status (Note: Even systems with a CID must have refrigerant charge verified by installer)	
11	Is the system of a type that the minimum airflow can be verified using an approved measurement procedure (RA3.3 or RA3.2.2.7)?	
12	Is the system of a type that approved refrigerant charge verification procedures can be used to verify compliance with the refrigerant charge verification requirements when temperatures are ≥ 55°F (RA3.2.2, or RA1)?	
13	Date of HERS Rater Refrigerant Charge Verification for this system	
14	Refrigerant charge verification method used by installer.	
15	Person who performed the Refrigerant Charge Verification reported on the Certificate of Installation:	
16	HERS Verification Compliance Requirement Status	
17	Refrigerant charge verification method used by HERS Rater.	

Weigh In Charging Procedure HERS Rater Observation- MCH25c

B. Measurement Access Hole (MAH) Verification – HERS Raters are required to visually field verify MAH
Procedures for installing MAH are specified in Reference Residential Appendix RA3.2.2.3

01	Method used to demonstrate compliance with the Measurement Access Hole (MAH) requirement	

C. Minimum System Airflow Rate Verification
Procedures for verifying minimum system airflow are specified in Reference Residential Appendix RA3.2.2.7.

01	Minimum Required System Airflow Rate (cfm)	
02	System Airflow Rate Verification Status	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 2 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Weigh In Charge Procedure – HERS Rater Must Observe and Confirm All Data Collected
Procedures for Refrigerant Charge using the Weigh-in Charging Procedure are given in Reference Residential Appendix RA3.2.2.2 and RA3.2.3.

01	Measured Condenser air entering dry-bulb temperature ($T_{condenser, db}$)	
02	Specify the method of weigh-in	
03	Manufacturer's Standard charge for condenser (lbs)	
04	Manufacturer's Standard liquid line length (ft)	
05	Manufacturer's Standard liquid line diameter (in)	
06	Manufacturer's Standard indoor coil size (tons)	
07	Installed liquid line length (ft)	
08	Installed liquid line diameter (in)	
09	Installed indoor coil size (tons)	
10	Charge adjustment to standard charge from manufacturer's specifications (ounces, positive = add, negative = remove)	
11	Refrigerant required to be weighed in by the installer (lbs, oz)	
12	Refrigerant weighed in by Installer (lbs, oz)	
13	Verification Status	

If Verification Status for this table indicates "Fail", the reason shall be described in the correction notes for this table.

Correction Notes for this table:

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

E. Weigh In Charge Procedure – Additional Requirements

01	The indoor coil correction to refrigerant weight is used if it is supplied by the manufacturer	
02	Prior to introducing refrigerant, system is evacuated to 500 microns or less and, when isolated, has risen no more than 300 microns after 5 minutes.	
03	Verification Status	

If Verification Status for this table indicates "Fail", the reason shall be described in the correction notes for this table.

Correction Notes for this table:

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 3 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

F. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 4 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-25c-H User Instructions

Section A. System Information

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
4. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
5. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
6. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
7. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Choose the type of refrigerant used by the system being verified. R-22 and R-410A are the most common, but other types may occasionally be encountered.
8. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If "Other" is chosen in Row A07, then installer will indicate the type of refrigerant being used. If R-22 or R-410A is being used (regardless of trade name, Puron, Genetron, etc.) it should be indicated in Row A07, not here. This row is only for refrigerants other than R-22 and R-410a. Documentation of other refrigerants should be requested. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
9. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). These are defined in detail the Residential Compliance Manual. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Indicate whether the HVAC system is Completely New, Replacement or an Alteration.
10. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to select the appropriate choice regarding whether this system has a Charge Indicator Display (CID). Qualifying CID's may exempt a system from HERS refrigerant charge verification. CID's are described in Joint Appendix JA6.1. Qualifying CID's must appear on a list of approved devices kept by the Commission. If installed system does not match the description here, it fails. Note: Installation of a CID does not exempt the installer from proper refrigerant charge verification. It may only exempt the need for third party refrigerant charge verification. Third party verification of the CID is required. Other requirements may also be triggered.
11. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that minimum airflow can be verified using an approved measurement procedure. Examples of systems that do not meet this description are ductless systems. Selecting "No" here may subject the project to additional scrutiny by enforcement personnel.
12. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) Most ducted split systems and package systems are of the type that approved refrigerant charge verification procedures detailed in Residential Appendix RA3.2.2 or RA1 can be used (i.e., Standard Charge Verification or Winter Setup Verification procedures). Examples of systems that may not meet this description are "mini splits" or variable refrigerant flow systems that may only be charged using weigh-in procedures. Selecting "No" here may subject the project to additional scrutiny.
13. HERS rater to input date of their refrigerant charge verification.
14. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer is to have selected the refrigerant charge verification method used from the choices provided:

- Superheat (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with fixed orifice refrigerant metering devices (non-variable metering devices). This method is detailed in Reference Appendix RA3.2.2.6.1. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25a.
- Subcooling (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with variable metering devices (TXV or EXV). This method is detailed in Reference Appendix RA3.2.2.6.2. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25b.
- Weigh-in; this verification method can be used by the installer at any outdoor temperature allowed by the equipment manufacturer. This method is detailed in Reference Appendix RA3.2.3. Systems verified using this method are NOT eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25c.
- Winter Setup (applicable when outdoor temperature is < 55 degF); The Winter Setup verification method is a special version of the Subcooling method. It can be used when the outdoor temperature is between 37 and 55 degF. It can only be used on equipment where the manufacturer has specifically approved it for the equipment being tested. The Winter Setup procedure is details in Residential Appendix RA1.2. Choosing this option will generate a CF2R-MCH-25e.
- New Package Unit Factory Charge; the installer should choose this option when a new package unit is being installed that has an AHRI rating. This helps ensure that the unit was properly charged at the factory. HERS verification of refrigerant charge may not be required in this case. Choosing this option will generate a CF2R-MCH-25f.

15. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer (or rater) is to have identified who performed the verification that is documented on the Certificate of Installation. Note that HERS verification compliance by Group Sampling requires that the installer perform their own refrigerant charge verification as part of the installation of the equipment prior to the system being put into a sample group for possible selection by a HERS rater for verification. If Group Sampling is not intended, the HERS Rater may perform the refrigerant charge verification on behalf of the Installing Contractor (applies to any method but Weigh-In) and the Rater will enter same results on both the CF2R and CF3R.
16. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The Group Sampling status is automatically displayed based on the input results of Row A14 and Row A15 on the CF2R. Group Sampling procedures are detailed in Residential Appendix RA2.3.
17. Specify the refrigerant charge verification used by the HERS rater. Choices vary depending on what method was specified in Row A10, A11, and A14.

Section B. Measurement Access Hole (MAH) Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have indicated the method used to demonstrate compliance with the MAH requirement by selecting the appropriate method from the drop down list. Procedures for installing MAH’s are detailed in RA3.2.2.3. Selecting that the MAH cannot be installed consistent with Figure 3.2-1 may result in additional scrutiny by enforcement personnel.) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. If A11 = NO, then system is exempt from the MAH requirement and a special message will show up here.

Section C. Minimum System Airflow Rate Verification

1. This information is automatically calculated based on the information given in line A09. This is the target minimum system airflow required for the system being verified.
2. This information is automatically calculated based on either the CF3R-MCH-23, or CF3R-MCH-28, which documents the rater's measured airflow of the system being verified (or alternative method). If the measured airflow is not adequate it will not comply with the airflow requirements and refrigerant charge verification cannot be performed until the airflow meets the requirement. If A11 = NO, then system is exempt from the airflow rate requirement and a special message will show up here.

Section D. Weigh In Charge Procedure

1. HERS rater must visually observe the installer taking this measurement and confirm that correct values are entered into the CF2R. Measure and record the outside air dry-bulb temperature in degrees F. This will affect the procedures that may be used for HERS verification.
2. HERS rater must confirm that correct values are entered into the CF2R. Specify the method of weigh-in. There are two options that may be used. One is to add or remove a small, weighed portion of refrigerant from a factory charged unit (Charge Adjustment). The other is to weigh the entire charge of refrigerant before introducing it into the system (Total Charge). Select either one. Note: The amount of refrigerant in systems that are not newly installed cannot be assumed to be the factory charge. Altered systems using existing refrigerant must use the Total Charge method. Only new, factory installed equipment can utilize the Charge Adjustment method.
3. HERS rater must confirm that correct values are entered into the CF2R. Enter the Manufacturer's Standard Charge for condenser in pounds and ounces. This is the amount of refrigerant that the manufacturer specifies for a "standard" installation (typical coil match, typical line set size and length). For the Charge Adjustment method, this is the amount of refrigerant that factory charges the system to. Rater should request to see manufacturer's documentation to support this value.
4. HERS rater must confirm that correct values are entered into the CF2R. The Manufacturer's Standard Charge, specified in E03 is based on a standard liquid line length, typically 25 feet. Enter the value here, in feet. Be prepared to provide manufacturer's documentation to support this value.
5. HERS rater must confirm that correct values are entered into the CF2R. The Manufacturer's Standard Charge, specified in E03 is based on a standard liquid line diameter. Enter the value here, in inches (for example: 1/4", 3/8", etc.). Rater should request to see manufacturer's documentation to support this value.
6. HERS rater must confirm that correct values are entered into the CF2R. The Manufacturer's Standard Charge, specified in E03 is based on a standard indoor (evaporator) coil size. Enter the value here, in tons. Rater should request to see manufacturer's documentation to support this value.
7. HERS rater must confirm that correct values are entered into the CF2R. Enter the length of the liquid line installed on the system being verified, in feet. This value must be compared to the standard liquid line length entered in E04 and used to determine if the Manufacturer's Standard Charge entered in E03 is appropriate.
8. HERS rater must confirm that correct values are entered into the CF2R. Enter the diameter of the liquid line installed on the system being verified, in inches (for example: 1/4", 3/8", etc.). This value must be compared to the standard liquid line diameter entered in E05 and used to determine if the Manufacturer's Standard Charge entered in E03 is appropriate.
9. HERS rater must confirm that correct values are entered into the CF2R. Enter the size of the indoor (evaporator) coil installed on the system being verified, in tons. This value must be compared to the standard coil size entered in E06 and used to determine if the Manufacturer's Standard Charge entered in E03 is appropriate.
10. HERS rater must confirm that correct values are entered into the CF2R. Enter the Charge Adjustment to Standard Charge, in ounces. This is the amount of refrigerant that the manufacturer specifies to add to, or remove from, the Manufacturer's Standard Charge entered in E03. This value must come from manufacturer's specifications using the standard values entered in Rows E04 through E06 to the installed values entered in Rows E07 through E09. If refrigerant is to be added, this value should be a positive number. If refrigerant is to

be removed, this value should be a negative number. Rater should request to see manufacturer's documentation to support this value.

11. HERS rater must confirm that correct values are entered into the CF2R. This value is calculated automatically. If "Charge Adjustment" was specified in Row E02, then the value shown here will be the same as the value shown in Row E10. This is the amount of weighed refrigerant that will be added or removed from the factory charged unit. If refrigerant is to be added, this value should be a positive number. If refrigerant is to be removed, this value should be a negative number. If "Total Charge" was specified in Row E02, then the value shown here will be the value in row E03 added to the value in row E10. This is the total amount of refrigerant that will be in the system, all of which must be weighed before introducing into the system.
12. HERS rater must confirm that correct values are entered into the CF2R. Enter the amount of refrigerant weighed and added to, or removed from, system. If refrigerant is to be added, this value should be a positive number. If refrigerant is to be removed from a factory charged system, this value should be a negative number. This value must match the value in E11 for the system to pass.
13. HERS rater to indicate whether system passes or not. If not, use the next line to provide notes as to why system did not pass.

Section E. Weigh In Charge Verification – Additional Requirements

1. The Rater must confirm that a correction is made to the refrigerant weight to allow for the indoor coil when that information is supplied by the Manufacturer as required by Residential Appendix RA3.2.3.1.5.
2. The Rater must confirm refrigerant lines were checked for leaks by evacuating to 500 microns or less and rising by no more than 300 microns after 5 minutes as required by Residential Appendix RA3.2.3.1.5.

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Refrigerant Charge Verification		(Page 1 of 3)
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Dwelling Address:	City	Zip Code

A. System Information
HERS Rater to field-verify all system information, discrepancies to be noted by overwriting entry.

01	System Identification or Name	
02	System Location or Area Served	
03	Condenser (or package unit) Make or Brand	
04	Condenser (or package unit) Model Number	
05	Nominal Cooling Capacity (tons) of Condenser	
06	Condenser (or package unit) Serial Number	
07	Refrigerant Type	
08	Other Refrigerant Type (if applicable)	
09	System Installation Type	
10	Charge Indicator Display (CID) Status (Note: Even systems with a CID must have refrigerant charge verified by installer)	
11	Is the system of a type that the minimum airflow can be verified using an approved measurement procedure (RA3.3 or RA3.2.2.7)?	
12	Is the system of a type that approved refrigerant charge verification procedures can be used to verify compliance with the refrigerant charge verification requirements when temperatures are ≥ 55°F (RA3.2.2, or RA1)?	
13	Date of HERS Rater Refrigerant Charge Verification for this System	
14	Refrigerant Charge Verification Method Used by Installer	
15	Person who performed the Refrigerant Charge Verification reported on the Certificate of Installation:	
16	HERS Verification Compliance Requirement Status	
17	Refrigerant Charge Verification Method Used by HERS Rater:	

Verification of Charge Indicator Display – CF2R-MCH-25d – CID

B. Charge Indicator Display Verification Applicability

01	Measured Condenser Air Entering Dry-bulb Temperature ($T_{condenser, db}$) (degreeF)	
02	Outdoor Temperature Qualification Status	
03	Self Diagnostic Reporting (SDR)	
04	Charge Indicator Display Verification Applicability	

C. Measurement Access Hole (MAH) Verification – HERS Raters are required to visually field verify MAH
Procedures for installing MAH are specified in Reference Residential Appendix RA3.2.2.3

01	Method used to demonstrate compliance with the Measurement Access Hole (MAH) requirement	

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D. Minimum System Airflow Rate Verification Procedures for verifying minimum system airflow are specified in Reference Residential Appendix RA3.2.2.7.		
01	Minimum Required System Airflow Rate (cfm)	
02	System Airflow Rate Verification Status	

E. Charge Indicator Display Procedures for the Charge Indicator Display Verification are detailed in RA3.4.2		
01	CID Manufacturer Name/Make	
02	CID Model Number	
03	The display module is mounted adjacent to the system thermostat	
04	The manufacturer has certified to the Energy Commission that the CID model meets the requirements of Reference Joint Appendix JA6 (Make and model found on CEC list of approved CID devices)	
05	The system has operated for at least 15 minutes and the CID reports that the system is operating within acceptable parameters.	
06	Compliance Statement:	

F. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 3 of 3)
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DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION:	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-25d-H User Instructions

Section A. System Information

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
4. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
5. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
6. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
7. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Choose the type of refrigerant used by the system being verified. R-22 and R-410A are the most common, but other types may occasionally be encountered.
8. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If “Other” is chosen in Row A07, then installer will indicate the type of refrigerant being used. If R-22 or R-410A is being used (regardless of trade name, Puron, Genetron, etc.) it should be indicated in Row A07, not here. This row is only for refrigerants other than R-22 and R-410a. Documentation of other refrigerants should be requested. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
9. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). These are defined in detail the Residential Compliance Manual. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Indicate whether the HVAC system is Completely New, Replacement or an Alteration.
10. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to select the appropriate choice regarding whether this system has a Charge Indicator Display (CID). Qualifying CID’s may exempt a system from HERS refrigerant charge verification. CID’s are described in Joint Appendix JA6.1. Qualfying CID’s must appear on a list of approved devices kept by the Commission. If installed system does not match the description here, it fails. Note: Installation of a CID does not exempt the installer from proper refrigerant charge verification. It may only exempt the need for third party refrigerant charge verification. Third party verification of the CID is required. Other requirements may also be triggered.
11. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that minimum airflow can be verified using an approved measurement procedure. Examples of systems that do not meet this description are ductless systems. Selecting “No” here may subject the project to additional scrutiny by enforcement personnel.
12. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25) Most ducted split systems and package systems are of the type that approved refrigerant charge verification procedures detailed in Residential Appendix RA3.2.2 or RA1 can be used (i.e., Standard Charge Verification or Winter Setup Verification procedures). Examples of systems that may not meet this description are “mini splits” or variable refrigerant flow systems that may only be charged using weigh-in procedures. Selecting “No” here may subject the project to additional scrutiny.
13. HERS rater to input date of their refrigerant charge verification.
14. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer is to have selected the refrigerant charge verification method used from the choices provided:
    - Superheat (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with fixed orifice refrigerant metering devices (non-variable metering devices). This method is detailed in Reference Appendix RA3.2.2.6.1. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25a.
    - Subcooling (outdoor temperature must be ≥ 55 degF); This verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with variable metering devices (TXV or EXV). This method is detailed in Reference Appendix RA3.2.2.6.2. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25b.
    - Weigh-in; This verification method can be used by the installer at any outdoor temperature allowed by the equipment manufacturer. This method is detailed in Reference Appendix RA3.2.3. Systems verified using this method are NOT eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25c.
    - Winter Setup (applicable when outdoor temperature is < 55 degF); The Winter Setup verification method is a special version of the Subcooling method. It can be used when the outdoor temperature is between 37 and 55 degF. It can only be used on equipment where the manufacturer has specifically approved it for the equipment being tested. The Winter Setup procedure is details in Residential Appendix RA1.2. Choosing this option will generate a CF2R-MCH-25e.

- New Package Unit Factory Charge; the installer should choose this option when a new package unit is being installed that has an AHRI rating. This helps ensure that the unit was properly charged at the factory. HERS verification of refrigerant charge may not be required in this case. Choosing this option will generate a CF2R-MCH-25f.

15. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer (or rater) is to have identified who performed the verification that is documented on the Certificate of Installation. Note that HERS verification compliance by Group Sampling requires that the installer perform their own refrigerant charge verification as part of the installation of the equipment prior to the system being put into a sample group for possible selection by a HERS rater for verification. If Group Sampling is not intended, the HERS Rater may perform the refrigerant charge verification on behalf of the Installing Contractor (applies to any method but Weigh-In) and the Rater will enter same results on both the CF2R and CF3R.
16. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The Group Sampling status is automatically displayed based on the input results of Row A14 and Row A15 on the CF2R. Group Sampling procedures are detailed in Residential Appendix RA2.3.
17. Specify the refrigerant charge verification used by the HERS rater. Choices vary depending on what method was specified in Row A10, A11, and A14.

Section B. Charge Indicator Display Verification Applicability

1. Measure and record the condenser entering dry bulb air temperature (outdoor air at condenser).
2. This box is filled automatically. If the outdoor temperature is less than 55 degF, the CID must be equipped with self diagnostic reporting capabilities for it to operate correctly when it is below 55 degF.
3. Rater to verify whether or not CID is equipped with SDR capability. This can be determined by checking model number against CEC list of approved CIDs.
4. This box is filled automatically. The outdoor temperature must be above 55 degF or the CID must be equipped with SDR capability for CID verification to proceed.

Section C. Measurement Access Hole (MAH) Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have indicated the method used to demonstrate compliance with the MAH requirement by selecting the appropriate method from the drop down list. Procedures for installing MAH's are detailed in RA3.2.2.3. Selecting that the MAH cannot be installed consistent with Figure 3.2-1 may result in additional scrutiny by enforcement personnel.) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.

Section D. Minimum System Airflow Rate Verification

1. This information is automatically calculated based on the information given in line A09. This is the target minimum system airflow required for the system being verified.
2. This information is automatically calculated based on either the CF3R-MCH-23, or CF3R-MCH-28, which documents the rater's measured airflow of the system being verified. If the measured airflow is not adequate it will not comply with the airflow requirements and refrigerant charge verification cannot be performed.

Section E. Verification of Charge Indicator Display

1. Information retrieved from CF2R-MCH-25. Rater to confirm that entry matches name shown on the list of approved devices kept by the Commission. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. Information retrieved from CF2R-MCH-25. Rater to confirm that entry matches model number shown on the list of approved devices kept by the Commission. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. The rater must confirm that the CID display module is mounted adjacent to thermostat that controls the system being verified. This requirement is detailed in Residential Appendix RA3.4.2.
4. The rater must confirm that the installed CID is approved and appears the list of approved devices kept by the Commission. This requirement is detailed in Residential Appendix RA3.4.2.
5. The rater must confirm that the system has operated for at least 15 minutes and that they system is operating within acceptable parameters as specified by the CID and equipment manufacturers. This requirement is detailed in Residential Appendix RA3.4.2.

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 1 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

A. System Information
HERS Rater to field-verify all system information, discrepancies to be noted by overwriting entry.

01	System Identification or Name	
02	System Location or Area Served	
03	Condenser (or package unit) Make or Brand	
04	Condenser (or package unit) Model Number	
05	Nominal Cooling Capacity (tons) of Condenser	
06	Condenser (or package unit) Serial Number	
07	Refrigerant Type	
08	Other Refrigerant Type (if applicable)	
09	System Installation Type	
10	Charge Indicator Display (CID) Status (Note: Even systems with a CID must have refrigerant charge verified by installer)	
11	Is the system of a type that the minimum airflow can be verified using an approved measurement procedure (RA3.3 or RA3.2.2.7)?	
12	Is the system of a type that approved refrigerant charge verification procedures can be used to verify compliance with the refrigerant charge verification requirements when temperatures are ≥ 55°F (RA3.2.2, or RA1)?	
13	Date of HERS Rater Refrigerant Charge Verification for this System	
14	Refrigerant Charge Verification Method Used by Installer	
15	Person Who Performed the Refrigerant Charge Verification Reported on the Certificate of Installation	
16	HERS Verification Compliance Requirement Status	
17	Refrigerant Charge Verification Method Used by HERS Rater	

MCH-25e - Winter Setup Charge Verification Procedure
Winter Setup for the Standard Charge Verification Procedure is specified in Reference Residential Appendix RA1.2.Procedures for determining Refrigerant Charge using the Standard Charge Verification Procedure are given in Reference Residential Appendix RA3.2.2.

B. System Model Applicability for Winter Setup Method – HERS Rater must verify applicability of Winter Setup Method

01	Refrigerant Metering Device	
02	Winter Setup Method Applicability Status	
03	**The responsible person's signature on this document indicates confirmation that the installed model number is currently listed as approved for Winter Setup Method on the Energy Commission website:** http://www.energy.ca.gov/title24/2008standards/special_case_appliance/	

C. Instrument Calibration – HERS Raters are required to calibrate their diagnostic tools
Procedures for instrument calibration are given in Reference Residential Appendix RA3.2.2 and RA3.2.2.2

01	Date of Digital Refrigerant Gauge Calibration	
02	Date of Digital Thermocouple Calibration	
03	Digital Refrigerant Gauge Calibration Status	
04	Digital Thermocouple Calibration Status	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 2 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

D. Measurement Access Hole (MAH) Verification – HERS Raters are required to visually field verify MAH Procedures for installing MAH are specified in Reference Residential Appendix RA3.2.2.3		
01	Method Used to Demonstrate Compliance with the Measurement Access Hole (MAH) Requirement	

E. Minimum System Airflow Rate Verification Procedures for verifying minimum system airflow are specified in Reference Residential Appendix RA3.2.2.7.		
01	Minimum Required System Airflow Rate (cfm)	
02	System Airflow Rate Verification Status	

F. Data Collection and Calculations – HERS Rater must independently collect all data in this section Procedures for determining Refrigerant Charge using the Standard Charge Verification Procedure are given in RA3.2.2.		
01	The responsible person's signature on this document indicates confirmation that, with a Condenser Outlet Air Restrictor installed, and after system operation was stabilized for at least 15 minutes, throughout the data collection for this verification, the difference between the liquid line pressure and suction line pressure was maintained between 160 and 220 psi for R-410A systems, or between 100 and 145 psi for R-22 systems.	
02	Lowest Return Air Dry bulb Temperature that Occurred During the Refrigerant Charge Verification Procedure (degreeF)	
03	Measured Condenser Air Entering Dry-bulb Temperature ($T_{condenser, db}$)	
04	Outdoor Temperature Qualification Status	
05	Measured Liquid Line Temperature (T_{liquid}) (degreeF)	
06	Measured Liquid Line Pressure (P_{liquid}) (psig)	
07	Condenser Saturation Temperature ($T_{condensor, sat}$) from Digital Gauge or P-T Table using Line F05 (degreeF)	
08	Measured Subcooling (Line F07 – Line F05) (degreeF)	
09	Target Subcooling from Manufacturer (degreeF)	
10	Compliance Statement:	

G. Metering Device Verification– HERS Rater must independently collect all data in this section Procedures for the verification of proper metering device operation are specified in RA3.2.2.6.2		
01	Measured Suction Line Temperature ($T_{suction}$) (degreeF)	
02	Measured Suction Line Pressure ($P_{suction}$) (psig)	
03	Evaporator Saturation Temperature ($T_{evaporator, sat}$) from Digital Gauge or P-T Table using line G02 (degreeF)	
04	Measured Superheat (Line G01 – Line G03) (degreeF)	
05	Measured Superheat (Line G04) is between 3 and 26 deg F (inclusive)	
06	Measured Superheat (Line G04) is within Manufacturer's Specifications, if known.	
07	Compliance Statement:	

H. Confirmation of Refrigerant Pressure Differential – HERS Rater must independently collect all data in this section Procedures for the Winter Setup are detailed in RA1.2.22		
01	P_{high}, – P_{low} (psi) from F06 and G02	
02	Compliance Statement:	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 3 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

I. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-25-H
Refrigerant Charge Verification		(Page 4 of 4)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable):
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider:	Date Signed:

CF3R-MCH-25e-H User Instructions

Section A. System Information

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
3. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
4. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
5. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
6. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
7. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Choose the type of refrigerant used by the system being verified. R-22 and R-410A are the most common, but other types may occasionally be encountered.
8. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). If “Other” is chosen in Row A07, then installer will indicate the type of refrigerant being used. If R-22 or R-410A is being used (regardless of trade name, Puron, Genetron, etc.) it should be indicated in Row A07, not here. This row is only for refrigerants other than R-22 and R-410a. Documentation of other refrigerants should be requested. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
9. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). These are defined in detail the Residential Compliance Manual. If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail. Indicate whether the HVAC system is Completely New, Replacement or an Alteration.
10. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to select the appropriate choice regarding whether this system has a Charge Indicator Display (CID). Qualifying CID’s may exempt a system from HERS refrigerant charge verification. CID’s are described in Joint Appendix JA6.1. Qualfying CID’s must appear on a list of approved devices kept by the Commission. If installed system does not match the description here, it fails. Note: Installation of a CID does not exempt the installer from proper refrigerant charge verification. It may only exempt the need for third party refrigerant charge verification. Third party verification of the CID is required. Other requirements may also be triggered.
11. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that minimum airflow can be verified using an approved measurement procedure. Examples of systems that do not meet this description are ductless systems. Selecting “No” here may subject the project to additional scrutiny by enforcement personnel.
12. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Most ducted split systems and package systems are of the type that approved refrigerant charge verification procedures detailed in Residential Appendix RA3.2.2 or RA1 can be used (i.e., Standard Charge Verification or Winter Setup Verification procedures). Examples of systems that may not meet this description are “mini splits” or variable refrigerant flow systems that may only be charged using weigh-in procedures. Selecting “No” here may subject the project to additional scrutiny.
13. HERS rater to input date of their refrigerant charge verification.
14. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer is to have selected the refrigerant charge verification method used from the choices provided:
    - Superheat (outdoor temperature must be ≥ 55 degF); this verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with fixed orifice refrigerant metering devices (non-variable metering devices). This method is detailed in Reference Appendix RA3.2.2.6.1. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25a.
    - Subcooling (outdoor temperature must be ≥ 55 degF); this verification method can only be used when the outdoor temperature is at or above 55 degF. It is only used on systems with variable metering devices (TXV or EXV). This method is detailed in Reference Appendix RA3.2.2.6.2. Systems verified using this method may be eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25b.
    - Weigh-in; this verification method can be used by the installer at any outdoor temperature allowed by the equipment manufacturer. This method is detailed in Reference Appendix RA3.2.3. Systems verified using this method are NOT eligible for HERS verification compliance using Group Sampling. Choosing this option will generate a CF2R-MCH-25c.
    - Winter Setup (applicable when outdoor temperature is < 55 degF); the Winter Setup verification method is a special version of the Subcooling method. It can be used when the outdoor temperature is between 37 and 55 degF. It can only be used on equipment where the manufacturer has specifically approved it for the equipment being tested. The Winter Setup procedure is details in Residential Appendix RA1.2. Choosing this option will generate a CF2R-MCH-25e.

- New Package Unit Factory Charge; the installer should choose this option when a new package unit is being installed that has an AHRI rating. This helps ensure that the unit was properly charged at the factory. HERS verification of refrigerant charge may not be required in this case. Choosing this option will generate a CF2R-MCH-25f.

15. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The installer (or rater) is to have identified who performed the verification that is documented on the Certificate of Installation. Note that HERS verification compliance by Group Sampling requires that the installer perform their own refrigerant charge verification as part of the installation of the equipment prior to the system being put into a sample group for possible selection by a HERS rater for verification. If Group Sampling is not intended, the HERS Rater may perform the refrigerant charge verification on behalf of the Installing Contractor (applies to any method but Weigh-In) and the Rater will enter same results on both the CF2R and CF3R.
16. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). The Group Sampling status is automatically displayed based on the input results of Row A14 and Row A15 on the CF2R. Group Sampling procedures are detailed in Residential Appendix RA2.3.
17. Specify the refrigerant charge verification used by the HERS rater. Choices vary depending on what method was specified in Row A10, A11, and A14.

Section B. System Model Applicability for Winter Setup Method

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have selected the correct metering device used on the system being verified. This will check against the refrigerant charge verification method selected in Row A14. An error message will appear in Row B02 if the wrong verification method may has been selected. Winter Setup verification can only be used on systems with variable metering devices (TXV or EXV). If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.
2. This box is automatically filled out. Winter Setup verification can only be used on systems with variable metering devices (TXV or EXV).
3. Rater must verify that the system being tested appears on the list of approved equipment for Winter Setup Method.

Section C. Instrument Calibration

1. Enter the date of most recent Digital Refrigerant Gauge Calibration Field Check by rater. Analog gauges are not allowed for verification purposes under the 2013 Standards. Specification for pressure gauges is found in Residential Appendix RA3.2.2.2.3. Procedures for the field check procedure are detailed in RA3.2.2.4.2. Calibration field check must happen at least once every 30 days.
2. Enter the date of the most recent Digital Thermocouple Calibration by rater. Specifications for thermocouples and temperature sensors can be found in Residential Appendix RA3.2.2.2.2. Procedures for calibration are detailed in RA3.2.2.4.1. Calibration must happen at least once every 30 days.
3. Digital Refrigerant Gauge Calibration status will appear automatically. If the date entered in Row C01 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.
4. Digital Thermocouple Calibration status will appear automatically. If the date entered in Row C02 is more than 30 days prior to date of verification this row will indicate that calibration is required and you will not be allowed to continue filling out this document until calibration is performed.

Section D. Measurement Access Hole (MAH) Verification

1. This information is automatically pulled from the Certificate of Installation (CF2R-MCH-25). Installer is to have indicated the method used to demonstrate compliance with the MAH requirement by selecting the appropriate method from the drop down list. Procedures for installing MAH's are detailed in RA3.2.2.3. Selecting that the MAH cannot be installed consistent with Figure 3.2-1 may result in additional scrutiny by enforcement personnel.) If installed system does not match this entry, it can be overwritten by rater but it will be flagged as a possible fail.

Section E. Minimum System Airflow Rate Verification

1. This information is automatically calculated based on the information given in line A09. This is the target minimum system airflow required for the system being verified.
2. This information is automatically calculated based on either the CF3R-MCH-23, or CF3R-MCH-28, which documents the rater's measured airflow of the system being verified (or alternative method). If the measured airflow is not adequate it will not comply with the airflow requirements and refrigerant charge verification cannot be performed.

Section F. Subcooling Charge Verification Method – Data Collection

1. The Rater must independently collect this data. Measure and record the lowest return air dry-bulb temperature that occurred during the refrigerant charge procedure in degrees F. This temperature must remain above 70 degF during the verification procedure. This requirement is detailed in Residential Appendix RA3.2.2.5.
2. The Rater must independently collect this data. Measure and record the condenser air dry-bulb temperature ($T_{condenser}$) in degrees F. This value must be at least 55 degF and no more than 115 degF to use the Subcooling Charge Verification Method.
3. If a value less than 55 degF or greater than 115 degF is entered in Row F02 the Subcooling Method cannot be used.
4. The Rater must independently collect this data. Measure and record the liquid line temperature (T_{liquid}) in degrees F. This procedure is detailed in RA3.2.2.5. This value is used to calculate the measured subcool temperature.

5. The Rater must independently collect this data. Measure and record the liquid line pressure (P_{liquid}) in psig. This procedure is detailed in RA3.2.2.5. This value is used to determine the condenser saturation temperature ($T_{condenser,sat}$) from a pressure temperature chart for the appropriate refrigerant (can be internal to a digital gauge), which is entered into Row F06.
6. Enter the condenser saturation temperature ($T_{condenser,sat}$) from the digital gauge or a separate pressure-temperature chart that corresponds to the liquid line pressure entered in Row F05, in degrees F.
7. Measured Subcooling is automatically calculated as the difference between the liquid line temperature (Row F04) and the condenser saturation temperature (Row F06)
8. The Rater must independently collect this data. Enter target subcooling from manufacturer. This may be a challenge to find for older equipment. Internet searches can sometimes result in archived equipment specifications for the equipment in question, or sometimes a very similar model. If the manufacturer's target cannot be found the Commission's Executive Director may provide additional guidance for compliance.
9. System passes Subcooling method when Row F08 is within plus or minus 6 degrees of Row F07. Note that the target for the installer, on the CF2R, is plus or minus 3 degrees.

Section G. Metering Device Verification

1. The Rater must independently collect this data. Measure and record the suction line temperature ($T_{suction}$) in degrees F. This procedure is detailed in RA3.2.2.5. This value is used to calculate the measured superheat.
2. The Rater must independently collect this data. Measure and record the suction line pressure ($P_{suction}$) in psig. This procedure is detailed in RA3.2.2.5. This value is used to determine the evaporator saturation temperature ($T_{evaporator,sat}$) from a pressure temperature chart for the appropriate refrigerant (can be internal to a digital gauge), which is entered into Row G03.
3. Enter the evaporator saturation temperature ($T_{evaporator,sat}$) from the digital gauge or a separate pressure-temperature chart that corresponds to the suction line pressure entered in Row G02, in degrees F.
4. Measured superheat is automatically calculated as the difference between the suction line temperature (Row G01) and the evaporator saturation temperature (Row G03)
5. There are two possible criteria for passing. If the manufacturer's specification is known it should be used, otherwise the CEC requirement is that the superheat be between 4 and 25 degF, inclusive. This row checks the CEC requirement.
6. If the manufacturer's target superheat for ensuring proper metering device operation is known, it supersedes the CEC requirement of being between 4 and 25 degF. If "Yes, documentation to be provided upon request." is selected, the installer should be prepared to provide documentation for the target values used.
7. There are two possible criteria for passing. If the manufacturer's specification is known it should be used, otherwise the CEC requirement is that the superheat be between 4 and 25 degF, inclusive. If "Yes, documentation to be provided upon request." is selected in Row G06, the installer should be prepared to provide documentation for the target values used.

Section H. Confirmation of Refrigerant Pressure Differential

1. This box is automatically filled out. It verifies that the correct refrigerant pressure was maintained.
2. This box is automatically filled out. It verifies that the correct refrigerant pressure was maintained. With a Condenser Outlet Air Restrictor installed, and after system operation was stabilized for at least 15 minutes, throughout the data collection for this verification, the difference between the liquid line pressure and suction line pressure must be maintained between 160 and 220 psi for R-410A systems, or between 100 and 145 psi for R-22 systems. If not an error message will appear here.

STATE OF CALIFORNIA

RATED SPACE CONDITIONING SYSTEM EQUIPMENT VERIFICATION

CEC-CF3R-MCH-26-H (Revised 03/15) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-MCH-26-H
Rated Space Conditioning System Equipment Verification		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
Procedures for verification of High SEER and EER Equipment are described in Reference Appendix RA3.4. Each HVAC system requiring verification must use a separate form.		
01	System Name or Identification/Tag	
02	System Location or Area Served	
03	Status: SEER and EER Performance Compliance Credit Check	
04	Directory Used to Certify Product Performance	
05	AHRI certification number for the installed space conditioning system from http://www.ahridirectory.org	
06	Is a specific air handler/furnace make and model required by the AHRI certification document?	
07	Is a time delay relay specifically called out (+TDR) on the AHRI certification document?	
08	Is a TXV specifically called out (+TXV) on the AHRI certification document?	

B. Rated Space Conditioning System Equipment Verification				
The data on nameplate of the installed component shall conform to the data for the component as shown in the Directory used to certify product performance in order to demonstrate compliance.				
	Data from Nameplate of Installed system component		Data from the Directory used to certify the rated system component	
Outdoor Condenser or Package Unit - Installed Manufacturer Name	01		02	
Outdoor Condenser or Package Unit - Installed Model Number	03		04	
Inside Coil - Installed Manufacturer Name	05		06	
Inside Coil - Installed Model Number	07		08	
Air Handler/Furnace - Installed Manufacturer Name	09		10	
Air Handler/Furnace - Installed Model Number	11		12	

C. Verified Cooling System SEER		
01	Required Minimum SEER	
02	Installed SEER	
03	Compliance Statement:	
Signature by responsible party below certifies that the installed cooling equipment meets or exceeds the required value listed on the CF2R.		

D. Verified Cooling System EER		
01	Required Minimum EER	
02	Installed EER	
03	Compliance Statement:	
Signature by responsible party below certifies that the installed cooling equipment meets or exceeds the required value listed on the CF2R.		

E. Verified Cooling System Air Handler/Furnace		
01	If a specific air handler or furnace is required by the AHRI certificate, the responsible party certifies by signing below that the installed air handler/furnace matches the equipment on the AHRI Certificate.	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-MCH-26-H
Rated Space Conditioning System Equipment Verification		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

F. Verified Cooling System Time Delay Relay		
01	If a Time Delay Relay is required by the AHRI certificate, the responsible party certifies by signing below that the Time Delay Relay is installed and has been tested to operate correctly according to the protocols of RA3.4.3.	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

G. Verified Cooling System TXV		
01	If a TXV is required by the AHRI certificate, the responsible party certifies by signing below that the TXV is properly installed and has been visually verified, including proper placement of sensing bulb.	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-26-H
Rated Space Conditioning System Equipment Verification		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-26-H User Instructions

Section A. System Information

1. System Identification or Name: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2. System Location or Area Served: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
3. Status: SEER and EER performance compliance credit check: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
4. Directory used to certify product performance: User to select from dropdown list the certification data base used to document equipment efficiency.
5. AHRI certification number for the installed space conditioning system: If not using AHRI, select "N/A." Otherwise, enter the complete AHRI certification number for the equipment installed. This number represents a specific piece of equipment (e.g., package units) or combination of equipment (e.g., split systems) that must match the installed equipment.
6. If a specific air handler/furnace make and model required by the AHRI certification document: If not using AHRI, select "N/A." Note that when using AHRI, this does not apply to package units. Sometimes, for split systems, a specific model air handler/furnace will be called out in addition to the condenser and coil. When it is, it must be installed and verified for the AHRI certificate to be valid for the installed system. Sometimes, the AHRI certificate only calls out the condenser and coil model numbers. In this case the furnace make/model need not be verified. If not, select "No".
7. Is a time delay relay specifically called out (+TDR) on the AHRI certification document?: If not using AHRI, select "N/A." If the AHRI certificate specifies that a TDR was on the system when it was tested, then the TDR is required for the system to achieve its certified efficiency and it must be verified. If not, select "No". The indication for a TDR usually consists of a "+TDR" at the end of the model number. Sometimes it may just be a "+D" (delay).
8. Is a TXV specifically called out (+TXV) on the AHRI certification document?: If not using AHRI, select "N/A." If the AHRI certificate specifies that a TXV was on the system when it was tested, then the TXV is required for the system to achieve its certified efficiency and it must be verified. If not, select "No". The indication for a TXV usually consists of a "+TXV" at the end of the model number. Sometimes it may just be a "+V" (valve).

Section B. Rated Space Conditioning System Equipment Verification

1. Outdoor Condenser or Package Unit - Installed Manufacturer Name, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2. Outdoor Condenser or Package Unit - Installed Manufacturer Name, Data from the Directory used to certify product performance for the rated system component: Enter the Manufacturer's name for the condenser as it appears in the Directory. For Package units, this will be the only Manufacturer's name.
3. Outdoor Condenser or Package Unit - Installed Model Number, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
4. Outdoor Condenser or Package Unit - Installed Model Number, Data from the Directory used to certify product performance for the rated system component: Enter the Manufacturer's model number for the condenser as it appears in the Directory. For Package units, this will be the only model number required.
5. Inside Coil - Installed Manufacturer Name, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
6. Inside Coil - Installed Manufacturer Name, Data from the Directory used to certify product performancefor the rated system component: Enter the Manufacturer's name for the inside coil (aka, indoor coil, evaporator coil) as it appears in the Directory. For package units and fan coil units, there is no separate inside coil, so enter "N/A".
7. Inside Coil - Installed Model Number, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
8. Inside Coil - Installed Model Number, Data from the Directory used to certify product performance for the rated system component: Enter the Manufacturer's model number for the inside coil (aka, indoor coil, evaporator coil) as it appears in the Directory. For package units and fan coil units, there is no separate inside coil, so enter "N/A".
9. Air Handler/Furnace - Installed Manufacturer Name, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
10. Air Handler/Furnace - Installed Manufacturer Name, Data from AHRI Certificate for the rated system component: If not using AHRI, select "N/A." Enter the Manufacturer's name for the air handler/furnace as it appears on the AHRI certificate. For package units there is no separate air handler, so enter "N/A". Also enter "N/A" if a specific furnace or air handler is not called out on the AHRI certificate, as indicated in Section A, above.

11. Air Handler/Furnace - Installed Model Number, Data from Nameplate of Installed system component: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document
12. Air Handler/Furnace - Installed Model Number, Data from AHRI Certificate for the rated system component: If not using AHRI, select “N/A.” Enter the Manufacturer’s model number for the air handler/furnace as it appears on the AHRI certificate. For package units there is no separate air handler, so enter “N/A”. Also enter “N/A” if a specific furnace or air handler is not called out on the AHRI certificate, as indicated in Section A, above.

Section C. Verified Cooling System SEER

1. Required Minimum SEER: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2. Installed SEER: Enter the exact SEER value shown in the Directory used to certify the equipment shown in Section B, above.
3. Compliance Statement: This field is filled out automatically. Compliance requires that the installed SEER meet the required minimum SEER.

Section D. Verified Cooling System EER

1. Required Minimum EER: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2. Installed EEREnter the exact EER value shown in the Directory used to certify for the equipment shown in Section B, above.
3. Compliance Statement: This field is filled out automatically. Compliance requires that the installed EER meet the required minimum EER

Section E. Verified Cooling System Air Handler/Furnace

1. This statement must be true for the system to comply.
2. Verification Status: Select the appropriate choice from the following list:
    a. Select “Pass” if the installed air handler/furnace matches the air handler/furnace on the AHRI certificate.
    b. Select “Fail” if the installed air handler/furnace does not match the air handler/furnace on the AHRI certificate. You will be required to enter an explanation in the notes section below.
    c. Select “N/A”if this section does not apply.
3. Correction Notes: If “Fail” is selected in the previous row, indicate specifically why in this section.

Section F. Verified Cooling System Time Delay Relay

1. This statement must be true for the system to comply.
2. Verification Status: Select the appropriate choice from the following list:
    a. Select “Pass” if the installed has a time delay relay that meets the verification requirements of RA3.4.3.
    b. Select “Fail” if the installed system does not meet the verification requirements of RA3.4.3.
    c. Select “N/A”if this section does not apply.
3. Correction Notes: If “Fail” is selected in the previous row, indicate specifically why in this section.

Section G. Verified Cooling System TXV

1. This statement must be true for the system to comply.
2. Verification Status: Select the appropriate choice from the following list:
    a. Select “Pass” if the installed has a TXV installed.
    b. Select “Fail” if the installed system does not have a TXV installed.
    c. Select “N/A”if this section does not apply.
3. Correction Notes: If “Fail” is selected in the previous row, indicate specifically why in this section.

CERTIFICATE OF VERIFICATION		CF3R-MCH-27a-H
Indoor Air Quality and Mechanical Ventilation		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

Title 24, Part 6, Section 150.0(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ANSI/ASHRAE Standard 62.2 Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. ***Equation and table numbering on this compliance document corresponds to the numbering for that information in the published ANSI/ASHRAE Standard 62.2-2010.***

A. Dwelling Mechanical Ventilation - General Information		
01	Dwelling unit name	
02	Building Type	
03	Project scope	
04	Total Conditioned Floor Area of dwelling unit (For addition projects the conditioned floor area equals existing area plus addition area)	
05	Number of bedrooms in dwelling unit (For addition projects the number of bedrooms equals the existing bedrooms plus addition bedrooms)	
06	Ventilation Operation Schedule	
07	Whole-Building Ventilation Rate Calculation Method.	
08	Whole Building Ventilation System Type	

MCH-27a - Continuous Ventilation Airflow - Fan Vent Rate Method

B. Whole-Building Continuous Ventilation - Fan Ventilation Rate Method - A mechanical supply system, exhaust system, or combination thereof shall provide whole-building ventilation with outdoor air each hour at no less than the rate in equation 4.1a.		
01	Required Continuous Whole-Building Ventilation Rate (Q_{fan})	
02	Installed Continuous Whole-Building Ventilation Rate	

C. Compliance Statement	
01	

D. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-27a-H
Indoor Air Quality and Mechanical Ventilation		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

User Instructions – MCH-27a:

Section A. General Information

1 This information is automatically pulled from the CF1R. This is the unique identifier for this dwelling unit. Needed mostly for multifamily dwelling units. Ventilation is calculated and provided for each dwelling unit individually.

2 This information is automatically pulled from the CF1R. Choices are “single family” and “low-rise multifamily”.

3 This information is automatically pulled from the CF1R. Choices are “New Construction” and “Addition greater than 1000sf”.

4 Value to be entered in the field equals the conditioned floor area of the space for which the ventilation is being calculated, in square feet. For additions over 1000 sqft, this will be the floor area of the existing home plus the addition.

5 Value to be entered in the field equals the number of bedrooms in the home. For additions over 1000 sqft, this will be the number of bedrooms in the existing home plus the number of bedrooms in the addition.

6 Select the Ventilation Operation Schedule method used from the choices provided:

- Continuous (the fan that provides ventilation will run 24/7.
- Intermittent (the fan that provides ventilation will be on some of the time and off some of the time)

7 Select the Whole Building Ventilation Rate Calculation Method from the choices provided:

- Fan Ventilation Rate Method (only assumes ventilation from the ventilation fan)
- Total Ventilation Rate Method (assumes that some ventilation is provided by infiltration)

8 Select the Whole Building Ventilation System Type from the choices provided:

- Standalone – Exhaust (ventilation fan[s] push air out of the house)
- Standalone – Supply (ventilation fan[s] push air into house)
- Standalone - Balanced (ventilation fan[s] push air into AND out of the house in equal amounts)
- Central Fan Integrated – CFI (central space condition system fan is used to pull air into the house). Note: these may not run continuously. If “Continuous” is chosen in A06 an error message will be shown.

Section B. Whole Building Continuous Ventilation – Fan Ventilation Rate Method

1 This value is automatically calculated using equation 4.1a. The equation used to calculate this value in the field equals:

a. If A02= Single Family then [(0.01 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Continuous Whole-Building Ventilation Rate

b. If A02= Multifamily then [(0.03 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Continuous Whole-Building Ventilation Rate

2 User entered value equals the total installed, continuous mechanical ventilation in CFM. This value must meet or exceed that value in B01.

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CERTIFICATE OF VERIFICATION		CF3R-MCH-27b-H
Indoor Air Quality and Mechanical Ventilation		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

Title 24, Part 6, Section 150.0(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ANSI/ASHRAE Standard62.2. Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. ***Equation and table numbering on this form corresponds to the numbering for that information in the published ANSI/ASHRAE Standard 62.2-2010.***

A. Dwelling Mechanical Ventilation - General Information		
01	Dwelling unit name	
02	Building Type	
03	Project scope	
04	Total Conditioned Floor Area of dwelling unit (For addition projects the conditioned floor area equals existing area plus addition area)	
05	Number of bedrooms in dwelling unit (For addition projects the number of bedrooms equals the existing bedrooms plus addition bedrooms)	
06	Ventilation Operation Schedule	
07	Whole-Building Ventilation Rate Calculation Method.	
08	Whole Building Ventilation System Type	

MCH-27b - Continuous Ventilation Airflow – Total Ventilation Rate Method

B. Whole-Building Continuous Ventilation - Total Ventilation Rate Method - A mechanical supply system, exhaust system, or combination thereof shall provide whole-building ventilation with outdoor air each hour at no less than the rate in 62.2 equation 4.7.		
01	Total Required Ventilation rate (fan + infiltration), (Qtot)	
02	CFM50 - Depressurization	
03	Equivalent Leakage Area Depressurization	
04	CFM50 – Pressurization	
05	Equivalent Leakage Area Pressurization	
06	Equivalent Leakage Area used for ventilation	
07	What is the vertical distance from the lowest above-grade floor to the highest ceiling in feet?	
08	What is the weather and shielding factor (wsf) for the city listed in 62.2 Appendix X Table X1 ?	
09	Normalized Leakage (NL)	
10	Ventilation provided by infiltration in (Qinf)	
11	Required Continuous Whole-Building Ventilation Rate (Q_{fan})	
12	Installed Continuous Whole-Building Ventilation Rate	

C. Compliance Statement	
01	

D. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-27b-H
Indoor Air Quality and Mechanical Ventilation		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

User Instructions – MCH-27b:

Section A. General Information

1 This information is automatically pulled from the CF1R. This is the unique identifier for this dwelling unit. Needed mostly for multifamily dwelling units. Ventilation is calculated and provided for each dwelling unit individually.
2 This information is automatically pulled from the CF1R. Choices are “single family” and “low-rise multifamily”.
3 This information is automatically pulled from the CF1R. Choices are “New Construction” and “Addition greater than 1000sf”.
4 Value to be entered in the field equals the conditioned floor area of the space for which the ventilation is being calculated, in square feet. For additions over 1000 sqft, this will be the floor area of the existing home plus the addition.
5 Value to be entered in the field equals the number of bedrooms in the home. For additions over 1000 sqft, this will be the number of bedrooms in the existing home plus the number of bedrooms in the addition.
6 Select the Ventilation Operation Schedule method used from the choices provided:
- Continuous (the fan that provides ventilation will run 24/7.
- Intermittent (the fan that provides ventilation will be on some of the time and off some of the time)

7 Select the Whole Building Ventilation Rate Calculation Method from the choices provided:
- Fan Ventilation Rate Method (only assumes ventilation from the ventilation fan)
- Total Ventilation Rate Method (assumes that some ventilation is provided by infiltration)

8 Select the Whole Building Ventilation System Type from the choices provided:
- Standalone – Exhaust (ventilation fan[s] push air out of the house)
- Standalone – Supply (ventilation fan[s] push air into house)
- Standalone - Balanced (ventilation fan[s] push air into AND out of the house in equal amounts)
- Central Fan Integrated – CFI (central space condition system fan is used to pull air into the house). Note: these may not run continuously. If “Continuous” is chosen in A06 an error message will be shown.

Section B. Whole Building Continuous Ventilation – Total Ventilation Rate Method

1 This value is automatically calculated using 62.2 equation 4.2a. The equation used to calculate this value in the field equals:
   a. If A02= Single Family then [(0.03 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Required Continuous Whole-Building Ventilation Rate
   b. If A02= Multifamily then [(0.05 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Required Continuous Whole-Building Ventilation Rate

2 This information is automatically pulled from the registered MCH24 for this dwelling unit. Note: The Total Ventilation Rate Method requires specific infiltration measurements that must be documented on either a MCH24.
3 This value is automatically calculated. The equation used to calculate this value in the field equals: (CFM50 B02 x 0.055)/144 = Equivalent Leakage Area (ELA)
4 This information is automatically pulled from the registered MCH24 for this dwelling unit. Note: The Total Ventilation Rate Method requires specific infiltration measurements that must be documented on either a MCH24.
5 This value is automatically calculated. The equation used to calculate this value in the field equals: (CFM50 B04 x 0.055)/144 = Equivalent Leakage Area (ELA)
6 Calculated value. This is the average of the pressurization and depressurization equivalent leakage areas.
7 User entered value. Enter the vertical distance from the lowest above-grade floor to the highest ceiling, in feet.
8 User entered value. Enter the Weather Shielding Factor (wsf) from 62.2 Appendix X Table X1.

NORMATIVE APPENDIX X:
INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)
TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
690150	0.5	Twentynine Palms	34.3	–116.17	California
722860	0.43	March AFB	33.9	–117.25	California
722868	0.45	Palm Springs Intl	33.83	–116.50	California
722869	0.42	Riverside Muni	33.95	–117.45	California
722880	0.39	Burbank–Glendale–Pasadena AP	34.2	–118.35	California
722885	0.39	Santa Monica Muni	34.02	–118.45	California
722886	0.39	Van Nuys Airport	34.22	–118.48	California
722895	0.55	Lompoc (AWOS)	34.67	–120.47	California
722897	0.51	San Luis Co Rgnl	35.23	–120.63	California
722899	0.45	Chino Airport	33.97	–117.63	California
722900	0.38	San Diego Lindbergh Field	32.73	–117.17	California
722903	0.39	San Diego/Montgomery	32.82	–117.13	California

NORMATIVE APPENDIX X:
INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)
TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
722904	0.4	Chula Vista Brown Field NAAS	32.58	–116.98	California
722906	0.39	San Diego North Island NAS	32.7	–117.20	California
722926	0.4	Camp Pendleton MCAS	33.3	–117.35	California
722927	0.38	Carlsbad/Palomar	33.13	–117.28	California
722930	0.39	San Diego Miramar NAS	32.87	–117.13	California
722950	0.42	Los Angeles Intl Arpt	33.93	–118.40	California
722956	0.38	Jack Northrop Fld H	33.92	–118.33	California
722970	0.38	Long Beach Daugherty Fld	33.83	–118.17	California
722976	0.34	Fullerton Municipal	33.87	–117.98	California
722977	0.36	Santa Ana John Wayne AP	33.68	–117.87	California
723805	0.51	Needles Airport	34.77	–114.62	California
723810	0.59	Edwards AFB	34.9	–117.87	California
723815	0.58	Daggett Barstow–Daggett AP	34.85	–116.80	California
723816	0.62	Lancaster Gen Wm Fox Field	34.73	–118.22	California
723820	0.57	Palmdale Airport	34.63	–118.08	California
723830	0.68	Sandberg	34.75	–118.72	California
723840	0.43	Bakersfield Meadows Field	35.43	–119.05	California
723890	0.45	Fresno Yosemite Intl AP	36.78	–119.72	California
723895	0.42	Porterville (AWOS)	36.03	–119.07	California
723896	0.43	Visalia Muni (AWOS)	36.32	–119.40	California
723910	0.45	Point Mugu Nf	34.12	–119.12	California
723925	0.44	Santa Barbara Municipal AP	34.43	–119.85	California
723926	0.43	Camarillo (AWOS)	34.22	–119.08	California
723927	0.45	Oxnard Airport	34.2	–119.20	California
723940	0.52	Santa Maria Public Arpt	34.92	–120.47	California
723965	0.53	Paso Robles Municipal Arpt	35.67	–120.63	California
724800	0.55	Bishop Airport	37.37	–118.35	California
724815	0.46	Merced/Macready Fld	37.28	–120.52	California
724830	0.51	Sacramento Executive Arpt	38.5	–121.50	California
724837	0.45	Beale AFB	39.13	–121.43	California
724838	0.5	Yuba Co	39.1	–121.57	California
724839	0.51	Sacramento Metropolitan AP	38.7	–121.58	California
724915	0.49	Monterey Naf	36.6	–121.87	California
724917	0.54	Salinas Municipal AP	36.67	–121.60	California
724920	0.5	Stockton Metropolitan Arpt	37.9	–121.23	California
724926	0.47	Modesto City–County AP	37.63	–120.95	California
724927	0.53	Livermore Municipal	37.7	–121.82	California
724930	0.54	Oakland Metropolitan Arpt	37.72	–122.22	California
724935	0.47	Hayward Air Term	37.67	–122.12	California
724936	0.53	Concord–Buchanan Field	38	–122.05	California
724940	0.6	San Francisco Intl AP	37.62	–122.40	California
724945	0.48	San Jose Intl AP	37.37	–121.93	California
724955	0.55	Napa Co. Airport	38.22	–122.28	California
724957	0.49	Santa Rosa (AWOS)	38.52	–122.82	California
725845	0.44	Blue Canyon AP	39.3	–120.72	California
725846	0.66	Truckee–Tahoe	39.32	–120.13	California
725847	0.64	South Lake Tahoe	38.9	–120.00	California
725905	0.47	Ukiah Municipal AP	39.13	–123.20	California
725910	0.5	Red Bluff Municipal Arpt 40.15 –122.25 California	40.15	–122.25	California
725920	0.47	Redding Municipal Arpt 40.52 –122.	40.52	–122.32	California
725945	0.56	Arcata Airport 40.98 –124.10 California	40.98	–124.10	California

NORMATIVE APPENDIX X Cont:
INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)
TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
725946	0.6	Crescent City Faa Ai 41.78 –124.2	41.78	–124.23	California
725955	0.55	Montague Siskiyou County AP 41.78 –122.47 California	41.78	–122.47	California
725958	0.59	Alturas 41.50 –120.5	41.5	–120.53	California
745090	0.45	Mountain View Moffett Fld NAS	37.4	–122.05	California
745160	0.67	Travis Field AFB	38.27	–121.93	California
746120	0.52	China Lake Naf	35.68	–117.68	California
747020	0.5	Lemoore Reeves NAS	36.33	–119.95	California
747185	0.46	Imperial	32.83	–115.58	California
747187	0.46	Palm Springs Thermal AP	33.63	–116.17	California
747188	0.48	Blythe Riverside Co Arpt	33.62	–114.72	California

9 This value is automatically calculated using 62.2 equation 4.5. The equation used to calculate this value in the field equals: [1000 x (Equivalent Leakage Area (ELA) row B06/ conditioned floor area A04) x (Vertical Distance B07/8.2)^0.4]= Normalized Leakage (NL)

10 This value is automatically calculated using 62.2 equation 4.6a. The equation used to calculate this value in the field equals: (Normalized Leakage (NL) row B09 x conditioned floor area A04)/7.3= Ventilation Provided by Infiltration in (CFM)

11 This value is automatically calculated using 62.2 equation 4.7. It is the difference between the total required ventilation and the ventilation provided by infiltration. The equation used to calculate this value in the field equals: (Required Continuous Whole-Building Ventilation Rate row B01 - Ventilation Provided by Infiltration row B10 = Required Continuous Whole-Building Ventilation Rate of the fan in (CFM)

12 User entered value equals the installed ventilation rate of the fan in (CFM).

CERTIFICATE OF VERIFICATION		CF3R-MCH-27c-H
Indoor Air Quality and Mechanical Ventilation		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

Title 24, Part 6, Section 150.0(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ANSI/ASHRAE Standard62.2. Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. ***Equation and table numbering on this form corresponds to the numbering for that information in the published ANSI/ASHRAE Standard 62.2-2010.***

A. Dwelling Mechanical Ventilation - General Information		
01	Dwelling unit name	
02	Building Type	
03	Project scope	
04	Total Conditioned Floor Area of dwelling unit (For addition projects the conditioned floor area equals existing area plus addition area)	
05	Number of bedrooms in dwelling unit (For addition projects the number of bedrooms equals the existing bedrooms plus addition bedrooms)	
06	Ventilation Operation Schedule	
07	Whole-Building Ventilation Rate Calculation Method.	
08	Whole Building Ventilation System Type	

MCH-27c - Intermittent Ventilation Airflow - Fan Vent Rate Method

B. Whole-Building Continuous Ventilation - Fan Ventilation Rate Method - A mechanical supply system, exhaust system, or combination thereof shall provide whole-building ventilation with outdoor air each hour at no less than the rate in 62.2 equation 4.1a.		
01	Required Continuous Whole-Building Ventilation Rate (Q_{fan})	

C. Intermittent Ventilation: The effective ventilation rate of an **intermittent** system is the combination of its delivered capacity, its fractional on-time, cycle time, and the ventilation effectiveness from Table 4.2.		
01	In a single on off cycle, what is the ON time in hours?	
02	In a single on off cycle, what is the OFF time in hours??	
03	Fan Cycle Time Check	
04	Daily fractional on time (*f* used in Table 4.2)	
05	Daily Fractional on Time Check.	
06	Turnover (N used in Table 4.2)	
07	Ventilation effectiveness (e, from Table 4.2)	
08	Intermittent ventilation rate	
09	Installed Intermittant ventilation Rate	
10	System Fan Efficacy Compliance Status	
11	System Fan Efficacy Compliance	

D. Compliance Statement	
01	

E. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-27c-H
Indoor Air Quality and Mechanical Ventilation		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

User Instructions – MCH-27c:

Section A. General Information

1 This information is automatically pulled from the CF1R. This is the unique identifier for this dwelling unit. Needed mostly for multifamily dwelling units. Ventilation is calculated and provided for each dwelling unit individually.
2 This information is automatically pulled from the CF1R. Choices are "single family" and "low-rise multifamily".
3 This information is automatically pulled from the CF1R. Choices are "New Construction" and "Addition greater than 1000sf".
4 Value to be entered in the field equals the conditioned floor area of the space for which the ventilation is being calculated, in square feet. For additions over 1000 sqft, this will be the floor area of the existing home plus the addition.
5 Value to be entered in the field equals the number of bedrooms in the home. For additions over 1000 sqft, this will be the number of bedrooms in the existing home plus the number of bedrooms in the addition.
6 Select the Ventilation Operation Schedule method used from the choices provided:
- Continuous (the fan that provides ventilation will run 24/7.
- Intermittent (the fan that provides ventilation will be on some of the time and off some of the time)

7 Select the Whole Building Ventilation Rate Calculation Method from the choices provided:
- Fan Ventilation Rate Method (only assumes ventilation from the ventilation fan)
- Total Ventilation Rate Method (assumes that some ventilation is provided by infiltration)

8 Select the Whole Building Ventilation System Type from the choices provided:
- Standalone – Exhaust (ventilation fan[s] push air out of the house)
- Standalone – Supply (ventilation fan[s] push air into house)
- Standalone - Balanced (ventilation fan[s] push air into AND out of the house in equal amounts)

Central Fan Integrated – CFI (central space condition system fan is used to pull air into the house) Note: these may not run continuously. If "Continuous" is chosen in A06 an error message will be shown.

Section B. Whole Building Continuous Ventilation – Fan Ventilation Rate Method

1 This value is automatically calculated using equation 4.1a. The equation used to calculate this value in the field equals:
   a. If A02= Single Family then [(0.01 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Continuous Whole-Building Ventilation Rate
   b. If A02= Multifamily then [(0.03 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Continuous Whole-Building Ventilation Rate

Section C. Intermittent Ventilation

1 Intermittent ventilation requires controls that ensure a regular operating schedule every 24 hours. Within a 24 hour period there will be one or more regular on off cycles. For a single on off cycle, enter the ON time in hours. This value will be verified by a HERS rater.
2 Intermittent ventilation requires controls that ensure a regular operating schedule every 24 hours. Within a 24 hour period there will be one or more regular on off cycles. For a single on off cycle, enter the OFF time in hours. This value will be verified by a HERS rater.
3 This row performs an automatic check. The intermittent ventilation system must operate at least once every 24 hours. For this to occur, the on time plus the off time in a single on off cycle must be less than 24 hours. If this is true, "OK" will appear. If this is not true, an error will appear here and correct values will need to be entered into Rows C01 and C02. The equation used to calculate this value in the field equals: Time on in hours row C01 + Time off in hours row C02.
4 This value is automatically calculated. It is the daily fractional on time (*f*) used in 62.2 Table 4.2. A value of 0.60 means that in a 24 hour period the fan will run 60% of the time. The equation used to calculate this value in the field equals: On time in Hours row C01/(On time in Hours row C01 + Off time in Hours row C02)= Daily fractional on time (decimal).
5 This row performs an automatic check. The ventilation system must operate at least 10% of the time. Row C04 must be greater than or equal to 0.10. If this is true, "OK" will appear. If this is not true, an error message will appear here and correct values will need to be entered into Rows C01 and C02.
6 This value is automatically calculated. It is the turnover (N) used in 62.2 Table 4.2. The equation used to calculate this value in the field equals: [12.8 x Continuous Whole-Building Ventilation Rate row B01 x (On time in Hours row C01 + Off time in Hours row C02)]/ Conditioned floor area of dwelling unit row A04= Turnover N
7 User entered value from table 4.2. Use the daily fractional time (*f*) from Row C04 and the turnover (N) from Row C06 to determine the ventilation effectiveness value (e) from 62.2 table 4.2.

TABLE 4.2

Mechanical Ventilation Effectiveness for Intermittent Fans

Fractional On-Time, f	Turnover, N														
	0	1	1.5	2	2.5	3	3.5	4	5	6	8	12	20	40	100+
0.00	1.00	0.95	0.88	0.78	0.60	0.00									
0.05	1.00	0.96	0.90	0.81	0.67	0.41	0.00								
0.10	1.00	0.96	0.91	0.83	0.72	0.55	0.21	0.00							
0.15	1.00	0.96	0.92	0.85	0.76	0.63	0.44	0.18	0.00						
0.20	1.00	0.97	0.93	0.87	0.79	0.69	0.56	0.40	0.03	0.00					
0.25	1.00	0.97	0.94	0.89	0.82	0.74	0.64	0.53	0.26	0.02	0.00				
0.30	1.00	0.98	0.95	0.90	0.85	0.78	0.71	0.62	0.42	0.24	0.00				
0.35	1.00	0.98	0.95	0.92	0.87	0.82	0.76	0.69	0.54	0.39	0.14	0.00			
0.40	1.00	0.98	0.96	0.93	0.89	0.85	0.80	0.75	0.63	0.52	0.32	0.02	0.00		
0.45	1.00	0.99	0.97	0.94	0.91	0.88	0.84	0.79	0.70	0.61	0.45	0.21	0.00		
0.50	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.83	0.76	0.69	0.57	0.37	0.13	0.00	0.00
0.60	1.00	0.99	0.98	0.97	0.96	0.94	0.92	0.90	0.86	0.81	0.74	0.61	0.45	0.27	0.14
0.70	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.94	0.92	0.90	0.85	0.78	0.68	0.55	0.46
0.80	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.98	0.97	0.96	0.94	0.90	0.85	0.77	0.70
0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.93	0.88
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

8 This value is automatically calculated using 62.2 equation 4.8. It represents the required airflow in cfm that must be delivered during the ventilation system ON times. This value will be verified by a HERS rater. The equation used to calculate this value in the field equals: Continuous Whole-Building Ventilation Rate row B01/(Daily fractional on time row C04 x ventilation effectiveness value row C07= required Intermittent ventilation rate (CFM).

9 User entered value equals the installed intermittent ventilation rate in (CFM)

10 This information is automatically pulled from the registered MCH-22 row B07 Note: this line only visible if CFI System selected in A08.

11 This information is automatically calculated based on C10 Note: this line only visible if CFI System selected in A08.

12

INDOOR AIR QUALITY AND MECHANICAL VENTILATION

CERTIFICATE OF VERIFICATION		CF3R-MCH-27-H
Indoor Air Quality and Mechanical Ventilation		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

Title 24, Part 6, Section 150.0(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ANSI/ASHRAE Standard62.2. Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. ***Equation and table numbering on this form corresponds to the numbering for that information in the published ANSI/ASHRAE Standard 62.2-2010.***

A. Dwelling Mechanical Ventilation - General Information		
01	Dwelling unit name	
02	Building Type	
03	Project scope	
04	Total Conditioned Floor Area of dwelling unit (For addition projects the conditioned floor area equals existing area plus addition area)	
05	Number of bedrooms in dwelling unit (For addition projects the number of bedrooms equals the existing bedrooms plus addition bedrooms)	
06	Ventilation Operation Schedule	
07	Whole-Building Ventilation Rate Calculation Method.	
08	Whole Building Ventilation System Type	

MCH-27d - Intermittent Ventilation Airflow – Total Vent Rate Method

B. Continuous Ventilation Airflow – Total Vent Rate Method – A mechanical supply system, exhaust system, or combination thereof shall provide whole-building ventilation with outdoor air each hour at no less than the rate in 62.2 equation 4.7.		
01	Total Required Ventilation rate (fan + infiltration), (Q_{tot})	
02	CFM50 - Depressurization	
03	Equivalent Leakage Area Depressurization	
04	CFM50 – Pressurization	
05	Equivalent Leakage Area Pressurization	
06	Equivalent Leakage Area used for ventilation	
07	What is the vertical distance from the lowest above-grade floor to the highest ceiling in feet?	
08	What is the weather and shielding factor (wsf) for the city listed in 62.2 Appendix X Table X1 ?	
09	Normalized Leakage (NL)	
10	Ventilation provided by infiltration in (Q_{inf})	
11	Required Continuous Whole-Building Ventilation Rate (Q_{fan})	

C. Intermittent Ventilation: The effective ventilation rate of an **intermittent** system is the combination of its delivered capacity, its fractional on-time, cycle time, and the ventilation effectiveness from Table 4.2.		
01	In a single on off cycle, what is the ON time in hours?	
02	In a single on off cycle, what is the OFF time in hours?	
03	Fan Cycle Time Check	
04	Daily fractional on time (*f* used in Table 4.2).	
05	Daily Fractional on Time Check.	
06	Turnover (N used in Table 4.2)	
07	Ventilation effectiveness (e, from Table 4.2)	
08	Intermittent ventilation rate	
09	Installed Intermittent ventilation Rate	
10	System Fan Efficacy Compliance Status	
11	System Fan Efficacy Compliance	

CERTIFICATE OF VERIFICATION		CF3R-MCH-27-H
Indoor Air Quality and Mechanical Ventilation		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. Compliance Statement	
01	

E. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-27-H
Indoor Air Quality and Mechanical Ventilation		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

Instructions for MCH-27d:

Section A. General Information

1 This information is automatically pulled from the CF1R. This is the unique identifier for this dwelling unit. Needed mostly for multifamily dwelling units. Ventilation is calculated and provided for each dwelling unit individually.

2 This information is automatically pulled from the CF1R. Choices are "single family" and "low-rise multifamily".

3 This information is automatically pulled from the CF1R. Choices are "New Construction" and "Addition greater than 1000sf".

4 Value to be entered in the field equals the conditioned floor area of the space for which the ventilation is being calculated, in square feet. For additions over 1000 sqft, this will be the floor area of the existing home plus the addition.

5 Value to be entered in the field equals the number of bedrooms in the home. For additions over 1000 sqft, this will be the number of bedrooms in the existing home plus the number of bedrooms in the addition.

6 Select the Ventilation Operation Schedule method used from the choices provided:
- Continuous (the fan that provides ventilation will run 24/7.
- Intermittent (the fan that provides ventilation will be on some of the time and off some of the time)

7 Select the Whole Building Ventilation Rate Calculation Method from the choices provided:
- Fan Ventilation Rate Method (only assumes ventilation from the ventilation fan)
- Total Ventilation Rate Method (assumes that some ventilation is provided by infiltration)

8 Select the Whole Building Ventilation System Type from the choices provided:
- Standalone – Exhaust (ventilation fan[s] push air out of the house)
- Standalone – Supply (ventilation fan[s] push air into house)
- Standalone - Balanced (ventilation fan[s] push air into AND out of the house in equal amounts)

Central Fan Integrated – CFI (central space condition system fan is used to pull air into the house) Note: these may not run continuously. If "Continuous" is chosen in A06 an error message will be shown.

Section B. Whole Building Continuous Ventilation – Total Ventilation Rate Method

1. This value is automatically calculated using 62.2 equation 4.2a. The equation used to calculate this value in the field equals:
   a. If A02= Single Family then [(0.03 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Required Continuous Whole-Building Ventilation Rate
   b. If A02= Multifamily then [(0.05 x conditioned floor area A04) + 7.5(Number of bedrooms A05 + 1)] = Required Continuous Whole-Building Ventilation Rate
2. This information is automatically pulled from the registered MCH24 for this dwelling unit. Note: The Total Ventilation Rate Method requires specific infiltration measurements that must be documented on either a MCH24.
3. This value is automatically calculated. The equation used to calculate this value in the field equals: (CFM50 B02 x 0.055)/144 = Equivalent Leakage Area (ELA)
4. This information is automatically pulled from the registered MCH24 for this dwelling unit. Note: The Total Ventilation Rate Method requires specific infiltration measurements that must be documented on either a MCH24.
5. This value is automatically calculated. The equation used to calculate this value in the field equals: (CFM50 B04 x 0.055)/144 = Equivalent Leakage Area (ELA)
6. Calculated value. This is the average of the pressurization and depressurization equivalent leakage areas.
7. User entered value. Enter the vertical distance from the lowest above-grade floor to the highest ceiling, in feet.
8. User entered value. Enter the Weather Shielding Factor (wsf) from 62.2 Appendix X Table X1.

NORMATIVE APPENDIX X:

INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)

TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
690150	0.5	Twentynine Palms	34.3	–116.17	California
722860	0.43	March AFB	33.9	–117.25	California
722868	0.45	Palm Springs Intl	33.83	–116.50	California
722869	0.42	Riverside Muni	33.95	–117.45	California
722880	0.39	Burbank–Glendale–Pasadena AP	34.2	–118.35	California
722885	0.39	Santa Monica Muni	34.02	–118.45	California
722886	0.39	Van Nuys Airport	34.22	–118.48	California
722895	0.55	Lompoc (AWOS)	34.67	–120.47	California
722897	0.51	San Luis Co Rgnl	35.23	–120.63	California
722899	0.45	Chino Airport	33.97	–117.63	California
722900	0.38	San Diego Lindbergh Field	32.73	–117.17	California
722903	0.39	San Diego/Montgomery	32.82	–117.13	California

NORMATIVE APPENDIX X:

INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)

TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
722904	0.4	Chula Vista Brown Field NAAS	32.58	–116.98	California
722906	0.39	San Diego North Island NAS	32.7	–117.20	California
722926	0.4	Camp Pendleton MCAS	33.3	–117.35	California
722927	0.38	Carlsbad/Palomar	33.13	–117.28	California
722930	0.39	San Diego Miramar NAS	32.87	–117.13	California
722950	0.42	Los Angeles Intl Arpt	33.93	–118.40	California
722956	0.38	Jack Northrop Fld H	33.92	–118.33	California
722970	0.38	Long Beach Daugherty Fld	33.83	–118.17	California
722976	0.34	Fullerton Municipal	33.87	–117.98	California
722977	0.36	Santa Ana John Wayne AP	33.68	–117.87	California
723805	0.51	Needles Airport	34.77	–114.62	California
723810	0.59	Edwards AFB	34.9	–117.87	California
723815	0.58	Daggett Barstow–Daggett AP	34.85	–116.80	California
723816	0.62	Lancaster Gen Wm Fox Field	34.73	–118.22	California
723820	0.57	Palmdale Airport	34.63	–118.08	California
723830	0.68	Sandberg	34.75	–118.72	California
723840	0.43	Bakersfield Meadows Field	35.43	–119.05	California
723890	0.45	Fresno Yosemite Intl AP	36.78	–119.72	California
723895	0.42	Porterville (AWOS)	36.03	–119.07	California
723896	0.43	Visalia Muni (AWOS)	36.32	–119.40	California
723910	0.45	Point Mugu Nf	34.12	–119.12	California
723925	0.44	Santa Barbara Municipal AP	34.43	–119.85	California
723926	0.43	Camarillo (AWOS)	34.22	–119.08	California
723927	0.45	Oxnard Airport	34.2	–119.20	California
723940	0.52	Santa Maria Public Arpt	34.92	–120.47	California
723965	0.53	Paso Robles Municipal Arpt	35.67	–120.63	California
724800	0.55	Bishop Airport	37.37	–118.35	California
724815	0.46	Merced/Macready Fld	37.28	–120.52	California
724830	0.51	Sacramento Executive Arpt	38.5	–121.50	California
724837	0.45	Beale AFB	39.13	–121.43	California
724838	0.5	Yuba Co	39.1	–121.57	California
724839	0.51	Sacramento Metropolitan AP	38.7	–121.58	California
724915	0.49	Monterey Naf	36.6	–121.87	California
724917	0.54	Salinas Municipal AP	36.67	–121.60	California
724920	0.5	Stockton Metropolitan Arpt	37.9	–121.23	California
724926	0.47	Modesto City–County AP	37.63	–120.95	California
724927	0.53	Livermore Municipal	37.7	–121.82	California
724930	0.54	Oakland Metropolitan Arpt	37.72	–122.22	California
724935	0.47	Hayward Air Term	37.67	–122.12	California
724936	0.53	Concord–Buchanan Field	38	–122.05	California
724940	0.6	San Francisco Intl AP	37.62	–122.40	California
724945	0.48	San Jose Intl AP	37.37	–121.93	California
724955	0.55	Napa Co. Airport	38.22	–122.28	California
724957	0.49	Santa Rosa (AWOS)	38.52	–122.82	California
725845	0.44	Blue Canyon AP	39.3	–120.72	California
725846	0.66	Truckee–Tahoe	39.32	–120.13	California
725847	0.64	South Lake Tahoe	38.9	–120.00	California
725905	0.47	Ukiah Municipal AP	39.13	–123.20	California
725910	0.5	Red Bluff Municipal Arpt 40.15 –122.25 California	40.15	–122.25	California
725920	0.47	Redding Municipal Arpt 40.52 –122.	40.52	–122.32	California
725945	0.56	Arcata Airport 40.98 –124.10 California	40.98	–124.10	California

NORMATIVE APPENDIX X:
INFILTRATION EFFECTIVENESS WEATHER AND SHIELDING FACTORS (WSF)
TABLE X1 U.S. Climates

TMY3	wsf	Weather Station	Latitude	Longitude	State
725946	0.6	Crescent City Faa Ai 41.78 –124.2	41.78	–124.23	California
725955	0.55	Montague Siskiyou County AP 41.78 –122.47 California	41.78	–122.47	California
725958	0.59	Alturas 41.50 –120.5	41.5	–120.53	California
745090	0.45	Mountain View Moffett Fld NAS	37.4	–122.05	California
745160	0.67	Travis Field AFB	38.27	–121.93	California
746120	0.52	China Lake Naf	35.68	–117.68	California
747020	0.5	Lemoore Reeves NAS	36.33	–119.95	California
747185	0.46	Imperial	32.83	–115.58	California
747187	0.46	Palm Springs Thermal AP	33.63	–116.17	California
747188	0.48	Blythe Riverside Co Arpt	33.62	–114.72	California

9. This value is automatically calculated using 62.2 equation 4.5. The equation used to calculate this value in the field equals: [1000 x (Equivalent Leakage Area (ELA) row B06/ conditioned floor area A04) x (Vertical Distance B07/8.2)^0.4]= Normalized Leakage (NL)
10. This value is automatically calculated using 62.2 equation 4.6a. The equation used to calculate this value in the field equals: (Normalized Leakage (NL) row B09 x conditioned floor area A04)/7.3= Ventilation Provided by Infiltration in (CFM)

This value is automatically calculated using 62.2 equation 4.7. It is the difference between the total required ventilation and the ventilation provided by infiltration. The equation used to calculate this value in the field equals: (Required Contiguous Whole-Building Ventilation Rate row B01 - Ventilation Provided by Infiltration row B10 = Required Continuous Whole-Building Ventilation Rate of the fan in (CFM)

Section C. Intermittent Ventilation

1. Intermittent ventilation requires controls that ensure a regular operating schedule every 24 hours. Within a 24 hour period there will be one or more regular on off cycles. For a single on off cycle, enter the ON time in hours. This value will be verified by a HERS rater.
2. Intermittent ventilation requires controls that ensure a regular operating schedule every 24 hours. Within a 24 hour period there will be one or more regular on off cycles. For a single on off cycle, enter the OFF time in hours. This value will be verified by a HERS rater.
3. This row performs an automatic check. The intermittent ventilation system must operate at least once every 24 hours. For this to occur, the on time plus the off time in a single on-off cycle must be less than 24 hours. If this is true, "OK" will appear. If this is not true, an error will appear here and correct values will need to be entered into Rows C01 and C02. The equation used to calculate this value in the field equals: Time on in hours row C01 + Time off in hours row C02.
4. This value is automatically calculated. It is the daily fractional on time (*f*) used in 62.2 Table 4.2. A value of 0.60 means that in a 24 hour period the fan will run 60% of the time. The equation used to calculate this value in the field equals: On time in Hours row C01/(On time in Hours row C01 + Off time in Hours row C02)= Daily fractional on-time (decimal)
5. This row performs an automatic check. The ventilation system must operate at least 10% of the time. Row C04 must be greater than or equal to 0.10. If this is true, "OK" will appear. If this is not true, an error message will appear here and correct values will need to be entered into Rows C01 and C02.
6. This value is automatically calculated. It is the turnover (N) used in 62.2 Table 4.2. The equation used to calculate this value in the field equals: [12.8 x Continuous Whole-Building Ventilation Rate row B01 x (On time in Hours row C01 + Off time in Hours row C02)]/ Conditioned floor area of dwelling unit row A04= Turnover N
7. User entered value from table 4.2. Use the daily fractional time (*f*) from Row C04 and the turnover (N) from Row C06 to determine the ventilation effectiveness value (e) from 62.2 table 4.2.

TABLE 4.2

Mechanical Ventilation Effectiveness for Intermittent Fans

Fractional On-Time, f	Turnover, N														
	0	1	1.5	2	2.5	3	3.5	4	5	6	8	12	20	40	100+
0.00	1.00	0.95	0.88	0.78	0.60	0.00									
0.05	1.00	0.96	0.90	0.81	0.67	0.41	0.00								
0.10	1.00	0.96	0.91	0.83	0.72	0.55	0.21	0.00							
0.15	1.00	0.96	0.92	0.85	0.76	0.63	0.44	0.18	0.00						
0.20	1.00	0.97	0.93	0.87	0.79	0.69	0.56	0.40	0.03	0.00					
0.25	1.00	0.97	0.94	0.89	0.82	0.74	0.64	0.53	0.26	0.02	0.00				
0.30	1.00	0.98	0.95	0.90	0.85	0.78	0.71	0.62	0.42	0.24	0.00				
0.35	1.00	0.98	0.95	0.92	0.87	0.82	0.76	0.69	0.54	0.39	0.14	0.00			
0.40	1.00	0.98	0.96	0.93	0.89	0.85	0.80	0.75	0.63	0.52	0.32	0.02	0.00		
0.45	1.00	0.99	0.97	0.94	0.91	0.88	0.84	0.79	0.70	0.61	0.45	0.21	0.00		
0.50	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.83	0.76	0.69	0.57	0.37	0.13	0.00	0.00
0.60	1.00	0.99	0.98	0.97	0.96	0.94	0.92	0.90	0.86	0.81	0.74	0.61	0.45	0.27	0.14
0.70	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.94	0.92	0.90	0.85	0.78	0.68	0.55	0.46
0.80	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.98	0.97	0.96	0.94	0.90	0.85	0.77	0.70
0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.93	0.88
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

8. This value is automatically calculated using 62.2 equation 4.8. It represents the required airflow in cfm that must be delivered during the ventilation system ON times. This value will be verified by a HERS rater. The equation used to calculate this value in the field equals: Continuous Whole-Building Ventilation Rate row B01/(Daily fractional on time row C04 x ventilation effectiveness value row C07= required Intermittent ventilation rate (CFM)
9. User entered value equals the installed intermittent ventilation rate in (CFM) This value will be field verified by a HERS Rater.
10. This information is automatically pulled from the registered MCH-22. Note: this line only visible if CFI System selected in A08
11. This information is automatically calculated based on C10 Note: this line only visible if CFI System selected in A08

RETURN DUCT DESIGN AND AIR FILTER DEVICE SIZING ACCORDING TO TABLES 150.0-C OR D

CERTIFICATE OF VERIFICATION		CF3R-MCH-28-H
Return Duct Design and Air Filter Device Sizing According to Tables 150.0-C or D		(Page 1 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. System Information		
01	System Identification or Name	
02	System Location or Area Served	
03	Nominal Cooling Capacity (tons) of Condenser	
04	Number of Return Ducts	

B. One Return Duct		
01	Minimum Return Duct Diameter (inches)	
02	Installed Return Duct Diameter (inches)	
03	Minimum Total Return Filter Grille Gross Area (inch^2)	
04	Installed Total Return Filter Grille Gross Area (inch^2)	
05	Compliance Statement:	

C. Two Return Ducts		
01	Minimum Return Duct1 Diameter (inches)	
02	Installed Return Duct1 Diameter (inches)	
03	Minimum Return Duct2 Diameter (inches)	
04	Installed Return Duct2 Diameter (inches)	
05	Minimum Total Return Filter Grille Gross Area (inch^2)	
06	Installed Total Return Filter Grille Gross Area (inch^2)	
07	Compliance Statement:	

D. Additional Requirements for Compliance		
01	Qualification for the Alternative to Section 150.0(m)13B requires that the ducted space conditioning system shall not use zoning dampers. Systems that use zoning dampers shall comply with the requirements of Section 150.0(m)15.	
02	The return duct length for each return air filter grille shall not exceed 30 linear feet.	
03	The return duct(s) shall not contain more than a total of 180 degrees of bend.	
04	If the return duct contains more than 90 degrees of bend, one of the bends shall be a metal elbow.	
05	Return grille devices shall be labeled in accordance with the requirements in section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

E. Hole for the placement of a Static Pressure Probe (HSPP), and Permanently installed Static Pressure Probe (PSPP) in the Supply Plenum Procedures for installing HSPP or PSPP are specified in RA3.3.1.1.		
01	Method used to demonstrate compliance with the HSPP/PSPP requirement	

F. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-MCH-28-H
Return Duct Design and Air Filter Device Sizing According to Tables 150.0-C or D		(Page 2 of 2)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-28-H User Instructions

Section A. System Information

1. System Identification or Name: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
2. System Location or Area Served: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
3. Nominal Cooling Capacity (tons) of Condenser: This field is filled out automatically. It is referenced from the CF2R-MCH-01, which must be completed prior to this document.
4. Number of Return Ducts: Select the number of return ducts from the options given in the pull down list, either one or two return ducts. Those are the only options for this compliance approach. Other configurations will require that airflow and fan watt draw be verified by diagnostic testing.

Section B. One Return Duct

1. Minimum Return Duct Diameter: This field is automatically calculated based on row A03. Refer to Table 150.0-C/D.
2. Installed Return Duct Diameter: Enter the installed return duct diameter (inches).
3. Minimum Total Return Filter Grille Gross Area: This field is automatically calculated based on row A03. Refer to Table 150.0-C/D.
4. Installed Total Return Filter Grille Gross Area: Enter the installed return filter grille gross area (inch^2). The area is equal to the length (inches) multiplied by the width (inches).
5. Compliance Statement: This field is automatically populated based on the inputs to rows B02 and B04. Compliance requires that the installed duct diameter meet the required duct diameter AND the installed filter grille area meet the required filter grille area.

Section C. Two Return Ducts

1. Minimum Return Duct1 Diameter: This field is automatically calculated based on row A03. Refer to Table 150.0-C or D.
2. Installed Return Duct1 Diameter: Enter the diameter (inches) for the first return duct run.
3. Minimum Return Duct2 Diameter: This field is automatically calculated based on row A03. Refer to Table 150.0-C or D.
4. Installed Return Duct2 Diameter: Enter the diameter (inches) for the second return duct run.
5. Minimum Total Return Filter Grille Gross Area: This field is automatically calculated based on row A03. Refer to Table 150.0-C/D.
6. Installed Total Return Filter Grille Gross Area: Enter the total return filter grille gross area by summing up the two grille areas. The area of each grill is equal to the length (inches) multiplied by the width (inches).
7. Compliance Statement: This field is automatically populated based on the inputs to row C02, C04 and C06. Compliance requires that the installed duct diameters meet the required duct diameters AND the total installed filter grille area meet the total required filter grille area.

Section D Additional Requirements for Compliance

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply
6. Verification Status: If this Section does not apply, then select “All n/a”. If the system meets all of the additional requirements for compliance then select “Pass”, otherwise select “Fail”. The latter selection means that the system does not meet the requirements and the system will need to be modified to meet the requirements or airflow and fan efficacy will have to be verified by diagnostic testing.
7. Correction Notes: If one or more applicable requirements are not met “Fail” will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

Section E. Hole for the placement of a Static Pressure Probe (HSPP), and Permanently installed Static Pressure Probe (PSPP) in the Supply Plenum

1. A hole for a static pressure probe (HSPP) or a permanent static pressure probe (PSPP) is required when system airflow verification is required, whether the airflow test method used requires one or not. Select the appropriate choice from the following options using a dropdown box, the Static Pressure Measurement Method:
   A. If an Hole Static Pressure Probe is installed then select "HSPP Installed"
   B. If a Permanent Static Pressure Probe is installed then select "PSPP Installed"
   C. If the system is configured such that an HSPP nor PSPP can be installed, an alternate location that provides access for making supply plenum pressure measurement may be used. Select "An alternative location has been provided and clearly labeled."
   D. If the system is such that an HSPP or PSPP is not applicable, select "HSPP/PSPP are not applicable to this system".

Section F. Determination of HERS Verification Compliance

1. This field is filled out automatically. Compliance requires that all individual criteria pass.

DUCT SURFACE AREA REDUCTION; R-VALUE; BURIED DUCTS COMPLIANCE CREDIT

CERTIFICATE OF VERIFICATION		CF3R-MCH-29-H
Duct Surface Area Reduction; R-Value; Buried Ducts Compliance Credit		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

Note: Submit one Certificate of installation for each duct system that must demonstrate compliance in the dwelling.

A. DUCT SYSTEM INFORMATION		
01.	Duct System Name or Identification/Tag:	
02.	Duct System Location or Area Served:	
03	Status - Duct Surface Area Reduction And R-Value Compliance Credit	
04	Status - Buried Ducts Compliance Credit	
05	Status - Deeply Buried Ducts Compliance Credit	

B. DUCT SURFACE AREA REDUCTION AND R-VALUE COMPLIANCE CREDIT
Credit is available for supply duct systems with reduced surface area in unconditioned space with varying combinations of higher performance insulation if the system complies with the following requirements:

01	The duct system design shall be detailed in the special features section of the CF1R-PRF-01-E approved by the enforcement agency.	
02	A duct design layout that conforms to the duct system design details in the special features section of the CF1R-PRF-01-E shall be documented on the building design plans approved by the enforcement agency.	
03	The duct system installation, including duct sizes and locations of supply & return registers shall conform to the duct system design layout approved by the enforcement agency.	
04	The duct system installation shall be verified by a HERS rater according to the requirements in RA3.1.4.1.4.	
05	The duct system installation shall not have severely twisted or compressed sections that would restrict required operating airflow.	
06	Verification Status:	
07	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.		

C. BURIED DUCTS COMPLIANCE CREDIT
Ducts partly or completely buried in blown attic insulation in dwelling units meeting the requirements for verified quality insulation installation may take credit for increased effective duct insulation if the system complies with the following requirements:

01	The duct system design shall be detailed in the special features section of the CF1R-PRF-01-E approved by the enforcement agency.	
02	A duct design layout that conforms to the duct system design details in the special features section of the CF1R-PRF-01-E shall be documented on the building design plans approved by the enforcement agency.	
03	The duct system installation, including duct sizes and locations of supply & return registers shall conform to the duct system design layout approved by the enforcement agency.	
04	The duct system installation shall be verified by a HERS rater according to the requirements in RA3.1.4.1.5.	
05	The duct system installation shall not have severely twisted or compressed sections that would restrict required operating airflow.	
06	The dwelling shall comply with all Quality Insulation Installation requirements as documented on the applicable CF2R and CF3R.	
07	Verification Status:	
08	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.		

CERTIFICATE OF VERIFICATION		CF3R-MCH-29-H
Duct Surface Area Reduction; R-Value; Buried Ducts Compliance Credit		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. DEEPLY BURIED DUCTS COMPLIANCE CREDIT
Duct segments deeply buried in lowered areas of ceiling and covered by at least 3.5 inches of insulation above the top of the duct insulation jacket may claim effective insulation of R-25 for fiberglass insulation and R-31 for cellulose insulation if the system complies with the following requirements:

01	The duct system design shall be detailed in the special features section of the CF1R-PRF-01-E approved by the enforcement agency.	
02	A duct design layout that conforms to the duct system design details in the special features section of the CF1R-PRF-01-E shall be documented on the building design plans approved by the enforcement agency.	
03	The duct system installation, including duct sizes and locations of supply & return registers shall conform to the duct system design layout approved by the enforcement agency.	
04	The duct system installation shall be verified by a HERS rater according to the requirements in RA3.1.4.1.6.	
05	The duct system installation shall not have severely twisted or compressed sections that would restrict required operating airflow.	
06	The dwelling shall comply with all Quality Insulation Installation requirements as documented on the applicable CF2R and CF3R.	
07	Verification Status:	
08	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met.

CERTIFICATE OF VERIFICATION		CF3R-MCH-29-H
Duct Surface Area Reduction; R-Value; Buried Ducts Compliance Credit		(Page 3 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-MCH-29-H User Instructions

SECTION A. DUCT INFORMATION

1. *System Identification or Name:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
2. *System Location or Area Served:* This field is filled out automatically. It is referenced from the CF2R-MCH-23, which must be completed prior to this document.
3. Status – Duct Surface Area Reduction and R-Value Compliance Credit: This field is auto filled from the CF1R indicating if the credit is being used. If not, then N/A will be displayed.
4. Status – Buried Ducts Compliance Credit: This filed is auto filled from the CF1R indicating if the credit is being used. If not, then "N/A" will be displayed.
5. Status – Deeply Buried Ducts Compliance Credit: This field is auto filled from the CF1R indicating if the credit is being used. If not, then "N/A" will be displayed.

B. SUPPLY DUCT SURFACE AREA REDUCTION AND R-VALUE COMPLIANCE CREDIT

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply.
6. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *Supply Duct Surface Area Reduction And R-value Compliance Credit* then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
7. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

C. BURIED DUCTS COMPLIANCE CREDIT

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply.
6. This field must be a true statement (or not applicable) for the system to comply.
7. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *Buried Ducts Compliance Credit* then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
8. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

D. DEEPLY BURIED DUCTS COMPLIANCE CREDIT

1. This field must be a true statement (or not applicable) for the system to comply.
2. This field must be a true statement (or not applicable) for the system to comply.
3. This field must be a true statement (or not applicable) for the system to comply.
4. This field must be a true statement (or not applicable) for the system to comply.
5. This field must be a true statement (or not applicable) for the system to comply.
6. This field must be a true statement (or not applicable) for the system to comply.
7. *Verification Status:* If this Section does not apply, then select "All n/a". If the system meets the criteria for *Deeply Buried Ducts Compliance Credit* then select "Pass", otherwise select "Fail". The latter selection means that the system does not meet the requirements and the CF1R will have to be revised, or the system will need to be modified to meet the requirements.
8. *Correction Notes:* If one or more applicable requirements are not met "Fail" will appear in the row above. When this occurs the rater is required to enter detailed notes here that describe what failed and why.

STATE OF CALIFORNIA

HERS VERIFIED MULTIFAMILY CENTRAL HOT WATER SYSTEM DISTRIBUTION

CEC-CF3R-PLB-21-H (Revised 03/15)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF VERIFICATION		CF3R-PLB-21-H
HERS Verified Multifamily Central Hot Water System Distribution		(Page 1 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. Design HERS Verified Central Water Heating Systems Information

This table reports the water heating system features that were specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type

B. Installed HERS Verified Central Water Heating Systems Information

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type
15	Compliance Statement												

C. Installed Water Heater Manufacturer Information

01	02	03
Water Heating System ID or Name	Manufacturer	Model Number

HERS VERIFIED MULTIFAMILY CENTRAL HOT WATER SYSTEM DISTRIBUTION

CERTIFICATE OF VERIFICATION		CF3R-PLB-21-H
HERS Verified Multifamily Central Hot Water System Distribution		(Page 2 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

D. HERS Verification Requirements for all Central Domestic Hot Water Recirculation Systems		
01	All sections of the recirculation loop, and the first five feet of all branches off the loop are insulated, to the thicknesses required by Table 120.3A, except for the following: (RA4.4.1) • Piping installed in interior or exterior walls that is surrounded on all sides by at least 1inch of insulation. • Piping installed in attics with a minimum of 4 inches (10 cm) of attic insulation on top • Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing. Insulation shall butt securely against all framing members. • Insulation is not required on the cold water line when it is used as the return	
02	Hot water pipes that are buried below grade are installed in a water proof and non-crushable casing or sleeve that allows for installation, removal, and replacement of the enclosed pipe and insulation. (RA4.4.1)	
03	Insulation outside conditioned space is protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind. (RA4.4.1)	
04	Pipe insulation fits tightly to the pipe. (RA4.4.1)	
05	On insulated sections of pipe, no piping is visible due to insulation voids, and all elbows and tees are fully insulated.. (RA4.4.1)	
06	The recirculation pump is mounted on a vertical section of the return line, OR an automatic air release valve is installed on a riser at least 12 inches in length, on the inlet side of the recirculation pump, no more than 4 feet from the pump. (Section 110.3(c)5A).	
07	A check valve is located between the recirculation pump and the water heater. (Section 110.3(c)5B).	
08	A hose bibb is installed between the pump and the water heating equipment with an isolation valve between the hose bibb and the water heating equipment. (Section 110.3(c)5C).	
09	Isolation valves are installed on both sides of the pump. One of the isolation valves may be the same isolation valve as in item 12 above. (Section 110.3(c)5D).	
10	The cold water supply piping and the recirculation loop piping is not connected to the hot water storage tank drain port. (Section 110.3(c)5E).	
11	A check valve is installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply. (Section 110.3(c)5F).	
12	The hot water distribution system piping from the water heater(s) to the fixtures and appliances takes the most direct path. (RA 4.4.7.1)	
13	Installation and operation instructions that provide details of the operation of the pump and controls are available at the jobsite for inspection. (RA 4.4.7.1)	
14	More than one circulation loop may be installed. Each loop shall have its own pump and controls. (RA4.4.8, RA 4.4.9, RA 4.4.10)	
15	Verification Status:	
16	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-PLB-21-H
HERS Verified Multifamily Central Hot Water System Distribution		(Page 3 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

E. Multiple Dwelling Units – Recirculation Temperature Modulation Control Requirements Systems that utilize this distribution type shall comply with these requirements		
01	Controls have been installed that reduce the hot water supply temperature when hot water demand is determined to be low by the control system. The control system may use a fixed control schedule or dynamic control schedules based measurements of hot water demand. (RA4.4.11).	
02	Daily hot water supply temperature reduction (which is defined as the sum of temperature reduction by the control in each hour within a 24-hour period) shall be more than 50 degrees Fahrenheit. (RA4.4.11)	
03	Verification Status:	
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. Multiple Dwelling Units – Recirculation Continuous Monitoring Systems Requirements Systems that utilize this distribution type shall comply with these requirements		
01	The water heating system must have a means of communicating with the remote monitoring facility. (RA4.4.12)	
02	The monitoring system must record no less frequently than hourly measurement of key system operation parameters, including hot water supply and return temperatures, and status of gas valve relays. (RA4.4.12)	
03	A current contract must be available that demonstrate the system will be monitored. (RA4.4.12)	
04	Verification Status:	
05	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

G. Multiple Dwelling Units – Demand Recirculation Requirements Systems that utilize this distribution type shall comply with these requirements		
01	The system operates "on-demand", meaning that the pump begins to operate shortly before or immediately after hot water draw begins, and stops when the return water temperature reaches a certain threshold value. (RA4.4.13)	
02	After the pump has been activated, the controls shall allow the pump to operate until the water temperature at the thermo-sensor rises to one of the following values: (RA4.4.13) • Not more than 10 degrees Fahrenheit (5.6 degrees Celsius) above the initial temperature of the water in the pipe • Not more than 102 degrees Fahrenheit (38.9 degrees Celsius).	
03	The controls shall limit pump operation to a maximum of 10 minutes following any activation. This is provided in the event that the normal means of shutting off the pump have failed. (RA4.4.13)	
04	Pump and control placement shall meet one of the following criteria: (RA4.4.13) • When a dedicated return line has been installed the pump, controls and thermo-sensor are installed at the end of the supply portion of the recirculation loop; or • The pump and controls are installed on the dedicated return line near the water heater and the thermo-sensor is installed in an accessible location as close to the end of the supply portion of the recirculation loop as possible; or • When the cold water line is used as the return, the pump, demand controls and thermo-sensor shall be installed in an accessible location at the end of supply portion of the hot water distribution line (typically under a sink).	
05	Insulation is not required on the cold water line when it is used as the return. (RA4.4.13)	
06	Manual or sensor controls shall be installed and, if powered, each control has standby power of 1 Watt or less. Controls may be located in individual units or on the loop. Controls may be activated by wired or wireless mechanisms, including buttons, motion sensors, door switches and flow switches. (RA4.4.13)	
07	Verification Status:	
08	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

H. Multiple Dwelling Units – Non-demand control Recirculation Systems Requirements Systems that utilize this distribution type shall comply with these requirements		
01	The active control shall be either: timer, temperature, or time and temperature. Timers shall be set to less than 24 hours. The temperature sensor shall be connected to the piping and to the controls for the pump.	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-PLB-21-H
HERS Verified Multifamily Central Hot Water System Distribution		(Page 5 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

I. HERS-Verified Multiple Recirculation Loops for DHW Systems Serving Multiple Dwelling Units Requirements All distribution systems listed on this form shall comply with these requirements		
01	All buildings with 8 or more dwelling units have a **minimum** of 2 recirculation loops.	
02	Each loop roughly serves the same number of dwellings.	
03	Verification Status:	
04	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

J. Determination of HERS Verification Compliance All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.	
01	

CERTIFICATE OF VERIFICATION		CF3R-PLB-21-H
HERS Verified Multifamily Central Hot Water System Distribution		(Page 6 of 6)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:

HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)

HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-PLB-21-H User Instructions

A. Design Central Water Heating Systems Information

This table reports the water heating system features that were specified on the registered CF1R compliance document for this project. For information only and requires no user input.

B. Installed Central Water Heating Systems Information

This table reports the water heating system information that is being installed. Require one line for each central system.

1. Water Heating System ID or Name – Reference information from CF-1R
2. Water Heating System Type – Reference information from CF-1R. The different kinds of water heating system type are DHW or Combined Hydronic
3. Water Heater Type – Information from CF-1R. The different kinds of water heaters are Large Storage, Small Storage, Heat Pump, Boiler, Large Instantaneous, Small Instantaneous or Indirect
4. # of Water Heaters in system – Reference information from CF-1R
5. Water Heater Storage Volume (gal) – User input. Value may be N/A if water heater type is instantaneous with zero storage..
6. Fuel Type – Reference information from CF-1R. The different kinds of fuel types are natural gas, propane, oil, or electricity.
7. Rated Input Type – Reference information from CF-1R. For natural gas, propane and oil fuel type the input type is Btu/Hr. For electric the input type is kW
8. Rated Input Value – User input. Numerical value of the rated input. Must be equal to or less than value indicated on the CF-1R
9. Heating Efficiency Type – Reference information from CF-1R. Different efficiency types are Energy Factor, AFUE, and Thermal Efficiency
10. Heating Efficiency Value – User input. Numerical value of the Heating Efficiency. Must be equal to or higher efficiency than value indicated on the CF-1R
11. Standby Loss – User input. Must be equal to or less than value indicated on the CF-1R. Value may be N/A if CF-1R value is N/A.
12. Exterior Insul. R-Value – User input. Must be equal to or higher than value indicated on the CF-1R. Value may be N/A if CF-1R value is N/A.
13. Central DHW System Distribution Type - Reference information from CF-1R
14. Dwelling Unit DHW System Distribution Type - Reference information from CF-1R

C. Installed Water Heater Manufacturer Information

This table reports the manufacturer information of the installed water heater(s). Require one line for each installed water heater

1. Water Heating System ID or Name – Reference information from CF-1R.
2. Manufacturer – User input. Enter the name of the water heater manufacturer.
3. Model Number – User input. Enter the model number of the water heater.

D. HERS Verification Requirements for all Central Domestic Hot Water Recirculation Systems

This table lists the requirements for all central recirculation systems. HERS rater must ensure all the requirements on this table are met.

E. Multiple Dwelling Units – Recirculation Temperature Modulation Control Requirements

This table only applies to systems indicated in A13 and B13 as **Recirculation Temperature Modulation Control.** In additional the mandatory requirements in Table D, the HERS rater must ensure the requirements on this table are met.

F. Multiple Dwelling Units – Recirculation Continuous Monitoring Systems Requirements
This table only applies to systems indicated in A13 and B13 as **Recirculation Continuous Monitoring Systems.** In additional the mandatory requirements in Table D, the HERS rater must ensure the requirements on this table are met.

G. Multiple Dwelling Units – Demand Recirculation Requirements
This table only applies to systems indicated in A13 and B13 as **Demand Recirculation.** In additional the mandatory requirements in Table D, the HERS rater must ensure the requirements on this table are met.

H. Multiple Dwelling Units – Non-Demand Control Recirculation Systems Requirements
This table only applies to systems indicated in A13 and B13 as **Non-Demand Control Recirculation Systems.** In additional the mandatory requirements in Table D, the HERS rater must ensure the requirements on this table are met.

I. HERS-Verified Multiple Recirculation Loops for DHW Systems Serving Multiple Dwelling Units Requirements
This table applies to all systems identified on this form. This measure requires on site HERS verification that at least two central recirculation loops are included in the system design. This credit is available to buildings with 8 or more units. The recirculation loops must be relatively equal in length and supply approximately the same number of dwelling units.

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		(Page 1 of 7)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

A. General Information

01	Dwelling Unit Name	

B. Design HERS Verified Dwelling Unit Water Heating Systems Information

This table reports the water heating system features that were specified on the registered CF1R compliance document for this project.

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type

C. Installed HERS Verified Dwelling Unit Water Heating Systems Information

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Water Heating System ID or Name	Water Heating System Type	Water Heater Type	# of Water Heaters in system	Water Heater Storage Volume (gal)	Fuel Type	Rated Input Type	Rated Input Value	Heating Efficiency Type	Heating Efficiency Value	Standby Loss (%)	Exterior Insul. R-Value	Central DHW System Distribution Type	Dwelling Unit DHW System Distribution Type
15	Compliance Statement												

D. Installed Water Heater Manufacturer Information

01	02	03
Water Heating System ID or Name	Manufacturer	Model Number

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		
Project Name:	Enforcement Agency:	Permit Number:
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E. Mandatory Measures for all Domestic Hot Water Distribution Systems		
01	The following pipes are insulated, to the thicknesses required by Table 120.3A, except for those sections of pipe that are subject to one of the exceptions below: (RA4.4.1) • The first 5 feet (1.5 meters) of hot and cold water pipes from the storage tank. • All piping with a nominal diameter of 3/4 inch (19 millimeter) or larger. • All piping associated with a domestic hot water recirculation system regardless of the pipe diameter, except when cold water return is used in a demand system. • Piping from the heating source to storage tank or between tanks. • Piping buried below grade. • All hot water pipes from the heating source to the kitchen fixtures. The following sections of pipe do not have to be insulated: (RA4.4.1) • Piping installed in interior or exterior walls that is surrounded on all sides by at least 1 inch of insulation. • Piping installed in attics with a minimum of 4 inches (10 cm) of attic insulation on top • Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing. Insulation shall butt securely against all framing members.	
02	Piping buried below grade must be installed in a water proof and non-crushable casing or sleeve that allows for installation, removal, and replacement of the enclosed pipe and insulation. (Section 150.0(j))	
03	All elbows and tees shall be fully insulated. (RA4.4.1)	
04	Where insulation is required, no piping shall be visible due to insulation voids, and all insulation shall fit tightly to the pipe. (RA4.4.1)	
05	Verification Status:	
06	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

F. HERS-Verified Pipe Insulation Credit Requirements Systems that utilize this distribution type shall comply with these requirements		
01	All hot water piping shall comply with the insulation requirements in Table 120.3-A. (RA 4.4.14)	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION	CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution	(Page 3 of 7)

Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

G. HERS-Verified Parallel Piping Requirements
Systems that utilize this distribution type shall comply with these requirements

01	Each central manifold has 5 feet or less of pipe between manifold and water heater. (RA 4.4.15)	
02	For manifolds that include valves, the manifold must be readily accessible in accordance with the plumbing code. (RA 4.4.4)	
03	Hot water distribution system piping from the manifold to the fixtures and appliances must take the most direct path. For example, piping from a second story manifold cannot supply the first floor. (RA 4.4.4)	
04	The hot water distribution piping must be separated by at least two inches from any other hot water supply piping, and at least six inches from any cold water supply piping. Alternatively, the hot water supply piping must be insulated to the thicknesses shown in TABLE 120.3-A. (RA 4.4.4)	
05	Verification Status:	
06	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

H. HERS-Verified Compact Hot Water Distribution System Requirements
Systems that utilize this distribution type shall comply with these requirements

01	Total Conditioned floor area (square feet)	
02	Maximum allowed pipe run length from the water heater to the furthest point of use For the floor area served (feet).	
03	The pipe run length from each water heater to the furthest fitting served by that water heater must be no greater than the maximum pipe run length above.	
04	Verification Status:	
05	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		(Page 4 of 7)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

I. HERS-Verified Point of Use Requirements Systems that utilize this distribution type shall comply with these requirements		
01	All hot water supply pipe run lengths are equal to or less than the maximum values shown below, based on the pipe diameter. If a combination of piping is used in a single run then one half the allowed length of each size is the maximum installed length. The maximum allowed length of piping for the longest run terminating in: 3/8 inch - For only one pipe size - max length allowed is 15 feet For combination pipe sizes the max allowed length of 3/8 inch piping is 7.5 feet, of ½ inch piping is 5 feet, and ¾ inch piping is 2.5 feet. ½ inch - For only one pipe size – max length allowed is 10 feet For combination pipe sizes the allowed length of ½ inch piping is 5 feet, and ¾ inch piping is 2.5 feet. ¾ inch - For only one pipe size = 5 feet	
02	Verification Status:	
03	Correction Notes:	
The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.		

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		(Page 5 of 7)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

J. HERS-Verified Demand Recirculation Manual Control Requirements
Systems that utilize this distribution type shall comply with these requirements

01	The system operates “on-demand”, meaning that the pump begins to operate shortly before or immediately after hot water draw begins, and stops when the return water temperature reaches a certain threshold value. (RA4.4.13)	
02	After the pump has been activated, the controls shall allow the pump to operate until the water temperature at the thermo-sensor rises to one of the following values: (RA4.4.13) • Not more than 10 degrees Fahrenheit (5.6 degrees Celsius) above the initial temperature of the water in the pipe. • Not more than 102 degrees Fahrenheit (38.9 degrees Celsius).	
03	The controls shall limit pump operation to a maximum of 10 minutes following any activation. This is provided in the event that the normal means of shutting off the pump have failed. (RA4.4.13)	
04	Pump and control placement shall meet one of the following criteria: (RA4.4.13) • When a dedicated return line has been installed the pump, controls and thermo-sensor are installed at the end of the supply portion of the recirculation loop; or • The pump and controls are installed on the dedicated return line near the water heater and the thermo-sensor is installed in an accessible location as close to the end of the supply portion of the recirculation loop as possible; or • When the cold water line is used as the return, the pump, demand controls and thermo-sensor shall be installed in an accessible location at the end of supply portion of the hot water distribution line (typically under a sink).	
05	Insulation is not required on the cold water line when it is used as the return. (RA4.4.13)	
06	Each control shall have standby power of 1 Watt or less. Controls may be located in individual units or on the loop. Controls may be activated by wired or wireless mechanisms, including buttons, motion sensors, door switches and flow switches. (RA4.4.13)	
07	If more than one loop installed each loop shall have its own pump and controls	
08	Automatic Air release valve is installed on the inlet side of the recirculation pump per Section 110.3(c)5A.	
09	A check valve is located between the recirculation pump and the water heater per Section 110.3(c)5B.	
10	Hose bibb is installed between the pump and the water heating equipment with an isolation valve between the hose bibb and the water heating equipment per Section 110.3(c)5C.	
11	Isolation valves are installed on both sides of the pump. One of the isolation valves may be the same isolation valve as in item 10 above per Section 110.3(c)5D.	
12	The cold water supply piping and the recirculation loop piping is not connected to the hot water storage tank drain port per Section 110.3(c)5E.	
13	A check valve is installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply per Section 110.3(c)5F.	
14	Verification Status:	
15	Correction Notes:	

The responsible person’s signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		(Page 6 of 7)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

K. HERS-Verified Demand Recirculation Sensor Control Requirements

Systems that utilize this distribution type shall comply with these requirements

01	The system operates "on-demand", meaning that the pump begins to operate shortly before or immediately after hot water draw begins, and stops when the return water temperature reaches a certain threshold value. (RA4.4.13)	
02	After the pump has been activated, the controls shall allow the pump to operate until the water temperature at the thermo-sensor rises to one of the following values: (RA4.4.13) • Not more than 10 degrees Fahrenheit (5.6 degrees Celsius) above the initial temperature of the water in the pipe. • Not more than 102 degrees Fahrenheit (38.9 degrees Celsius).	
03	The controls shall limit pump operation to a maximum of 10 minutes following any activation. This is provided in the event that the normal means of shutting off the pump have failed. (RA4.4.13)	
04	Pump and control placement shall meet one of the following criteria: (RA4.4.13) • When a dedicated return line has been installed the pump, controls and thermo-sensor are installed at the end of the supply portion of the recirculation loop; or • The pump and controls are installed on the dedicated return line near the water heater and the thermo-sensor is installed in an accessible location as close to the end of the supply portion of the recirculation loop as possible; or • When the cold water line is used as the return, the pump, demand controls and thermo-sensor shall be installed in an accessible location at the end of supply portion of the hot water distribution line (typically under a sink).	
05	Insulation is not required on the cold water line when it is used as the return. (RA4.4.13)	
06	Each control shall have standby power of 1 Watt or less. Controls may be located in individual units or on the loop. Controls may be activated by wired or wireless mechanisms, including buttons, motion sensors, door switches and flow switches. (RA4.4.13)	
07	If more than one loop installed each loop shall have its own pump and controls	
08	Automatic Air release valve is installed on the inlet side of the recirculation pump per Section 110.3(c)5A.	
09	A check valve is located between the recirculation pump and the water heater per Section 110.3(c)5B.	
10	Hose bibb is installed between the pump and the water heating equipment with an isolation valve between the hose bibb and the water heating equipment per Section 110.3(c)5C.	
11	Isolation valves are installed on both sides of the pump. One of the isolation valves may be the same isolation valve as in item 8 above per Section 110.3(c)5D.	
12	The cold water supply piping and the recirculation loop piping is not connected to the hot water storage tank drain port per Section 110.3(c)5E.	
13	A check valve is installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply per Section 110.3(c)5F.	
14	Verification Status:	
15	Correction Notes:	

The responsible person's signature on this compliance document affirms that all applicable requirements in this table have been met unless otherwise noted in the Verification Status and the Corrections Notes in this table.

L. Determination of HERS Verification Compliance

All applicable sections of this document shall indicate compliance with the specified verification protocol requirements in order for this Certificate of Verification as a whole to be determined to be in compliance.

01	

HERS VERIFIED SINGLE DWELLING UNIT HOT WATER SYSTEM DISTRIBUTION

CERTIFICATE OF VERIFICATION		CF3R-PLB-22-H
HERS Verified Single Dwelling Unit Hot Water System Distribution		(Page 7 of 7)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City	Zip Code

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Verification documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Date Signed:
Address:	CEA/HERS Certification Information (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. The installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification identified on this Certificate of Verification comply with the applicable requirements in Reference Appendices RA2, RA3, and the requirements specified on the Certificate of Compliance for the building approved by the enforcement agency.
4. The information reported on applicable sections of the Certificate(s) of Installation (CF2R) signed and submitted by the person(s) responsible for the construction or installation conforms to the requirements specified on the Certificate(s) of Compliance (CF1R) approved by the enforcement agency.
5. I will ensure that a registered copy of this Certificate of Verification shall be posted, or made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a registered copy of this Certificate of Verification is required to be included with the documentation the builder provides to the building owner at occupancy.

BUILDER OR INSTALLER INFORMATION AS SHOWN ON THE CERTIFICATE OF INSTALLATION	
Company Name (Installing Subcontractor, General Contractor, or Builder/Owner):	
Responsible Builder or Installer Name:	CSLB License:
HERS PROVIDER DATA REGISTRY INFORMATION	
Sample Group Number (if applicable):	Dwelling Test Status in Sample Group (if applicable)
HERS RATER INFORMATION	
HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider	Date Signed:

CF3R-PLB-22-H User Instructions

A. Dwelling Unit Name

1. This identifies the dwelling unit on this form and is reference from the CF1R. One form is required for each dwelling unit in the building.

B. Design Central Water Heating Systems Information

This table reports the water heating system features that were specified on the registered CF1R compliance document for this project. For information only and requires no user input.

C. Installed Central Water Heating Systems Information

This table reports the water heating system information that is being installed. Require one line for each central system.

1. Water Heating System ID or Name – Reference information from CF-1R
2. Water Heating System Type – Reference information from CF-1R. The different kinds of water heating system type are DHW or Combined Hydronic
3. Water Heater Type – Information from CF-1R. The different kinds of water heaters are Large Storage, Small Storage, Heat Pump, Boiler, Large Instantaneous, Small Instantaneous or Indirect
4. # of Water Heaters in system – Reference information from CF-1R.
5. Water Heater Storage Volume (gal) – User input. Value may be N/A if water heater type is instantaneous with zero storage..
6. Fuel Type – Reference information from CF-1R. The different kinds of fuel types are natural gas, propane, oil, or electricity.
7. Rated Input Type – Reference information from CF-1R. For natural gas, propane and oil fuel type the input type is Btu/Hr. For electric the input type is kW
8. Rated Input Value – User input. Numerical value of the rated input. Must be equal to or less than value indicated on the CF-1R
9. Heating Efficiency Type – Reference information from CF-1R. Different efficiency types are Energy Factor, AFUE, and Thermal Efficiency
10. Heating Efficiency Value – User input. Numerical value of the Heating Efficiency. Must be equal to or higher efficiency than value indicated on the CF-1R
11. Standby Loss – User input. Must be equal to or less than value indicated on the CF-1R. Value may be N/A if CF-1R value is N/A.
12. Exterior Insul. R-Value – User input. Must be equal to or higher than value indicated on the CF-1R. Value may be N/A if CF-1R value is N/A.
13. Central DHW System Distribution Type - Reference information from CF-1R
14. Dwelling Unit DHW System Distribution Type - Reference information from CF-1R

D. Installed Water Heater Manufacturer Information

This table reports the manufacturer information of the installed water heater(s). Require one line for each installed water heater

1. Water Heating System ID or Name – Reference information from CF-1R.
2. Manufacturer – User input. Enter the name of the water heater manufacturer.
3. Model Number – User input. Enter the model number of the water heater.

E. Mandatory Measures for all Domestic Hot Water Distribution Systems

This table lists the requirements for all central recirculation systems. HERS rater must ensure all the requirements on this table are met.

F. HERS-Verified Pipe Insulation Credit Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Pipe Insulation Credit.** In additional the mandatory requirements in Table E, the HERS rater must ensure the requirements on this table are met.

G. HERS-Verified Parallel Piping Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Parallel Piping.** In additional the mandatory requirements in Table E, the HERS rater must ensure the requirements on this table are met.

H. HERS-Verified Compact Hot Water Distribution System Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Compact Hot Water Distribution System.** In additional the mandatory requirements in Table E, the HERS rater must ensure the distance between the water heater to furthest point of water use does not exceed the maximum indicated in Table H1 below. Calculated the Floor Area Served by dividing the conditioned floor area by the number of installed water heaters (Floor Area Served= CFA/# of WH). In addition all hot water lines shall be insulated.

TABLE H1
Compact Hot Water Distribution System (CHWDS)

Floor Area Served (ft2)	Maximum Measured Water Heater To Use Point Distance (ft)
< 1000	28
1001 – 1600	43
1601 – 2200	53
2201 – 2800	62
>2800	68

I. HERS-Verified Point of Use Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Point of Use.** In additional the mandatory requirements in Table E, the HERS rater must ensure the distance between the water heater to furthest point of water use does not exceed the maximum indicated in Table H1 below. If a combination of piping is used in a single run then one half the allowed length of each size is the maximum installed length. In additional all hot water lines shall be insulated.

TABLE I1
HERS-Verified Point of Use (POU-H)

Size Nominal, Inch	Maximum Measured Water Heater To Use Point Distance Length of Pipe (feet)
3/8”	15
1/2”	10
3/4”	5

J. HERS-Verified Demand Recirculation Manual Control Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Demand Recirculation Manual Control.** In additional the mandatory requirements in Table E, the HERS rater must ensure the requirements on this table are met.

K. HERS-Verified Demand Recirculation Sensor Control Requirements

This table only applies to systems indicated in B14 and C14 as **HERS-Verified Demand Recirculation Sensor Control.** In additional the mandatory requirements in Table E, the i HERS rater must ensure the requirements on this table are met.