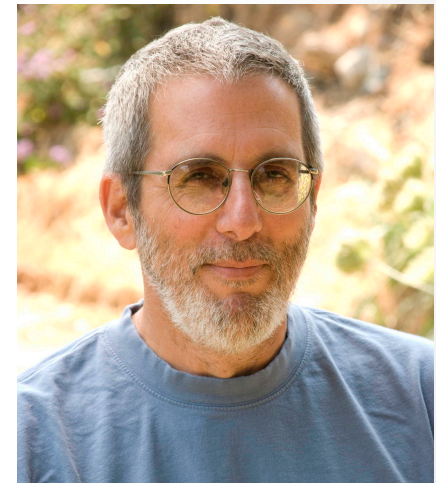


Energy Consultants and HERS Raters

Steve Mann, Home Energy Services

Res CEA, Non-Res CEPE, HERS Rater
CalCERTS QA Rater/Certified Instructor, LEED AP+ Homes
Certified Passive House Consultant and Builder



2014 CABEC Conference

Energy Consultants and HERS Raters

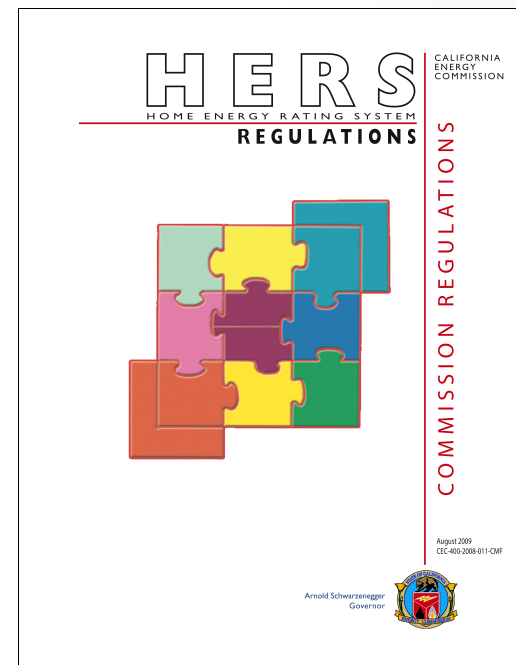
- Background/Terminology
- Project Life Cycle
- HERS FV/DT Verifications
- Issues/Opportunities

Why is This Important?

- **2013 Code Complexity**
 - More mandatory HERS measures
 - More stringent code = more HERS verifications required to comply
- **Success requires:**
 - Coordination, collaboration, communication (early and often!)
 - Energy consultant, builder, HERS rater
- **Primarily residential projects**

Where'd They Come From?

- **HERS Raters/Providers roles and responsibilities are defined in *HERS Regulations***
- **Title 20, Chapter 4, Article 8, Sections 1670-1675**
- **CEC-400-2008-011-CMF**
- **Compliance Raters and Whole House Raters**



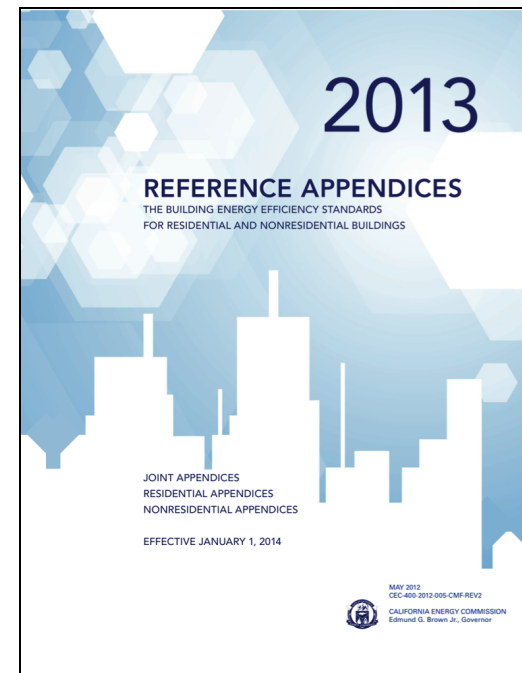
Compliance Rater

- Field verification and diagnostic testing (FV/DT)
- Specific energy efficiency measures
- Specific, clearly-defined protocols
- Mandatory: duct testing, ventilation verification
- Optional categories: ducts, AC, insulation, infiltration, hot water
- HERS raters are special building inspectors



Where'd They Come From?

- Compliance Rater procedures and protocols are defined in the **2013 Reference Appendices: RA1-RA3**
- **CEC-400-2012-005-CMF-REV2**



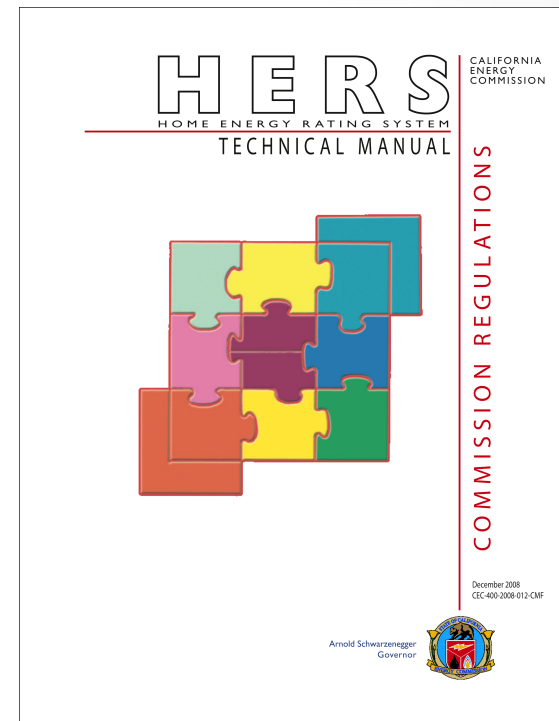
Whole House Rater

- Compliance rater with additional training for whole building analysis and modeling
- Required for some special programs
 - Energy efficient mortgages
 - Energy Upgrade California Raters
- E+A+A performance modeling may involve verification of existing conditions by a Whole House Rater



Where'd They Come From?

- Whole House Rater protocols and processes are define in CEC-400-2008-011-CMF and *HERS Technical Manual*
- CEC-400-2008-012-CMF



Above-code Program Inspections

- Above-code programs may require non-FV/DT inspections
- Program, not Title 24 requirements
 - California Advanced Homes Program (CAHP)
 - New Solar Homes Partnership (NSHP)
 - Energy Star
 - Zero Energy Ready (Challenge Home)
- These inspections must be done by a HERS Compliance Rater that may have additional training



The Registry

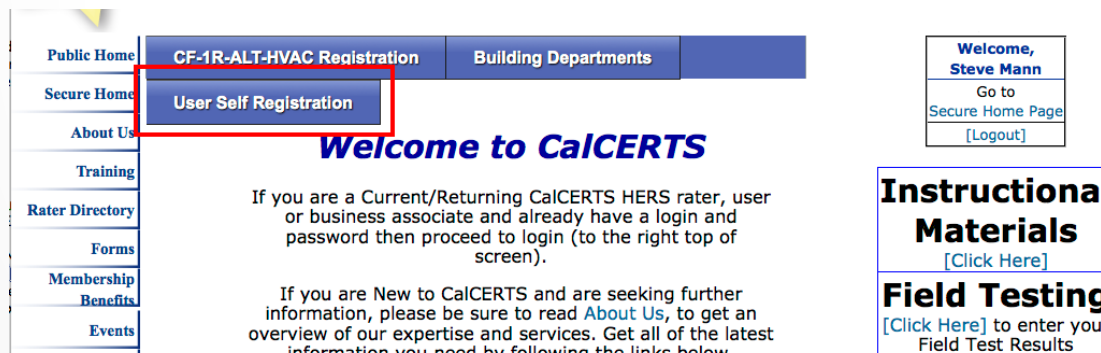
- An online database of building projects
- It contains all projects that require FV/DT by a Compliance Rater
 - The prescriptive or performance requirements (CF-1R)
 - Installer and HERS Rater inspection results
- The registry also contains:
 - E+A+A projects that require verification of existing features*
 - HERS inspections for above-code and incentive programs*
 - Selected non-FV/DT data from builders/installers

*With or without HERS FV/DT



Registry Access

- Various stakeholders need registry access
 - Sign project documents, enter inspection results
 - Builder, energy consultant, installer, architect, homeowner
- Registry users can self-register for an account



The screenshot displays the CalCERTS website interface. On the left is a vertical navigation menu with links: Public Home, Secure Home, About Us, Training, Rater Directory, Forms, Membership Benefits, and Events. The main content area features a top navigation bar with 'CF-1R-ALT-HVAC Registration' and 'Building Departments'. Below this, the 'User Self Registration' link is highlighted with a red rectangular box. The page title is 'Welcome to CalCERTS'. The main text area contains two paragraphs: one for current/returning users and another for new users, with a link to 'About Us'. On the right side, there is a user greeting box for 'Steve Mann' with links to 'Secure Home Page' and 'Logout'. Below that is a box for 'Instructional Materials' with a 'Click Here' link, and another for 'Field Testing' with a 'Click Here' link to enter field test results.

Public Home CF-1R-ALT-HVAC Registration Building Departments

Secure Home **User Self Registration**

About Us

Training

Rater Directory

Forms

Membership Benefits

Events

Welcome to CalCERTS

If you are a Current/Returning CalCERTS HERS rater, user or business associate and already have a login and password then proceed to login (to the right top of screen).

If you are New to CalCERTS and are seeking further information, please be sure to read [About Us](#), to get an overview of our expertise and services. Get all of the latest information you need by following the links below

Welcome, Steve Mann

Go to Secure Home Page

[Logout]

Instructional Materials

[Click Here]

Field Testing

[Click Here] to enter your Field Test Results



HERS Triggers

- **New Construction**
 - Prescriptive: mandatory HERS
 - Performance: mandatory and optional HERS
- **Existing + Additions + Alterations**
 - Prescriptive: mandatory HERS
 - Performance: mandatory and optional HERS
 - Performance: may require verification of existing conditions
- **HVAC-only alterations – no modeling**
 - Requires mandatory HERS

Questions



Project Life Cycle

- Project design/modeling
- Project creation in HERS registry*
- Project registration*
- Construction (with possible FV/DT)
- Installer testing and registry data entry
- HERS FV/DT and data entry*
- Permit sign-off/incentive application completion

*<https://www.calcerts.com/TrainingMaterials.cfm>



Prescriptive Projects

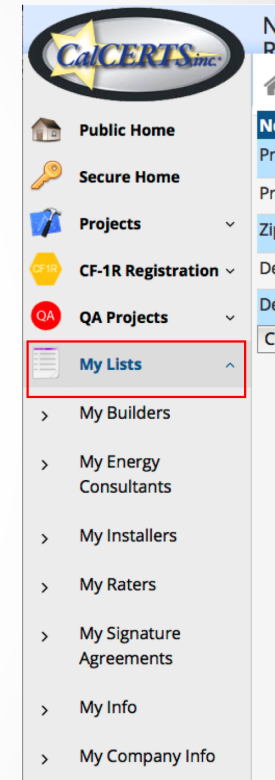
- Design the project to meet the prescriptive parameters
- If HERS verifications are required, talk to a HERS rater
- The registry can currently accept
 - 2008 prescriptive projects
 - 2013 prescriptive mechanical alterations
- 2013 prescriptive construction projects are unavailable
 - Need to use performance approach
 - Check with the local jurisdiction

Performance Projects

- Use any approved compliance software to do the modeling
- If HERS verifications are required/selected, talk to a HERS rater
- Create XML file of CF-1R using compliance software
 - AnalysisResults-BEES.xml
 - Typically done by energy consultant
- Upload XML file to registry
 - Energy consultant, builder, HERS rater, architect, anyone
- The person uploading has to have a registry account

Registry Project Creation


- Project can be created before or after XML upload
- Whoever creates the project needs to share it with designer, installers, and HERS rater
- Requires adding them to “My Lists” in the registry
- Those people need to have accounts



Project Registration

- Once created, the project needs to be signed
 - By the documentation author – energy consultant
 - By the designer – architect, builder, owner
- Signers have to have accounts AND set up their signatures
- Consultant signs first, shares with designer
- Designer signs
- Registry creates a registered CF-1R suitable for permitting

Creating a Signature



CalCERTS - My Info

[EDIT MY INFO](#)

Name: Steve Mann

Address Line 1: 1609 8th Street *

Address Line 2:

City/State/Zip: Berkeley * CA 94710 * [\[Lookup Zip\]](#)

Phone:

Home:

Office: 805-503-9553 *

Mobile: 805-503-9553

Fax:

E-Mail: steve@green-mann.com *

☒ YES, I want to receive the CalCERTS, Inc. Newsletter or News Flashes.

☒ YES, I want to receive Website Announcements.

C20 License: License Not on File. Contact our office to register your license.

Login: smann *

Password: If you wish to change your password, type your new password here:

Toolbar Style:

☒ Drop Down Style

☐ Basic Icons

My Signature: Your signature file has been approved.
To work with your signature: [\[Click Here\]](#)

Job Connections: Use Job Connections to let Rating Companies know you are looking for work!

Public Home

Secure Home

Projects

CF-1R Registration

QA Projects

My Lists

View/Pay Invoice

User Admin

General Admin

Training Schedule

Reports

Compliance Forms

Notices

Job Connections

Website Updates

Log Out



2014 CABEC Conference

E+A+A Modeling

- All building components of an E+A+A model are either “New”, “Existing”, or “Altered”
- Each has a different compliance baseline (Standard Design)
- “New” – Package A (Table 150.1-A)
- “Existing” – no affect on compliance margin
- “Altered” – Standard Design is column two of Table 150.2-B **OR** column three if HERS verifications are selected by the modeler

E+A+A Project Registration

- HERS verification should be selected whenever an “Altered” component is “worse” than Standard Design conditions listed in standards Table 150.2-B
- CF-1R-PRF-01 calls out measures that must be verified
- HERS rater verifies, completes CF-3R-EXC-20H, registered CF-1R is available after designer and documentation author sign it
- Registration (i.e., permitting) can’t be completed until HERS rater does verifications

Identifying Altered Components

Name: Existing Roof: Altered

Area: 1050 ft²

Surface Type: Altered

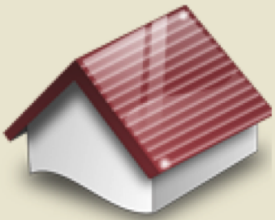
Existing Assembly: R-19 Roof Attic

New Assembly: R-38 Roof Attic

Orientation: 0

Slope: 4 / 12

☐ Replacing > 50% of Roof Surface (or > 2,000 sqft Nonres or >1,000 sqft Res)



Code Comparison

	U-Factor	Reflectance
T-24	0.025	0.20
90.1 Baseline:	0.032	0.25
Proposed:	0.025	0.1

Table 150.2-B

TABLE 150.2-B 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.

Table 150.2-B Summary

	<u>No HERS</u>	<u>HERS</u>
• Fenestration	0.40/0.35	Existing OR 0.40/0.35
• Heating/cooling	Package A	Existing
• Duct insulation	Proposed	Existing
• DHW	Prescriptive	Existing
• Insulation	Mandatory	Existing
• All Others	Proposed	Existing

Duct sealing & roofing – no difference

E+A+A Modeling

- **Modeler can select which assemblies are HERS verified**
- **That only makes sense when “Altered” component is “worse” than Standard Design conditions listed in standards Table 150.2-B**
- **You get extra compliance margin**
- **The items that must be verified are listed on the CF-1R report**

Selecting HERS Verifications

Project Design Data | Project Title | Designer | Lighting Designer | Mechanical Designer | **Residential** | Res Lighting | Utility

HERS Measures

Date of Rating: 9/16/2014

☐ Quality Insulation Installation

☒ Envelope Leakage Testing

Leakage Type: Existing

Existing Leakage: 5.0 ACH50

New Leakage: 5.0 ACH50

HERS Verified Existing Conditions being Altered

☐ Wall/Door Construction ☐ HVAC

☒ Roof Construction ☐ Domestic Hot Water

☐ Floor Construction ☐ Building Leakage

☐ Fenestration

Attic

☐ Conditioned

Crawlspace

Height: 2 feet

Ext. Perimeter: 90 feet

Multi-Family

☐ Central Laundry Facility Location:

Identifying HERS Verifications

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-02-E

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 10:01, Mon, Feb 17, 2014

Page 1 of 10

Calculation Description : Title 24 Analysis

Input File Name: Existing+Alterations+Addition.xml

GENERAL INFORMATION					
01	Project Name	Existing+Alterations+Addition			
02	Calculation Description	Title 24 Analysis			
03	Project Location	123 Main St.			
04	CA City	San Francisco	05	Standards Version	Compliance 2014
06	Zip code		07	Compliance Manager Version	BEMCompMgr 2013-1e (532)
08	Climate Zone	CZ12	09	Software Version	EnergyPro 6.1
10	Building Type	Single Family	11	Front Orientation (deg/Cardinal)	0
12	Project Scope	Addition and/or Alteration	13	Number of Dwelling Units	1
14	Total Cond. Floor Area (FT2)	1275	15	Number of Zones	2
16	Slab Area (FT2)	0	17	Number of Stories	1
18	Addition Cond. Floor Area	NA	19	Natural Gas Available	Yes
20	Addition Slab Area (FT2)	NA	21	Glazing Percentage (%)	14.3%

COMPLIANCE RESULTS	
01	Building Complies with Computer Performance
02	This building incorporates features that require field testing and/or verification by a certified HERS rater under the supervision of a CEC-approved HERS provider.
03	This building incorporates one or more Special Features shown below

<p>Detailed help on using the CF-1R Certificate of Compliance is available via the Internet by either scanning the QR code or browsing to http://www.title24energycode.org/t24help/cf1r.aspx</p>



2014 CABEC Conference

Identifying HERS Verifications

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

Calculation Date/Time: 16:35, Tue, Sep 16, 2014

Input File Name: Existing+Alterations+Addition.xml

CF1R-PRF-01

Page 3 of 8

OPAQUE SURFACES									
01	02	03	04	05	06	07	08	09	10
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft ²)	Window or Door Area (ft ²)	Tilt(deg)	Status	Verified Existing Condition
Front: To Remain	Existing Home	R-0 Wall	0	Front	180	50	90	Existing	No
Left: To Remain	Existing Home	R-0 Wall	90	Left	135		90	Existing	No
Left: New	Existing Home	R-15 Wall	90	Left	135	30	90	New	N/A
Rear: To Remain	Existing Home	R-0 Wall	180	Back	135	20	90	Existing	No
Right: To Remain	Existing Home	R-0 Wall	270	Right	405	42	90	Existing	No
Existing Roof: Altered	Existing Home	R-30 Roof Attic			1050			Altered	Yes
Existing Floor: Remains	Existing Home	R-0 Floor Crawlspace			1050			Existing	No
Front	New Addition	R-15 Wall	0	Front	54		90	New	N/A
Left	New Addition	R-15 Wall	90	Left	135	20	90	New	N/A
Rear	New Addition	R-15 Wall	180	Back	135	20	90	New	N/A
New Roof	New Addition	R-38 Roof Attic			225			New	N/A
New Floor	New Addition	R-22 Floor Crawlspace			225			New	N/A



2014 CABEC Conference

Identifying HERS Verifications

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:35, Tue, Sep 16, 2014

Page 7 of 8

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.xml

HVAC - COOLING SYSTEMS						
01	02	03	04	05	06	07
Name	System Type	Efficiency EER SEER		Zonally Controlled	Multi-speed Compressor	HERS Verification
Cooling Component 1	SplitAirCond - Split air conditioning system	7.06	8	No	No	Cooling Component 1-hers-cool

HVAC - DISTRIBUTION SYSTEMS									
01	02	03	04	05	06	07	08	09	08
Name	Type	Duct Leakage	Insulation R-value	Supply Duct Location	Return Duct Location	Bypass Duct	Status	Verify Existing Condition	HERS Verification

HERS RATER VERIFICATION OF EXISTING CONDITIONS

OPAQUE SURFACES - VERIFIED & ALTERED				
01	02	03	04	05
Name	Zone	Existing Construction	Surface Type	Total Cavity R-value
Existing Roof: Altered	Existing Home	R-19 Roof Attic	Wood Framed Ceiling	R 19



2014 CABEC Conference

E+A+A Example

- 150.2-B lists 150.0(a) as Standard Design for roof insulation
 - Mandatory minimum of R-30
- Existing roof = R-19, insulate to R-30
- Don't select HERS verification, Standard Design = R-30
- No compliance credit – merely upgrading the roof to mandatory minimum

TABLE 150.2-B STANDARD DESIGN FOR AN

Altered Component	Standard Design Without 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)

E+A+A Example

- If you select HERS verification, Standard Design = R-19
- Compliance credit for the increase from R-19 to R-30
- 5% on 1000 SF roof

Project Design Data | Project Title | Designer | Lighting Designer | Mechanical Designer | Residential | Res Lighting | Utility

HERS Measures

Date of Rating: 9/16/2014

☐ Quality Insulation Installation

☒ Envelope Leakage Testing

Leakage Type: Existing

Existing Leakage: 5.0 ACH50

New Leakage: 5.0 ACH50

HERS Verified Existing Conditions being Altered

☐ Wall/Door Construction ☐ HVAC

☒ Roof Construction ☐ Domestic Hot Water

☐ Floor Construction ☐ Building Leakage

☐ Fenestration

Attic

☐ Conditioned

Crawspace

Height: 2 feet

Ext. Perimeter: 90 feet

Multi-Family

☐ Central Laundry Facility Location:

E+A+A Timing

- You can't build an accurate model without knowing the existing conditions
- Logical/realistic sequence:
 - The HERS rater does their analysis **BEFORE** the modeling is done
 - Project is created in the registry, model is uploaded
 - Author and designer sign it
 - HERS rater enters the verification results
 - Registration happens and permit documents are submitted

Questions



HERS FV/DT Verifications

- If you know what's required
 - You can avoid surprises
 - You can educate your clients
 - You can advise your clients
- If you know what's available and the complexity
 - You can pick and choose what makes sense
- Outside of our scope today
 - How specific verifications are triggered

HERS FV/DT Verifications

- Duct Systems (8)
- Air Conditioning (9)
- Mechanical Ventilation (2)
- Building Envelope (3)
- Single Family Domestic Hot Water (6)
- Multi Family Domestic Hot Water (1)
- Reference: Table RA2-1

Parameters

- **Reference**: RA reference
- **Time**: Typical time required to complete the verification
 - Does not include registry data entry time – add 15-30 minutes
- **Timing**: In construction cycle – rough or final
- **Issues**: Unusual circumstances, special considerations, things to look out for.

Duct Systems



Duct Systems FV/DT Measures

- Duct Sealing (mandatory)
- Low Leakage Ducts in Conditioned Space
- Supply Duct Design/Location/R-value
- Low Leakage Air Handlers
- Return Duct Design (new)
- Air Filter Design (mandatory, new)
- Bypass Duct Verification (new)

Duct Sealing

- Probably most common verification
- Mandatory, some exceptions (asbestos, previous testing, < 40' unconditioned))
- Several variations, defined in Table RA3.1-2
- Separate passing thresholds for new and existing ducts
- Separate tests for multifamily buildings



Duct Sealing Variations

2013 Residential Appendices

RA3-7

Table RA3.1-2 – Duct Leakage Verification and Diagnostic Test Protocols and Compliance Criteria

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
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
Sealed and tested altered existing duct systems	Installer Testing HERS Rater Testing	15% Total Duct Leakage	RA3.1.4.3.1
Sealed and tested altered existing duct systems	Installer Testing HERS Rater Testing	10% Leakage to Outside	RA3.1.4.3.4
Sealed and tested altered existing duct systems	Installer Testing and Inspection HERS Rater Testing and Verification	Fails Leakage Tests but All Accessible Ducts are Sealed Inspection and Smoke Test with 100% Verification	RA3.1.4.3.5 RA3.1.4.3.6 RA3.1.4.3.7



2014 CABEC Conference

Duct Sealing

- Seal all ducts, measure the leakage, verify approved materials
- Reference: RA3.1.4.3
- Time: about 1 hour per system if no problems
- Timing: Final
- Issues: Ducts that are inaccessible at final, existing ducts that fail the initial leakage test (DLTO, SAAL, remediation).

Low Leakage Ducts in Conditioned Space

- Ducts in conditioned space + duct sealing
- Reference: RA3.1.4.3.8
- Time: One hour+ per system
- Timing: Final
- Issues: Requires simultaneous duct leakage and blower door testing, and verification of all ducts in conditioned space.



Supply Duct Design/Location/R-value

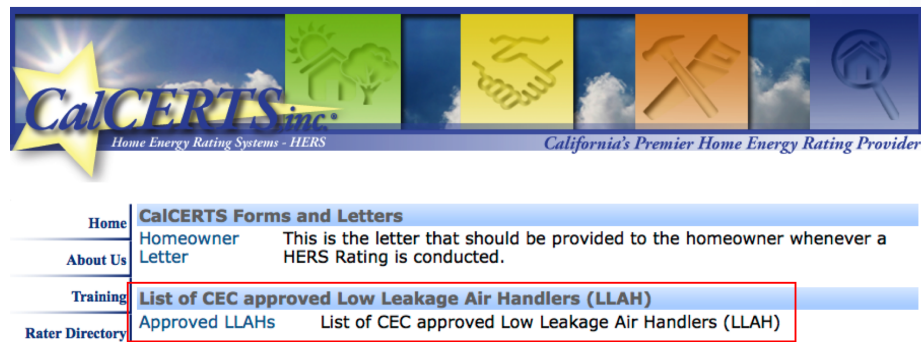
- Verify that installed ducts meet certain specifications
- Reference: RA3.1.4.1
- Time: Depends on specific credit
- Timing: Rough and/or final, depending on location & insulation
- Issues: Layout verification is complex, buried ducts have additional specific criteria (R-4.2 minimum, 2.5" max height from ceiling).

Supply Duct Design/Location/R-value

- **Individual parts/verifications/credits**
 - **Verify layout meets detailed design (rare)**
 - **< 12 linear feet of duct outside conditioned space**
 - **Ducts in conditioned space**
 - **Supply duct surface area reduction (rare, layout verification pre-req)**
 - **Buried ducts (layout verification pre-req)**
 - **Deeply buried ducts (layout verification pre-req)**

Low Leakage Air Handler

- Verify installed air handler is in CEC LLAH database
- Reference: RA4.1.4.3.9
- Time: 15 minutes on site, 15 minutes on line
- Timing: Final
- Issues: None



Return Duct Design

- Verify return duct sizing as per Tables 150.0-C/D
- Reference: RA3.1.4.4
- Time: 30 minutes
- Timing: Final (ducts may be done at rough)
- Issues: Alternative to new duct system air flow testing. Requires return grille filter labeling as per 150.0(m)12A.

Return Duct Design

TABLE 150.0-C: Return Duct Sizing for Single Return Duct Systems

Return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

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.

System Nominal Cooling Capacity (Ton)*	Minimum Return Duct Diameter (inch)	Minimum Total Return Filter Grille Gross Area (inch ²)
1.5	16	500
2.0	18	600
2.5	20	800

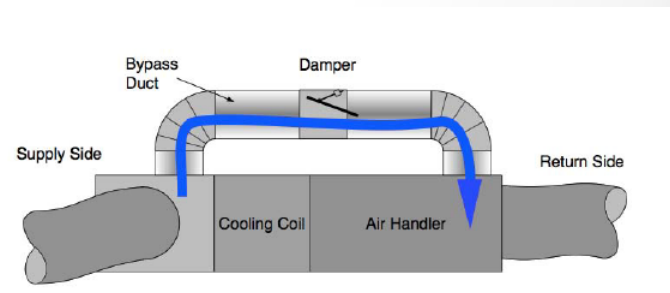
*Not applicable to systems with nominal cooling capacity greater than 2.5 tons or less than 1.5 ton

Air Filter Design

- Verify air filter specifications and labeling as per 150.0(m)12A
- Reference: RA3.1.4.5
- Time: 15 minutes
- Timing: Final
- Issues: Alternative to new duct system air flow testing. Requires return duct design as per RA3.1.4.4.

Bypass Duct Verification

- Verify existence of bypass duct for AC zonal control
- Reference: RA3.1.4.6
- Time: 15 minutes
- Timing: Final
- Issues: Not allowed unless CF-1R/HERS verification. Compliance penalty.
Handling existence w/o verification.



Air Conditioning



Air Conditioning

- Refrigerant Charge
- Minimum System Air Flow
- Charge Indicator Display
- System Air Flow
- Fan Efficacy

EER Verification

SEER Verification

Max Cooling Capacity

Evaporator Condenser

Ice Storage Air Conditioning

Refrigerant Charge

- Verify appropriate AC system refrigerant charge
- Reference: RA3.2
- Time: 30 minutes
- Timing: Final
- Issues: Prescriptive in CZ 2, 8-15, also requires verified system air flow/fan efficacy. Requires minimum 55° F outdoor temperature.

Verified System Airflow

- Measure system air flow in cooling mode
- Reference: RA3.3
- Time: 5 minutes to 1 hour, depending on measurement method
- Timing: Final
- Issues: Required for refrigerant charge; installers should measure before system modifications—may require remediation for existing duct systems that fail. Multispeed equipment.



Existing Ducts Airflow Remediation

- Clean filter
- Remove register/damper obstructions
- Replaced crushed, blocked, damaged ducts
- Clean evaporator coil
- Verify blower wheel/motor operation
- Upsize/redesign return ducting



Fan Efficacy

- Measure watt draw of air handler in cooling mode
- Reference: RA3.3
- Time: 15 minutes or longer, depending on method
- Timing: Final
- Issues: Required for refrigerant charge. Multispeed equipment.



Verified EER

- Verify high EER rating of cooling equipment
- Reference: RA3.4.3 (TDR), RA3.4.4.1
- Time: 15 minutes on site + 15 minutes online
- Timing: Final
- Issues: AHRI database searching can be frustrating.



Verified SEER

- Verify high SEER rating of cooling equipment
- Reference: RA3.4.3 (TDR), RA3.4.4.1
- Time: 15 minutes on site + 15 minutes online
- Timing: Final
- Issues: AHRI database searching can be frustrating.

Maximum Rated Cooling Capacity

- Verify that system cooling capacity is properly sized
- Reference: RA3.1.4.3, RA3.3, RA3.4.4, RA3.4.4.1
- Time: 1.5 hours + 15 minutes online
- Timing: Final
- Issues: Requires verifying airflow, EER/SEER, and duct leakage.
Not used very often.

Evaporatively Cooled Condenser

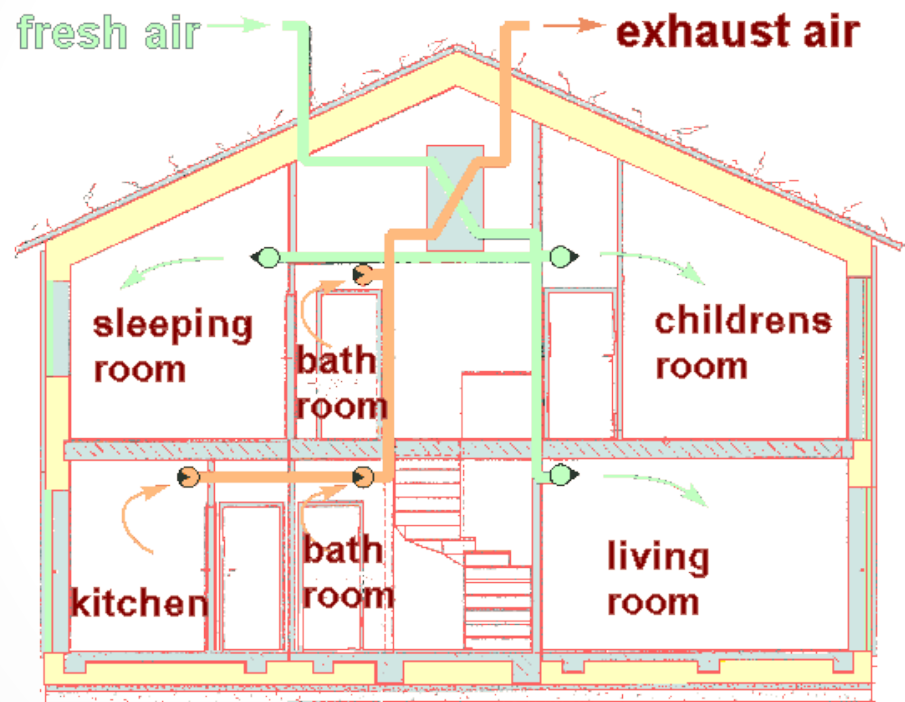
- Verify existence of evaporative condenser
- Reference: RA3.1.4.3, RA3.2, RA3.4.4, RA3.4.4.1
- Time: 2 hours + 15 minutes online
- Timing: Final
- Issues: Requires duct sealing, refrigerant charge (+airflow and fan efficacy), and EER. Not very common residential product.



Ice Storage Air Conditioner

- Verify installation of ice storage AC
- Reference: RA3.1.4.3, RA3.2, RA3.4.3, RA3.4.4.1
- Time: 1.5 hours
- Timing: Final
- Issues: Requires duct sealing, refrigerant charge (+airflow & fan efficacy). Not very common residential product.

Ventilation



Ventilation

- **Continuous Ventilation (mandatory)**
- **Intermittent Ventilation (mandatory)**

Continuous Ventilation

- Measure whole-house continuous ventilation rates
- Reference: RA3.7.4.1
- Time: 15 minutes
- Timing: Final
- Issues: None.



2014 CABEC Conference

Intermittent Ventilation

- Measure whole-house intermittent ventilation rates
- Reference: RA3.7.4.2
- Time: 15 minutes
- Timing: Final
- Issues: May require figuring out the workings of a complex ventilation controller. Not clear where the ventilation rate information comes from.

Envelope

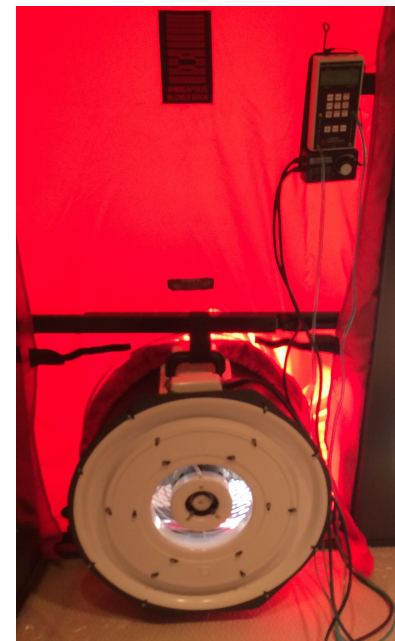


Envelope

- Envelope Leakage
- Insulation Installation (QII)

Envelope Leakage

- Test building infiltration using a blower door
- Reference: RA3.8
- Time: 30 minutes
- Timing: Final
- Issues: Selecting initial ACH50.



Insulation Installation

- Probably the toughest, most complex HERS verification
- Quality Insulation Installation (QII)
- Separate protocols for
 - Batt and blanket, loose fill, rigid board, spray foam, Structural Insulation Panels (SIPs), and Integrated Concrete Forms (ICFs)
- Requires rigorous detailing and execution

Insulation Installation

- **Proper R values**
- **Complete thermal envelope**
 - Insulation has air barrier on all six sides
- **Solid air barrier**
 - Elimination of air movement paths
- **Minimal thermal bridging**
 - Continuous exterior insulation, insulated headers

Insulation Installation

- Verify quality of air barrier/insulation installation
- Reference: RA3.5
- Time: 4-5 site visits, 30 minutes each
- Timing: Rough and final
- Issues: Should be detailed at design stage. Usually requires installer and builder training. Usually not suitable for E+A+A unless gut rehab. OK for addition alone.

Domestic Hot Water



Domestic Hot Water

- **Pipe Insulation**
- **Parallel Piping (new)**
- **Compact Distribution (new)**
- **Point of Use (new)**
- **Manual Demand Recirculation Loop (new)**
- **Sensor Demand Recirculation Loop (new)**
- **Multiple Recirculation Loops (new/multifamily)**

Pipe Insulation

- All DHW pipes fully insulated to R-value in Table 120.3-A. 1" – R-3 for 1" or smaller pipes at 140° or less.
- Reference: RA3.6.2, RA3.6.3
- Time: 15 minutes+ depending on complexity
- Timing: Pre-foundation (possibly) and rough
- Issues: QII for hot water pipes. Applies to underground pipes.

NOTE: RA3.6.2 == pipe insulation QII

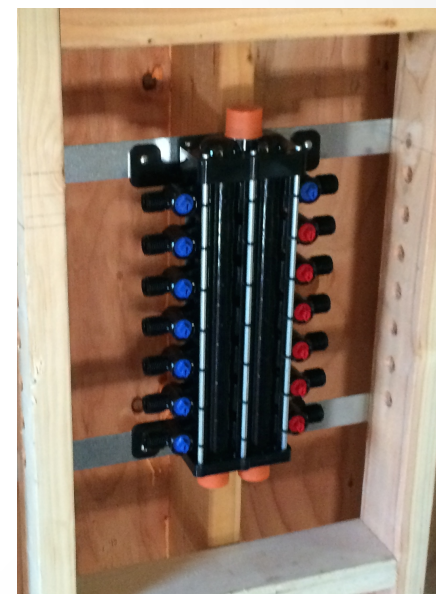
Pipe Insulation

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	0.25-0.28	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

Parallel Piping

- Verify water heater/manifold pipe length ≤ 5 feet, “most direct path” pipe runs for branches
- Reference: RA3.6.2, RA3.6.4
- Time: 30+ minutes depending on complexity
- Timing: Pre-foundation (possibly) and rough
- Issues: Only applies to manifold systems.



2014 CABEC Conference

Compact Distribution

- Verify longest pipe run from water heater based on Table 3.6.5
- Reference: RA3.6.2, RA3.6.5
- Time: 60+ minutes depending on complexity
- Timing: Pre-foundation (possibly) and rough
- Issues: Requires verifying floor area served (FAS) for each heater.

Compact Distribution

TABLE 3.6.5

Floor Area Served (ft ²)	Maximum Measured Water Heater To Use Point Distance (ft)
< 1000	28'
1001 – 1600	43'
1601 – 2200	53'
2201 – 2800	62'
>2800	68'

Point of Use

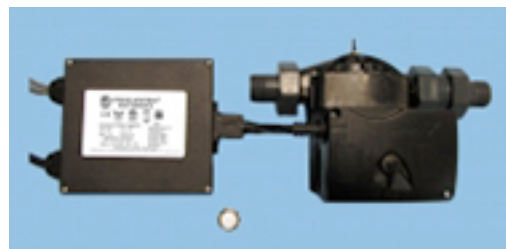
- Verify total pipe length for each hot water fixture (except tubs), not to exceed Table 2.6.6
- Reference: RA3.6.2, RA3.6.6
- Time: 60+ minutes depending on complexity
- Timing: Pre-foundation (possibly) and rough
- Issues: Requires calculations for mixed pipe length.

Table 2.6.6

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

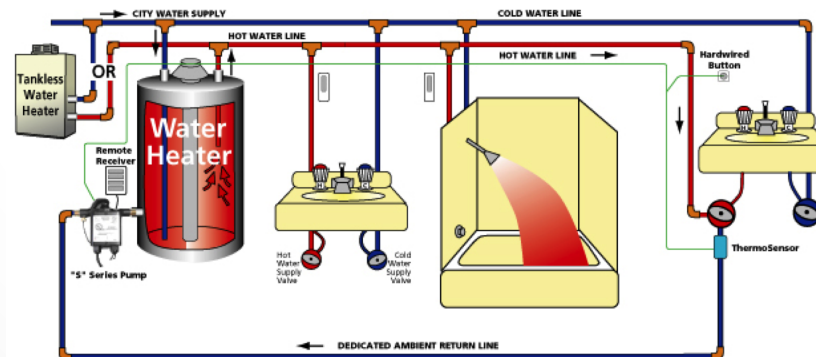
Demand Recirculation: Manual

- Verify demand recirculation loop design with manual controls
- Reference: RA3.6.2, RA3.6.7
- Time: 30+ minutes per loop per site visit depending on complexity
- Timing: Rough (layout) and final (controls)
- Issues: Complex, lots of details. May require plan review.



Demand Recirculation: Sensor

- Verify demand recirculation loop design with sensor controls
- Reference: RA3.6.2, RA3.6.8
- Time: 30+ minutes per loop per site visit depending on complexity
- Timing: Rough (layout) and final (controls)
- Issues: Complex, lots of details. May require plan review.



Multiple Recirculation Loop Design

- Verify multiple recirculation loops for buildings with 8+ units
- Reference: RA3.6.2, RA3.6.9
- Time: 30 minutes
- Timing: Rough or final
- Issues: No control specifications

Questions



Above Code Programs

- Energy Star, NSHP, CAHP, Challenge Home
- Voluntary programs
- HERS rater is typically required to verify envelope, mechanical specifications
- NSHP – HERS rater verifies PV array performance
- Requires at least two visits even if there are no FV/DT verifications: pre-drywall and final, possibly pre-slab
- Inspection timings fit with FV/DT verifications



Grouping Verifications

- **Some verifications MUST be grouped together**
 - Refrigerant charge/air flow/fan efficacy
 - Air flow/fan efficacy
- **Some verifications can be logically grouped together**
 - QII/blower door, especially SPF
 - Anything at final + above-code verifications + NSHP

Timing

- **Designer/builder/installer/HERS coordination is critical**
- **The energy consultant can facilitate that coordination**
- **HERS rater should be identified as early as possible**
- **Verification requirements need to be clearly communicated to builder and installer, early and often, by HERS rater/consultant**
- **Builder/installer education is critical**
- **Ideal—HERS rater and energy consultant are the same**

Timing

- Typical verification stages:
 - Pre-slab (underground hot water, slab insulation for EE)
 - Pre-insulation (framing AND post-drywall for attic blown-in)
 - Pre-drywall
 - Post-drywall
 - Final
- All can be very timing dependent
- Complicated areas: QII, duct testing, DHW



As-built Changes

- The HERS rater should ask about changes before doing the field verifications
- The energy consultant should talk to HERS rater and builder before making any changes – installer, cost, timing issues
- A new CF-1R may need to be filed to reflect changes
- Otherwise inspection results can't be properly recorded
- Responsibility of the documentation author/energy consultant
- Requires new signatures to create registered CF-1R

Above Code Programs

- CF-1R files are typically locked by program managers after plan check
- If there are as-built changes, the program manager, not the documentation author, has to re-load
- Typically coordinated by whomever is handling the rebate application or certification process
- Ideal—energy consultant, HERS rater, incentive application processor are all the same person

Conclusions

- Life is more complicated – teams will be most successful
- Energy consultants should get to know a few good HERS raters
- HERS raters should be working with energy consultants
- HERS raters should consider becoming CEAs
- CEAs should consider becoming HERS raters
- The key is timely communication with all parties, understanding what's involved in HERS verifications, and using them to your client's advantage

Energy Consultants and HERS Raters



Thank you!