

DOCKETED

Docket Number:	15-BSTD-02
Project Title:	Residential Compliance Manual and Documents
TN #:	232820-14
Document Title:	2016-CF3R-ENV-20b-BuildingEnvelopeAirLeakage-SinglePointTest-AutomaticMeterpdf
Description:	N/A
Filer:	Corrine Fishman
Organization:	California Energy Commission
Submitter Role:	Public Agency
Submission Date:	4/22/2020 9:54:01 AM
Docketed Date:	4/22/2020

BUILDING LEAKAGE DIAGNOSTIC TEST

CEC-CF3R-ENV-20-H (Revised 09/16)

CALIFORNIA ENERGY COMMISSION



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 (°F)	
04	Outdoor Temperature During Test (°F)	
05	Blower Door Location	
06	Building Elevation (ft)	
07	Building Volume (ft ³)	
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 (Pa)
10	Pre-Test Baseline Building Pressure (Pa)
11	Induced Building Pressure from Manometer (Pa)
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)

BUILDING LEAKAGE DIAGNOSTIC TEST

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CERTIFICATE OF VERIFICATION		CF3R-ENV-20-H
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Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

F. Compliance Statement

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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:	<input type="checkbox"/> Pass - all applicable requirements are met; or <input type="checkbox"/> Fail - one or more applicable requirements are not met. Enter reason for failure in corrections notes field below; or <input type="checkbox"/> 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.

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.

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BUILDING LEAKAGE DIAGNOSTIC TEST

CEC-CF3R-ENV-20-H (Revised 09/16)

CALIFORNIA ENERGY COMMISSION



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:

- The information provided on this Certificate of Verification is true and correct.
- I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
- 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.
- 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.
- 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):
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HERS RATER INFORMATION

HERS Rater Company Name:	
Responsible Rater Name:	Responsible Rater Signature:
Responsible Rater Certification Number w/ this HERS Provider:	Date Signed:

CF3R-ENV20b-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 CF1R 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 5,000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the CF1R. 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 A08, 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. 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. "Standard" is when the baseline range is less than 5 Pa; "Reduced" is when the baseline range is between 5 and 10 Pa (inclusive). If the baseline range is greater than 10 you must use a multi-point procedure.
9. This field is automatically calculated. 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.
12. This field is automatically calculated. 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).

Section D. Altitude and Temperature Correction

1. This field is automatically calculated. The equation used to calculate this value in the field equals:
 - a. If the elevation is 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 $1 + (0.000006 * \text{elevation in feet})$
- 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 Pressurization Testing- Calculated according to ASTM E779-10

Outside Temp (F)	Inside Temperature (F)									
	50	55	60	65	70	75	80	85	90	
-20	1.062	1.072	1.081	1.090	1.099	1.108	1.117	1.127	1.136	
-15	1.056	1.066	1.075	1.084	1.093	1.102	1.111	1.120	1.129	
-10	1.051	1.060	1.069	1.078	1.087	1.096	1.105	1.114	1.123	
-5	1.045	1.054	1.063	1.072	1.081	1.090	1.099	1.108	1.117	
0	1.039	1.048	1.057	1.066	1.075	1.084	1.093	1.102	1.111	
5	1.033	1.042	1.051	1.060	1.069	1.078	1.087	1.096	1.105	
10	1.028	1.037	1.046	1.055	1.064	1.072	1.081	1.090	1.099	
15	1.023	1.031	1.040	1.049	1.058	1.067	1.076	1.084	1.093	
20	1.017	1.026	1.035	1.044	1.052	1.061	1.070	1.079	1.087	
25	1.012	1.021	1.029	1.038	1.047	1.056	1.064	1.073	1.082	
30	1.007	1.015	1.024	1.033	1.041	1.050	1.059	1.067	1.076	
35	1.002	1.010	1.019	1.028	1.036	1.045	1.054	1.062	1.071	
40	0.997	1.005	1.014	1.023	1.031	1.040	1.048	1.057	1.065	
45	0.992	1.000	1.009	1.017	1.026	1.035	1.043	1.051	1.060	
50	0.987	0.995	1.004	1.012	1.021	1.029	1.038	1.046	1.055	
55	0.982	0.990	0.999	1.008	1.016	1.024	1.033	1.041	1.050	
60	0.997	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	

For information only. Not valid until HERS provided

Table RA3.8-3 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	0.865	0.861	0.857	0.853	0.849	0.845	0.841	0.837	0.833
	-15	0.874	0.870	0.866	0.862	0.858	0.854	0.850	0.846	0.842
	-10	0.883	0.879	0.874	0.870	0.866	0.862	0.858	0.854	0.850
	-5	0.892	0.887	0.883	0.879	0.875	0.871	0.867	0.863	0.859
	0	0.900	0.896	0.892	0.887	0.883	0.879	0.875	0.871	0.867
	5	0.909	0.905	0.900	0.896	0.892	0.888	0.883	0.879	0.875
	10	0.918	0.913	0.909	0.905	0.900	0.896	0.892	0.888	0.884
	15	0.927	0.922	0.918	0.913	0.909	0.905	0.900	0.896	0.892
	20	0.935	0.931	0.926	0.922	0.917	0.913	0.909	0.905	0.900
	25	0.944	0.939	0.935	0.930	0.926	0.922	0.917	0.913	0.909
	30	0.952	0.948	0.943	0.939	0.934	0.930	0.926	0.921	0.917
	35	0.961	0.956	0.952	0.947	0.943	0.938	0.934	0.930	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.969	0.964	0.960	0.955	0.951	0.946	0.942
	50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955	0.950
	55	0.995	0.990	0.986	0.981	0.976	0.972	0.967	0.963	0.958
	60	1.004	0.999	0.994	0.988	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	

- This field is automatically calculated. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

Section E. Accuracy Adjustment

- This field is automatically calculated:
 - If the Accuracy Level from Section C is "Standard", the Accuracy Adjustment will be 1 (no adjustment)
 - If the Accuracy Level from Section C is "Reduced", Accuracy Adjustment equation equals $1 + [0.1 + (50 / \text{Nominal CFM50})]$
- This field is automatically calculated. The Adjusted CFM50 is the Corrected CFM50 multiplied by 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 A02.

Section F. Compliance Statement

- This field is automatically calculated. 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

- This statement must be true (or not applicable) for the test to conform to the protocols.
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- This statement must be true (or not applicable) for the test to conform to the protocols.
- 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.
- 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

- This field is filled out automatically. Compliance requires that all individual criteria pass.

A. Building Air Leakage – General Information

01	Test Procedure Used	<<user input, pull down list: Single-Point Test with Manual Meter – Display ENV-20a below; Single-Point Test with Automatic Meter – Display ENV-20b below; Multi-Point Test – Display ENV-20c below; Repeated Single Point with Manual Meter – Display ENV-20d below; Repeated Single Point with Automatic Meter – Display ENV-20e below
02	Building Air Leakage Target from CF1R	<<number pulled from CF1R>>
03	Indoor Temperature During Test (°F)	<<user input, degF>>
04	Outdoor Temperature During Test (°F)	<<user input, degF>>
05	Blower Door Location	<<user input, text, maximum 50 characters>>
06	Building Elevation (ft)	<<user input, Ft>>
07	Building Volume (ft³)	<<pull from CF1R>>
08	Date of the Diagnostic Test for this Dwelling	<<user input: date (use date format validation control)>>

B. Diagnostic Equipment Information

01	Number of Manometers Used to Measure Home Pressurization				<<user input, integer>> For entries >1, duplicate lines B. 2-6
	02	03	04	05	06
	Manometer Make	Manometer Model	Manometer Serial Number	Manometer Calibration Date	Manometer Calibration Status
	<<user input, text, maximum 50 characters>>	<<user input, text, maximum 50 characters>>	<<user input, text, maximum 50 characters>>	<<user input, text (Date), maximum 50 characters>>	<<calculated field: if manometer Calibration Date in B. 5 is within 12 months of the date of the diagnostic test A. 8, then display message: Manometer Calibration is valid"; else display message: "WARNING - Manometer Calibration is expired. A manometer with current calibration is required in order to comply with this Building Leakage Diagnostic test">>
07	Number of Fans Used to Pressurize Home			<<user input, integer>> For entries >1, duplicate lines B. 8-11	
	08	09	10	11	
	Fan Make	Fan Model	Fan Serial Number	Fan Configuration (rings)	
	<<user input, text, maximum 50 characters>>	<<user input, text, maximum 50 characters>>	<<user input, text, maximum 50 characters>>	<<user input, text, maximum 50 characters>>	

ENV20b - Single Point Air Tightness Test With Automatic Meter

C. Envelope Leakage Diagnostic Test

01	Time Average Period of Meter	<<user entry but must be no less than 10, in second>>
02	Baseline Building Pressure Reading #1	<<user entry, Pa>> (Resolution of 0.1 Pa)
03	Baseline Building Pressure Reading #2	<<user entry, Pa>> (Resolution of 0.1 Pa)
04	Baseline Building Pressure Reading #3	<<user entry, Pa>> (Resolution of 0.1 Pa)
05	Baseline Building Pressure Reading #4	<<user entry, Pa>> (Resolution of 0.1 Pa)
06	Baseline Building Pressure Reading #5	<<user entry, Pa>> (Resolution of 0.1 Pa)
07	Baseline Range	<<calculated, subtract the lowest of rows C. 2-6 from the highest of rows C. 2-6>>
08	Accuracy Level	<<calculated, if row C. 7 < 5.0, then "Standard"; if row C. 7 ≥ 5 and ≤ 10, then "Reduced", if row C. 7 > 10, "cannot use single-point test", do not proceed.>>
09	Average Baseline Building Pressure Reading (Pa)	<< calculated average rows C. 2-6>>
10	Pre-test Baseline Building Pressure (Pa)	<<user input OR row C. 9, Pa>>
11	Induced Building Pressure from Manometer (Pa)	<<user entry, Pa, from manometer>>
12	Induced Building Pressure Check	<<calculated value: if both of the following two conditions are true: **absolute value C11 ≥ 15; and **absolute value C11 > absolute value (C10 * 4) Then report "Induced pressure within range for single point test"; Else report "Induced pressure too low for single point test – Do Not Proceed ">>
13	Nominal CFM50	<<user entry, CFM, from manometer>>

D. Altitude and Temperature Correction

01	Altitude Correction Factor	<<calculated value, if row A. 6 ≤ 5000 Ft = 1; row A. 6 > 5000 =, 1 + .000006 * row A. 6>>
02	Temperature Correction Factor	<<from tables RA3.8-2 and RA3.8-3 >>
03	Corrected CFM50	<<calculated value, Row C. 13 * altitude correction D. 1 * temperature correction D. 2>>

E. Accuracy Adjustment

01	Accuracy Adjustment Factor	<<calculated value, if row C. 8 is "Standard" = 1; row C. 8 is "Reduced" = 1+0.1*{50/[absolute value (row C. 11)]} >>
02	Adjusted CFM50 (measured air leakage rate)	<<calculated, row D. 3* row E. 1>>

F. Compliance Statement

01	<< if manometer Calibration Date in B. 5 is within 12 months of the date of the diagnostic test A. 8 and if Adjusted CFM50 Leakage in E. 2 is less than or equal to the Building Air Leakage Rate Target in A. 2 then display text: "Building Passes Envelope Leakage Test"; if manometer Calibration Date in B. 5 is more than 12 months from the date of the diagnostic test A. 8 or if Adjusted CFM50 Leakage in E. 2 is more than the Building Air Leakage Rate Target in A. 2 then display text: "Building Fails Envelope Leakage Test">>	
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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:	<<user pick from list: *** <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
07	Correction Notes:	<<if <u>Verification Status</u> = <u>Fail</u> , then text entry in this Corrections Notes field is required; user input text>>

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	<<if B. 6 = Manometer Calibration is valid; and C. 8 = Standard or Reduced; and C. 12 = Induced pressure within range for single point test; and F. 1 = Building Passes Envelope Leakage Test; and G. 6 = Pass or All n/a; then display: Complies: All specified verification protocol requirements on this document are met; else display: Does not comply: One or more specified verification protocol requirements on this document are not met.>>
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For information and data collection only. Not valid until registered with a HERS provider