Title 24 HERS Certification Training 2016 Guide to HERS Verification of Existing Conditions

CalCERTS, Inc.
HERS PROVIDER

Version: June 12, 2017

Acknowledgements

CalCERTS gratefully acknowledges the authors of these Existing Conditions Procedures Russ King, Michel Fourcroy and Mark Wiese. Additionally, material from California Energy Commission (CEC) publications is included to represent the relevant energy codes.

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Forward

This training manual is designed to convey important information relevant to the day-to-day function of a CalCERTS Certified Home Energy Rating System (HERS) Rater in compliance with Title 20 and Title 24, Part 6 of the *California Code of Regulations*. It draws from a variety of sources to summarize code requirements for HERS verification of existing conditions for the E+A+A compliance approach. These E+A+A procedures are considered an extension of the *CalCERTS New Construction Manual*.

Since you will be the one using this manual, we rely heavily on your feedback to help make this manual as useful and informative as it can be. We value your feedback and will be constantly updating this manual but only with your help.

CalCERTS will make every effort to keep Raters informed about revisions and interpretations of the energy codes and provide updated support material as applicable. Ultimately it is the Rater's responsibility to stay current with building codes, industry best practices or any special rules and regulations for the city, county, or utility program that they are working under.

Contents

E+A+A (Existing+Addition+Alteration) Performance Approach

The performance compliance approach[1] may be applied to alterations and additions to existing buildings, referred to as E+A+A (Existing + Addition + Alteration) projects. Specific to the E+A+A approach, the proposed design may claim compliance credit for efficiency improvements made to existing features (e.g. replacing windows or HVAC equipment) to help the overall building design, including the addition, meet the energy budget.

Designations for building components on the CF1R-PRF-01 for an E+A+A project will be one of the following:

1. "Existing" – building components that will remain unchanged by the alteration/addition (e.g., insulated exterior walls in the existing portion of the home that will not be touched).
2. "Altered" – building components that existed prior to the remodel, but are being changed (e.g., ceiling with insulation that will be added as part of the construction work, or a furnace that is being replaced as part of the construction work).
3. "New" –building components that did not exist prior to the construction work. (e.g., new walls added to create an addition).

In the compliance software, any building feature which is specified as "New" will be compared to a 'Standard' design based on the prescriptive requirements. The standard design for features specified as "Existing" will be set equal to the proposed value (existing condition) with no significant effect on the compliance margin. Those features which are specified as "Altered" will be compared to a standard design based on Table 150.2-C in the Energy Efficiency Standards.

Additional credit for upgrading *existing* features is generated in the compliance software depending on how the "Standard Design" is adjusted for those building features designated as "Altered." The greater the efficiency of the altered building feature relative to the pre-existing feature, the greater the resulting compliance credit. There are two columns in Table 150.2-C.

[1] The performance compliance approach allows a building design to incorporate energy features that do not meet the prescriptive requirements as long as the overall 'Proposed' design is at least as efficient as a 'Standard' Design' based on the prescriptive requirements. As such, the 'Proposed Design' will incorporate some features that are more efficient than prescriptive requirements or claim compliance credits based on 3rd party HERS verification in order to overcome the difference for those features which are less efficient than the prescriptive requirements.

- One column details how the standard design is calculated for altered components when the existing features are not verified by a HERS rater.
- The other column details how the standards design is calculated for altered components when the existing features are verified by a HERS rater prior to construction.

Specifying HERS verification of existing conditions in an E+A+A compliance model is completely optional depending on the amount of compliance credit needed for the project.

The protocols for performing the field verification of existing energy features is discussed at the end of this document.

Obviously, there is an expense associated with hiring a HERS rater for this verification, but it can result in a significant energy credit due to being able to show improvement over original features that are significantly worse than default (non-HERS verified) features.

TABLE 150.2-C STANDARD DESIGN FOR AN ALTERED COMPONENT

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	The U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed U-factor is ≤ 0.40 and SHGC value is ≤ 0.35, the standard design shall be based on the existing U-factor and SHGC values as verified. Otherwise, the standard design shall be based on the U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Table 110.6-A and Table 110.6-B.
Space-Heating and Space-Cooling Equipment	The requirements of TABLE 150.1-A.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Section 150.2(b)1D.	
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.1(b)1 without the solar water heating requirements.	The existing efficiency energy factor.
Roofing Products	The requirements of Section 150.2(b)1H.	
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

Ceiling, wall and raised floor insulation: without HERS verification the proposed R-value is being compared to the minimum mandatory levels (R-22, R-13 and R-19,

respectively). If the existing home has values significantly lower than these, HERS verified existing features will result in a significant credit.

Fenestration: Without HERS verification the proposed windows are being compared to the prescriptive requirements: U-factor of 0.40 and SHGC 0.35. If the existing home has windows significantly worse than these (e.g., dual pane, clear, aluminum frame), HERS verified existing features will result in a significant credit.

Verification of Existing Energy Features – CF3R-EXC-20

Specifying HERS verification of an existing condition in the compliance model will cause a significant change to the process of registering a CF1R. When the XML file (energy calculation file) is uploaded into the registry the resulting CF1R will be "provisional" and include a watermark stating "Not Valid for Compliance." Additionally, the registry will generate a **CF3R-EXC-20** listing the existing features specified in the compliance model which require HERS verification. A HERS rater must visit the building site *prior to the beginning of construction* to document the existing condition of those features. After a HERS rater has verified those features and *submitted* the CF3R-EXC-20 to the registry the watermark will be removed from the CF1R.

In practice, the HERS rater often verifies existing conditions in a building and reports their findings to the energy consultant before the CF1R and CF3R-EXC-20 are created in the registry. The energy consultant uses the rater's information to decide which combination of features to include in the model. The HERS rater may verify/submit the CF2R-EXC-20 without an additional site visit as long as:

1. the resulting CF2R-EXC-20 includes only those features originally inspected and
2. the HERS rater keeps a written/photographic record of their inspections,

In cases where the HERS rater inspects a building before the CF1R and EXC-20 have been generated it will be incumbent on that rater to collect *all pertinent data,* including surface areas, orientation, construction type, etc. To this end both written and photographic records are strongly encouraged.

Case 1 – CF1R is created before rater verifies existing features

1. Energy consultant performs energy calculations and determines that credit needs to be taken for existing features to achieve compliance. (Note: provisional compliance may be achieved based on information provided by homeowner or non-qualified party. Verification by qualified HERS rater is still required.)
2. Energy consultant contacts a qualified HERS rater and asked them to "officially" verify existing features. This may only be one or two features, depending on what it takes to achieve compliance.
3. Energy consultant uploads XML file to CalCERTS registry to generate a provisional CF1R-PRF-01 and CF3R-EXC-20.
4. HERS rater accesses the CF1R-PRF-01 and CF3R-EXC-20 to determine which features need to be field verified.
5. HERS rater visits home and verifies energy features.

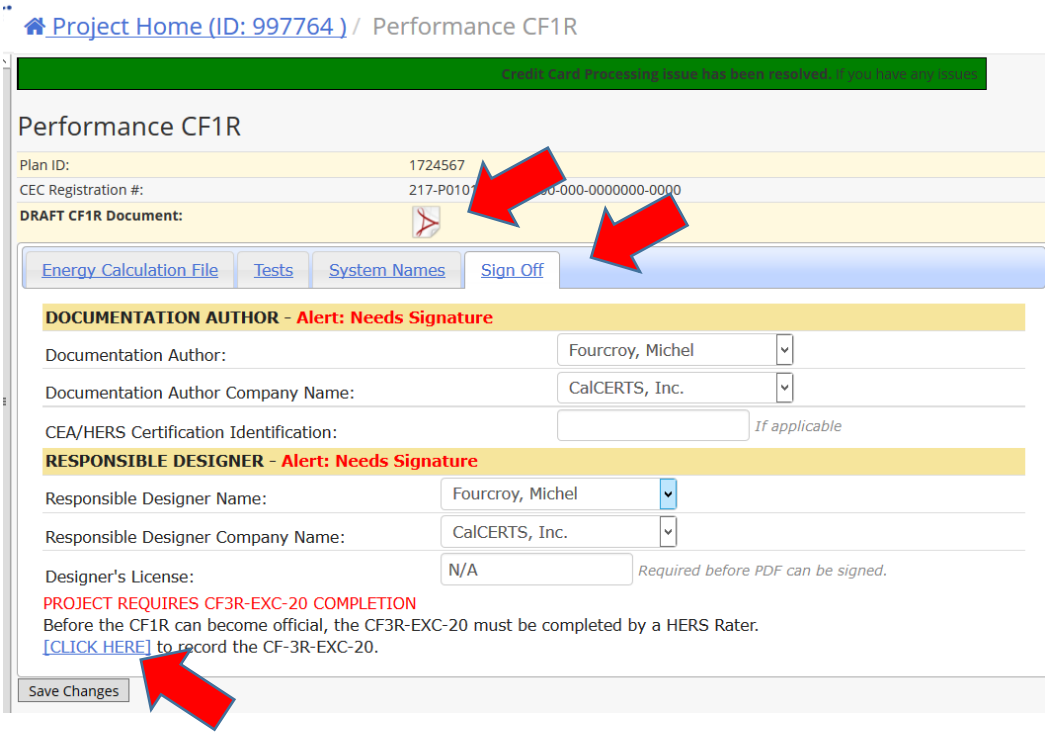
6. HERS rater completes CF3R-EXC-20 and submits to registry. A registered CF1R-PRF-01 is generated.
7. Remainder of process proceeds as usual.

Case 2 – CF1R is created after rater verifies existing features

1. Energy consultant is confident that project will require credit for improving existing features to achieve compliance, contacts a qualified HERS rater and asked them to verify all or most existing features. This may be all or most existing energy features. HERS rater may also be asked to collect/verify additional data to create compliance model, such as opaque surface areas, system type, duct locations, etc.
2. HERS rater visits home and verifies existing energy features.
3. Energy consultant performs energy calculations and takes credit for improving existing features to achieve compliance.
4. Energy consultant uploads XML file to CalCERTS registry to generate a provisional CF1R-PRF-01 and CF3R-EXC-20.
5. HERS rater accesses the CF1R-PRF-01 and CF3R-EXC-20..
6. HERS rater completes CF3R-EXC-20 and submits to registry. A registered CF1R-PRF-01 is generated.
7. Remainder of process proceeds as usual.

Accessing the CF3R-EXC-20:

The HERS rater will need to download a copy of the Draft CF1R by 'clicking' on the PDF icon to supplement information on the EXC-20 (e.g. altered wall surface area). Since the EXC-20 must be submitted before the CF1R is registered, the CF3R icon in the project roadmap will not be active. The rater will access the EXC-20 from a link in the "Sign-Off" tab on the CF1R page. (see image below)



EXC-20: Overview

As the rater verifies the EXC-20 to verify existing conditions, it will at times be necessary to cross reference the draft CF-1R for additional details such as the surface area affected. For example, Section B – Opaque Surfaces (walls, floors, ceilings) in the EXC-20 shown in the first screen shot below includes existing R-value and orientation but does not include the total surface area. Using the name listed on line-01 of the EXC-20, the rater must find that assembly on the CF-1R Opaque Surfaces section.

For example, the first assembly is named "Right: To Remain" and is defined as an existing R-0 wall facing west (270°). From the CF-1R this wall has a total surface area of 405 sq.ft. less 42 sq.ft. of windows and doors. If the actual surface area is significantly different then the verification status should be set to "Fail." Inspection procedures for an exterior wall assembly are found in Appendix A of the HERS Technical Manual (HTM-A), page A-12. Notice that for walls, the procedures provide specific directions with respect to measurement accuracy for determining total surface area. (see next three diagrams)

Right: To Remain		
01	Name:	Right: To Remain
02	Zone:	Existing Home
03	Existing Condition:	R-0 Wall
04	Surface Type:	ExteriorWall
05	Azimuth:	270
06	Orientation:	Right
07	Total Cavity R-value:	R0
08	Verification:	Pass
Existing Roof: Altered		
01	Name:	Existing Roof: Altered
02	Zone:	Existing Home
03	Existing Condition:	R-19 Roof Attic
04	Surface Type:	CeilingBelowAttic
05	Azimuth:	N/A
06	Orientation:	N/A
07	Total Cavity R-value:	R19
08	Verification:	Pass

OPAQUE SURFACES

01	02	03	04	05	06	07	08	09	10
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window & Door Area (ft^2)	Tilt (deg)	Status	Verified Existing Condition
Front: To Remain	Existing Home	R-13 Wall	0	Front	180	70	90	Altered	Yes
Left: To Remain	Existing Home	R-13 Wall	90	Left	135	0	90	Altered	Yes
Left: New	Existing Home	R-15 Wall	90	Left	135	30	90	New	N/A
Rear: To Remain	Existing Home	R-13 Wall	180	Back	135	20	90	Altered	Yes
Right: To Remain	Existing Home	R-13 Wall	270	Right	405	42	90	Altered	Yes
Existing Roof: Altered	Existing Home	R-49 Roof Attic			1050			Altered	Yes
Existing Floor: Remains	Existing Home	R-19 Floor Crawlspace			1050			Altered	Yes
Front	New Addition	R-15 Wall	0	Front	54	0	90	New	N/A
Left	New Addition	R-19 Wall w/1 XPS	270	Right	135	20	90	New	N/A
Rear	New Addition	R-19 Wall w/1 XPS	180	Back	135	20	90	New	N/A
New Roof	New Addition	R-49 Roof Attic			225			New	N/A

Determine surface area of all walls exposed to unconditioned space	Measure linear perimeter of the walls to the nearest ½ foot. Measure the interior wall height of the walls to the nearest 1/4 foot. Use these measurements to calculate surface area. Exclude surface area of any windows (including the window frame) when making the wall area measurement.

Inspection Protocols

Introduction

This document presents those features which may require HERS verification of existing conditions and follows the order that they would appear on the associated CF3R-EXC-20. For each feature an image from the CalCERTS registry of a sample E+A+A project is provided with explanations of the HERS verification procedures for existing conditions. The verification protocols presented are based on the HERS Technical Manual, Appendix-A (CEC-400-2008-012) which can be downloaded from the CEC.

- EXC-20 Section A – General Information
- EXC-20 Section B - Opaque Surfaces (exterior walls):
- EXC-20 Section B - Opaque Surfaces (ceiling):
- EXC-20 Section B - Opaque Surfaces (raised floors):
- EXC-20 Section C: Attic Ceiling/Roof Assemblies:
- EXC-20 Section D - Windows:
- EXC-20 Section E – Doors:
- EXC-20 Section F - Overhangs & Side-Fins:
- EXC-20 Section G - DHW Water Heater:
- EXC-20 Section H - DHW Distribution:
- EXC-20 Section I - HVAC Heating:
- EXC-20 Section J - HVAC Cooling:
- EXC-20 Section K - HVAC Distribution:

The primary purpose of an existing conditions verification is to confirm that the compliance model did not gain compliance credit by exaggerating the in-efficiency of the existing condition. If the existing condition is more efficient than that claimed in the compliance model then the verification fails! For example, if the model claims single-pane windows but in fact there are double-pane windows then the verification fails.

Default Values

In some cases it will not be possible to determine the exact efficiency level of older building components such as windows or mechanical equipment. In these cases the inspection procedures reference specific "Default" or "Vintage" tables based on a generic description of that features (e.g., dual pane, non-metal, clear) and/or the age of the feature.

- Tables 110.6-A and B from the 2016 Energy Efficiency Standards provide default values for window U-factor and SHGC. These tables are included in the section on windows below.

- Table 8-1 from the Residential Compliance Manual provides default values for mechanical equipment based on the manufacture date of that equipment. Relevant excerpts of Table 8-1 are included in applicable sections for HVAC and DHW equipment.

Before using default values, the HERS rater should try to look up existing equipment by conducting an internet search of the appliance model number. If there is any doubt about the efficiency level of an existing feature the HERS rater should error on the conservative side by assuming a *more* efficient feature.

EXC-20 Section A – General Information

Section A of the CF3R-EXC-20, shown in the screen shot below, summarizes project information. No HERS verified features are reported in this section. Accuracy of information will be confirmed by local building department during plan-check at the time of permit application. If the rater notes any obvious discrepancies they should report them to the energy consultant who prepared the compliance model so that it may be corrected before submission with the permit application. Substantial changes, such as the wrong climate zone, could affect the energy features required for compliance in which case the rater would have to wait for a revised CF1R before submitting the CF3R-EXC-20.

A. GENERAL INFORMATION		
01	Project Name:	Fourcroy 2016 EAA example
02	Calculation Description	Title 24 Analysis
03	Project Location:	31 Natoma
04	CA City:	Folsom
05	Standard Version:	Compliance2017
06	Zip code:	95630
07	Compliance Manager Version:	BEMCmpMgr 2016.2.1 (695)
08	Climate Zone:	12
09	Software Version	EnergyPro 7.1
10	Building Type:	Single Family
11	Building Front Orientation (deg):	0
12	Project Scope	Addition and/or Alteration
13	Number of Dwelling Units:	1
14	Total Conditioned Floor Area (ft^2):	1455
15	Number of Zones:	2
16	Slab Area (ft^2):	225
17	Number of Stories in Building	1
18	Addition Conditioned Floor Area (ft^2):	405
19	Natural Gas Available? (Yes/No):	Yes
20	Addition Slab Area (ft^2):	225
21	Glazing Percentage (%):	13

EXC-20 Section B - Opaque Surfaces (exterior walls):

Opaque surfaces include walls, ceilings and floors. Specific to opaque surfaces, the rater will need to refer to the Draft CF1R in order to determine the affected surface area (sq.ft.). The first screen shot below of a CF3R-EXC-20 section of the registry shows a sample existing conditions verification for an exterior wall. Following is a brief description of each field and its correlation to the draft CF1R and a screen-shot from the associated draft CF1R Opaque Surfaces section for comparison.

B. Opaque Surfaces		
Front: To Remain		
01	Name:	Front: To Remain
02	Zone:	Existing Home
03	Existing Condition:	R-0 Wall
04	Surface Type:	ExteriorWall
05	Azimuth:	0
06	Orientation:	Front
07	Total Cavity R-value:	R0
08	Verification:	Pass

- Name - User defined field in the compliance model. Text field only – does not affect compliance. (i.e., just because a surface is named R-13 wall, doesn't mean that is how it is modeled. Must also verify line 7. Use this name to identify assembly on the Draft CF-1R (example below), Opaque Surfaces section in order to determine the affected surface area (sq.ft.)
- Zone - Defined by the 'building tree' in the compliance model and reflected on the Draft CF-1R. For E+A+A verifications, zone should identify the existing structure, not the intended addition.
- Existing Conditions – User defined name in the compliance model for the assembly which represents the existing condition. This assembly is not reflected on the CF-1R.
- Surface Type – Exterior Wall, Raised Floor, Floor Over Crawlspace, Ceiling Below Attic
- Azimuth – compass direction (0° - north, 90° - east, 180° - south, 270° - west), applies to walls only.
- Orientation – as seen looking at the front of the house (front, right, back, left), applies to walls only.
- Total Cavity R-value - Value suggested in compliance model, to be verified by HERS rater (existing condition should be less than or equal to reported value).
- Verification – Status: Pass/Fail: In addition to verifying the "Total Cavity R-value" the HERS rater should confirm that the azimuth and surface area

(from CF1R Opaque Surfaces section) reflect the existing condition of the building.

DRAFT CF1R - Opaque Surfaces section:

OPAQUE SURFACES									
01	02	03	04	05	06	07	08	09	10
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft^2)	Window & Door Area (ft^2)	Tilt (deg)	Status	Verified Existing Condition
Front: To Remain	Existing Home	R-13 Wall	0	Front	180	70	90	Altered	Yes
Left: To Remain	Existing Home	R-13 Wall	90	Left	135	0	90	Altered	Yes
Left: New	Existing Home	R-15 Wall	90	Left	135	30	90	New	N/A
Rear: To Remain	Existing Home	R-13 Wall	180	Back	135	20	90	Altered	Yes
Right: To Remain	Existing Home	R-13 Wall	270	Right	405	42	90	Altered	Yes
Existing Roof: Altered	Existing Home	R-49 Roof Attic			1050			Altered	Yes
Existing Floor: Remains	Existing Home	R-19 Floor Crawlspace			1050			Altered	Yes
Front	New Addition	R-15 Wall	0	Front	54	0	90	New	N/A
Left	New Addition	R-19 Wall w/1 XPS	270	Right	135	20	90	New	N/A
Rear	New Addition	R-19 Wall w/1 XPS	180	Back	135	20	90	New	N/A
New Roof	New Addition	R-49 Roof Attic			225			New	N/A

Exterior Walls

Azimuth/Orientation

Using a compass adjusted magnetic deviation (cell phone app's available) confirm that the wall is within ±22.5° of the value reported on the EXC-20.

Surface Area

Confirm that surface area on CF1R Opaque Surfaces does not exceed the existing wall area to be verified. Measure the exterior length of the wall to the nearest ½ foot and the interior wall height to the nearest ¼ foot to calculate the surface area.

Cavity Insulation

To gain access into a framed wall assembly to verify the existing cavity insulation, or absence of insulation, the rater may be able to exploit one of the following locations (presented from most to least favorable). Probe the cavity around the exposed plate with a non-metal device such as a plastic crochet hook or wooden skewer. Determine the type of insulation (fiberglass, cellulose, foam, etc.) or absence of insulation.

- Plumbing penetrations may have a sufficient gap between the drywall to inspect inside the wall cavity.
- Low voltage outlet plates for cable (TV/Internet). Often times these are mounted to a 'frame', not a j-box, and will allow direct access into the wall cavity after the plate is removed.
- Line voltage outlet plates (plug receptacles and light switches).

When existing conditions verification of a wall cavity is triggered, in most cases it will be an un-insulated cavity which can be easily confirmed at some of the

locations suggested above. However, during major renovations of a home, it may be necessary to verify existing insulation in a wall cavity which would require more invasive inspection techniques (e.g. cutting inspection holes in the drywall) that would require permission from the property owner.

R-value table for all opaque surfaces

- R-3.85/inch for fiberglass blankets or batts,
- R-3.85/inch loose fill fiberglass
- R-3.41/inch for loose-fill cellulose,
- R-2.13/inch for vermiculite,

BPI Standards for existing insulation:

Typical Insulation R-values

Insulation Type	R-value per inch	Typical Applications
Cellulose, loose fill	3.7	Attic Floor
Cellulose, high density	3.2	Walls, Enclosed Cavities, Framing Transitions
Fiberglass, batts	3.0*	Basement Ceiling, Open Stud Walls, Attic Floor*
Fiberglass, loose fill	2.8	Attic Floor, Walls (existing)
Fiberglass, loose fill, fluffed below manufacturer's standards	uncertain	Do not install, or correct by blowing over with higher density
Rockwool	3.0	Attic Floor, Walls, Basement Ceiling (may be loose or batts)
Vermiculite	2.7	Attic Floor
Poly-isocyanurate, rigid board	7.0	Foundation Walls, Attic Access Doors
Polystyrene, expanded rigid board	4.0	Foundation Walls, Sill Plate
Polystyrene, extruded rigid board	5.0	Foundation Walls, Sub-Slab, Sill Plate
Low Density Urethane, sprayed foam	3.7	Attics, Walls (new construction); Sill Plate, Band Joist, Framing Transitions
Urethane, sprayed foam	6.0	Attics, Walls (new construction); Sill Plate, Band Joist, Framing Transitions
Urea Formaldehyde Foam	4.0	Attics, Walls (existing)

EXC-20 Section B - Opaque Surfaces (ceiling):

Roof/Attic – Ceiling Framing Assembly

Existing Roof: Altered		
01	Name:	Existing Roof: Altered
02	Zone:	Existing Home
03	Existing Condition:	R-19 Roof Attic
04	Surface Type:	CeilingBelowAttic
05	Azimuth:	N/A
06	Orientation:	N/A
07	Total Cavity R-value:	R19
08	Verification:	Pass

Surface Area

If the surface area modeled on CF1R Opaque Surfaces section exceeds the existing ceiling area to be verified then the verification fails. The model must be revised to accurately reflect the actual ceiling area. Measure the interior dimensions of the ceiling to the nearest ½ foot to calculate the surface area. Be sure to account for the additional surface area presented by a vaulted ceiling.

Cavity Insulation

To determine the insulation R-value which exists in the ceiling area (cavity) measure the depth of insulation in four places and take the average; if the depth in one section of the attic is different by 2 inches or more, for existing conditions verifications use the *largest* value (higher values for existing conditions result in less compliance credit for improving them). Determine the type of insulation present (may be a combination of more than one type); multiply the depth by the R-value per inch as follows:

R-value table for all opaque surfaces

- R-3.85/inch for fiberglass blankets or batts,
- R-3.85/inch loose fill fiberglass
- R-3.41/inch for loose-fill cellulose,
- R-2.13/inch for vermiculite,

EXC-20 Section B - Opaque Surfaces (raised floors):

Raised Floors (over crawlspace or other unconditioned zones)

Existing Floor: Remains		
01	Name:	Existing Floor: Remains
02	Zone:	Existing Home
03	Existing Condition:	R-0 Floor Crawlspace
04	Surface Type:	FloorOverCrawlspace
05	Azimuth:	N/A
06	Orientation:	N/A
07	Total Cavity R-value:	R0
08	Verification:	Pass

Surface Area

Confirm that surface area on CF1R Opaque Surfaces does not exceed the existing floor area to be verified. Measure the Interior dimensions of the floor to the nearest ½ foot to calculate the surface area.

Cavity Insulation

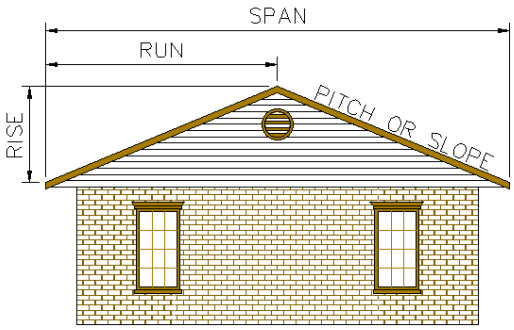
To determine the insulation R-value which exists in the floor area (cavity) measure the thickness of insulation in four places and take the average; if the thickness in one section of the floor is different by 2 inches or more, for existing conditions verifications use the largest value. Determine the type of insulation present (may be a combination of more than one type); multiply the depth by the R-value per inch as follows:

R-value table for all opaque surfaces

- R-3.85/inch for fiberglass blankets or batts,
- R-3.85/inch loose fill fiberglass
- R-3.41/inch for loose-fill cellulose,
- R-2.13/inch for vermiculite,

EXC-20 Section C: Attic Ceiling/Roof Assemblies:

C. Attic		
Attic Existing Home		
01	Name:	Attic Existing Home
02	Construction:	Attic RoofExExisting Home
03	Roof Rise:	4
04	Roof Reflectance:	0.1
05	Roof Emittance:	0.85
06	Radiant Barrier:	No
07	Cool Roof:	Yes
08	Verification:	Pass



Roof Rise (pitch)

Roof pitch is defined as the rise in vertical height divided by the run of horizontal distance of the roof surface. Typically expressed as a ratio over 12' (e.g. 3/12, 4/12, etc.). As shown in screen-shot above a roof rise of "4" represents a 4/12 roof.

Reflectance/Emittance

For existing homes the solar reflectance is assumed to be one of the default values unless it is measured per test methods listed in the HERS Technical Manual, Appendix A. For asphalt/composition shingles the default solar reflectance is 0.08. For all other roofing materials it is 0.10. The default emittance for all materials except unpainted metal roofing is 0.85.

- Reflectance values listed on the EXC-20 must be greater than or equal to the default value.
- Emittance values listed on the EXC-20 must be less than or equal to the default value.

Radiant Barrier (yes/no)

Not common on existing homes, but can be added as an upgrade. Radiant barrier can be identified by a shiny metallic coating on the attic side of the roof sheeting. It can either be installed as an integral part of the roof decking or retrofitted as a separate sheeting installed between the framing members.

EXC-20 Section D - Windows:

D. Windows E2/F2/G2: Replacements		
01	Name:	E2/F2/G2: Replacements
02	Azimuth:	270
03	Multiplier:	1
04	Area (ft^2)	42
05	U-factor:	1.04
06	SHGC:	0.76
07	Exterior Shading:	StandardBugScreen
08	Verification:	Pass

Azimuth/Orientation

Using a compass adjusted magnetic deviation (cell phone app's available) confirm that the window is within ±22.5° of the value reported on the EXC-20.

Area

Confirm that area listed on the EXC-20 is less than or equal to the existing windows to be replaced.

- Window dimensions are based on the rough opening of the window, NOT the glass or frame dimensions, and will usually be 1"-2" larger than the interior finished opening.

U-factor/SHGC

For existing homes without labeled windows, use default U-Factor/SHGC values found in Tables 110.6-A/B at the end of this section. Default tables are based on frame material, window type and the number of panes.

Frame material:

- Metal
- Metal thermal break
- Non-metal

Open the window and examine it to see whether the frame is made of metal, wood, or vinyl. Tap the frame with fingernail or knuckle to test if it's vinyl or metal. If the window is dual-pane or multiple-pane and is metal framed, determine if a thermal break is present by looking for two separated metal extrusions connected by a non-metallic (plastic, wood, or rubber) spacer.

Window Type:

- Operable
- Fixed

- Greenhouse/Garden window
- Skylight
- Door

Number of Panes: Panes are the layers of glass that give a window its thickness, not how many panels it has. Look at where the glass meets the frame to see if it is single pane, double pane, or triple pane (rare). Multiple pane windows will have air spaces between the panes, which improves the U-factor.

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-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

EXC-20 Section E – Doors:

E. Doors		
Entry Door		
01	Name:	Entry Door
02	Azimuth:	0
03	Area (ft^2):	20
04	U-factor:	0.5
05	Verification:	Pass
HERS RESULTS		
Verification Status:	Pass	

Azimuth/Orientation – Using a compass adjusted magnetic deviation (cell phone app's available) confirm that the door is within ±22.5° of the value reported on the EXC-20.

Area – Confirm that area listed on the EXC-20 is less than or equal to the existing doors to be replaced.

U-factor

Choices found in the software are:

- Metal – uninsulated
- Metal - insulated
- Solid wood

Choose a default U-factor from Table 4.5.1, below.

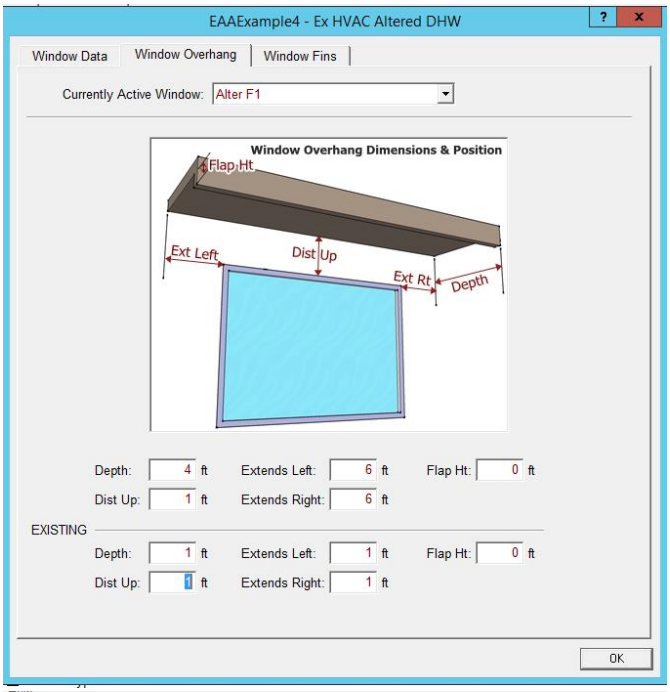
Table 4.5.1 – Doors

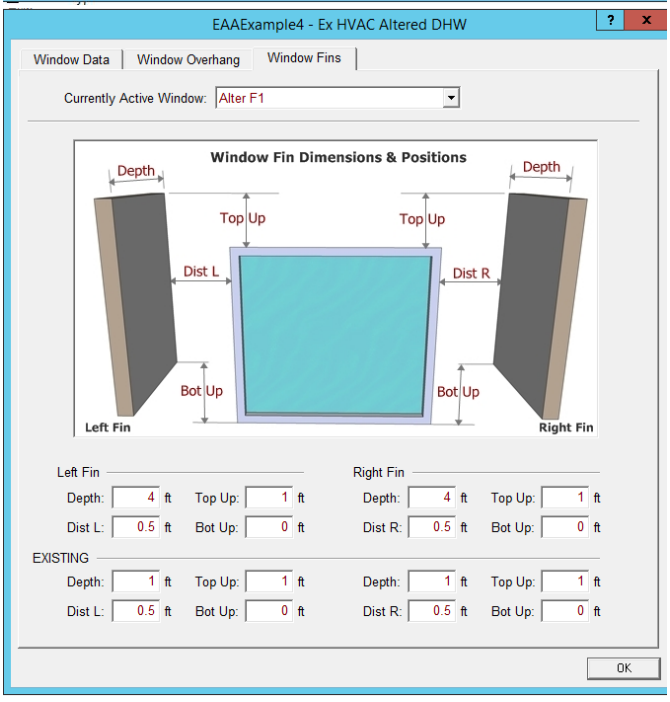
Description		U-factor (Btu/°F-ft²)
		A
Uninsulated single-layer metal *swinging doors* or *non-swinging doors*, including single-layer uninsulated access hatches and uninsulated smoke vents:	1	1.45
Uninsulated double-layer metal *swinging doors* or *non-swinging doors*, including double-layer uninsulated access hatches and uninsulated smoke vents:	2	0.70
Insulated metal *swinging doors*, including fire-rated *doors*, insulated access hatches, and insulated smoke vents:	3	0.50
Wood *doors*, minimum nominal thickness of 1-3/4 in. (44 mm), including panel *doors* with minimum panel thickness of 1-1/8 in. (28 mm), and solid core flush *doors*, and hollow core flush *doors*:	4	0.50
Any other wood *door*:	5	0.60
Uninsulated single layer metal *roll up doors* including fire rated *door*	6	1.45
Insulated single layer metal *sectional doors*, minimum insulation nominal thickness of 1-3/8 inch; expanded polystyrene (R-4 per inch).	7	0.179
Source: ASHRAE 90.1-2007, Section A7.		

Note: If a door contains more than 50% glass, then it may be counted as a window in the compliance model.

EXC-20 Section F - Overhangs & Side-Fins:

CBECC-res model – window, overhang and sidefin specification:





CF3R-EXC-20:

F. Overhangs & Fins Alter F1		
01	Window:	Alter F1
02	Overhang Depth:	1
03	Overhang Dist. Up:	1
04	Overhang Left Ext.:	1
05	Overhang Right Ext.:	1
06	Overhang Flap Ht:	0
07	Left Fin Depth:	1
08	Left Fin Top Up:	1
09	Left Fin Dist (Left):	0.5
10	Left Fin Bottom Up:	0
11	Right Fin Depth:	1
12	Right Fin Top Up:	1
13	Right Fin Dist (Right):	0.5
14	Right Fin Depth:	0
15	Verification:	Pass

Note: Verifying existing overhangs is only necessary if an overhang is going to be added to or extended on an existing window.

EXC-20 Section G - DHW Water Heater:

G. Water Heaters DHW Heater 2		
01	Name:	DHW Heater 2
02	Heater Element Type:	NaturalGas
03	Tank Type:	StorageSmall
04	Tank Volume (gal):	50
05	Energy Factor or Efficiency:	0.6 EF
06	Input Rating:	40000
07	Tank Exterior Insulation R-value:	0
08	Standby Loss (Fraction):	0
09	Verification:	Pass

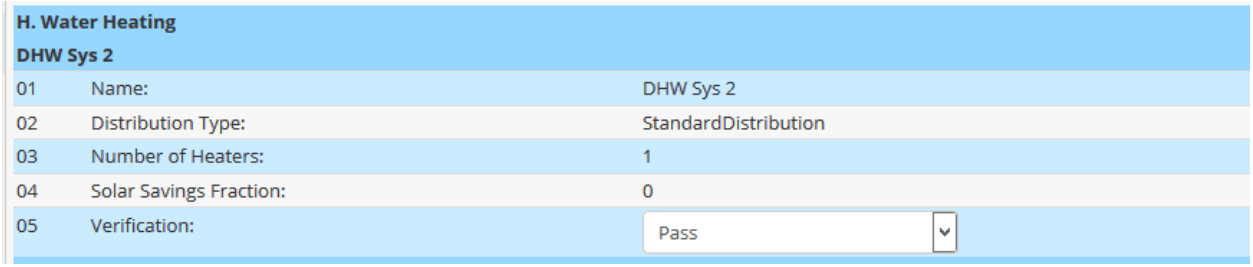
Verify the following features of the existing water heater. You will need to provide some specific evidence for the values verified (manufacturer's nameplate or specifications).

- Type (gas/electric)
- Storage or tankless, Volume
- EF (energy factor)
- Input rating
- Exterior insulation
- Standby loss

If the nameplate does not provide sufficient information try an internet search of the appliance model number. Otherwise, using the manufacture date of the appliance, choose default values based on Vintage Table 8-1 from the 2016 Residential Compliance Manual:

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 to 2000	2001 to 2003	2004 to 2005	2006 to 2013	2014 to 2016
WATER HEATING									
Energy Factor	0.525	0.525	0.525	0.525	0.575	0.575	0.575	0.575	0.575

EXC-20 Section H - DHW Distribution:



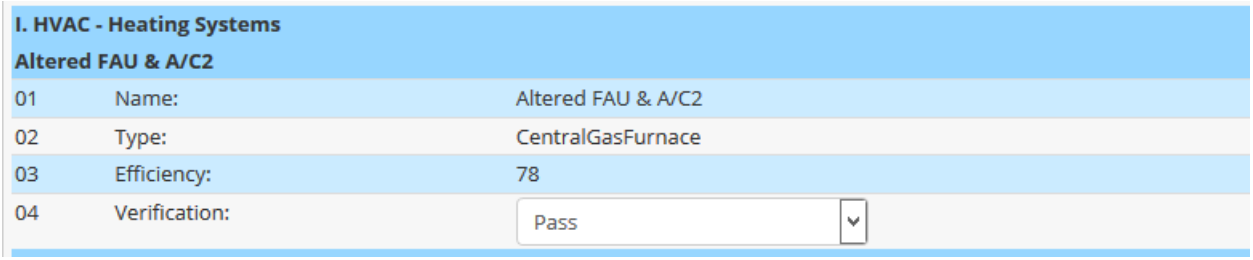
H. Water Heating DHW Sys 2		
01	Name:	DHW Sys 2
02	Distribution Type:	StandardDistribution
03	Number of Heaters:	1
04	Solar Savings Fraction:	0
05	Verification:	Pass

Distribution Type

For anything other than regular copper pipe with minimal insulation (StandardDistribution) see the HERS Technical Manual Appendix A, page A-23 for more detail.

- Other distribution types described in the CalCERTS New Construction training manual.

EXC-20 Section I - HVAC Heating:



I. HVAC - Heating Systems Altered FAU & A/C2		
01	Name:	Altered FAU & A/C2
02	Type:	CentralGasFurnace
03	Efficiency:	78
04	Verification:	Pass

Heating System Type:

Gas furnace

- Central – These can be either split or package units. They will be ducted and have supply registers (grilles) in multiple rooms. This is the most common type of system in homes less than 30 years old.
- Gravity, wall – This is an older style furnace that is wall mounted. It has no ducts and only heats the room that it is located in. Other rooms must be heated by air circulation between the rooms. It has no fan. Heat is circulated purely by natural convection.
- Fan, wall – Similar to a gravity wall furnace but this type has an electric fan to circulate air rather than relying on natural convection.
- Floor – typically only found in older homes this is similar to a wall furnace but it is located in the floor. There are no ducts, heat is circulated by natural convection.

Electric resistance

- May be in the form of baseboards, wall furnaces, or central air handlers. Heat is generated by elements (wires) that get very hot when a high electric current is passed through them. They usually hum or buzz when turned on.

Heat pump

- Essentially an air conditioner that runs backwards in the winter. It can be a split system or package unit, ducted or un-ducted. May be distinguished from a gas furnace by the absence of a fuel source (other than electricity) and the absence of a flue pipe for combustion exhaust.

Heating System Efficiency:

Record the make and model number from the appliance nameplate and review the CEC appliance directory or historical GAMA product directories to determine the efficiency.

- AFUE is used to measure the efficiency of furnaces and boilers.

- HSPF is used to measure the heating performance of heat pumps.

If a certificate supporting the modeled existing efficiency is not available then try an internet search of the appliance model number. Otherwise, using the manufacture date of the appliance and choose default values based on Vintage Table 8-1 from the 2016 Residential Compliance Manual:

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 to 2000	2001 to 2003	2004 to 2005	2006 to 2013	2014 to 2016
SPACE HEATING EFFICIENCY									
Gas Furnace (Central) AFUE	0.75	0.78	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	0.65
Hydronic/Comb Hydronic	0.78	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	7.7
Electric Resistance HSPF	3.413	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	3.413

EXC-20 Section J - HVAC Cooling:

J. HVAC - Cooling Systems Altered FAU & A/C2		
01	Name:	Altered FAU & A/C2
02	System Type:	CentralSplitAC
03	EER:	8
04	SEER:	10
05	Verification:	Pass

Efficiency - EER / SEER:

Record the make and model numbers for the existing condenser (outdoor unit) and evaporator coil (indoor unit). Search the AHRI or CEC appliance directories for published efficiencies. If a certificate supporting the modeled existing efficiency is not available then try an internet search of the appliance model number. Otherwise, using the manufacture date of the appliance and choose default values based on Vintage Table 8-1 from the 2016 Residential Compliance Manual:

Note: if a certificate documenting the existing EER value cannot be found on the AHRI or CEC directories, then existing EER value cannot be verified and may not be claimed as a verified existing condition.

Conservation Measure		Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 to 2000	2001 to 2003	2004 to 2005	2006 to 2013	2014 to 2016
SPACE COOLING EFFICIENCY										
All Types,	SEER	8.0	8.0	8.9	9.7	9.7	9.7	9.7	13.0	13.0

EXC-20 Section K - HVAC Distribution:

K. HVAC Distribution Air Distribution System 2		
01	Name:	Air Distribution System 2
02	Duct R-Value:	2.1
03	Supply Duct Location:	UnconditionedAttic
04	Return Duct Location:	UnconditionedAttic
05	Verification:	Pass

Note: Assumes an existing ducted HVAC system since credit would not be appropriate for adding a duct system where none previously existed.

Duct R-Value:

Inspect existing ducting for R-value labeling. If the insulation level is not marked, with the R-value, measure thickness of insulation and multiply thickness of insulation times the R-value per inch for fiberglass (fiberglass: R-3.85/inch) or use default tables based on the age of the duct system.

Conservation Measure	Before 1978	1978 to 1983	1984 to 1991	1992 to 1998	1999 to 2000	2001 to 2003	2004 to 2005	2006 to 2013	2014 to 2016
Ducts	R-2.1	R-2.1	R-2.1	R-4.2	R-4.2	R-4.2	R-4.2	Pkg. A	Pkg. A

Duct location:

- Ducts Attic
  - Unconditioned - ducts located in a vented attic with insulation at the ceiling (common).
  - Indirectly Conditioned - ducts located in an unvented attic with insulation at the roof deck.
- Ducts Garage – ducts are located in an unconditioned garage
- Ducts Outdoor - all or most of the ducts are location outside of the home, such as on the roof and/or along the side of the building (rare)
- Ducts Crawl – ducts are located within an unconditioned crawlspace of a raised floor home.
- Ducts In All - ducts are located entirely within conditioned space (rare, except in some apartments)

