

**BUILDING LEAKAGE WORKSHEET**

CEC-CF2R-MCH-24-H (Revised 06/16)

CALIFORNIA ENERGY COMMISSION



CERTIFICATE OF INSTALLATION		CF2R-MCH-24-H
Building Leakage Worksheet		(Page 1 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

**A. Building Air Leakage - General Information**

01	Indoor Temperature During Test (degreeF)	
02	Outdoor Temperature During Test (degreeF)	
03	Blower Door Location	
04	Building Elevation (ft)	
05	Building Volume (ft <sup>3</sup> )	
06	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)	

**C. Envelope Leakage Worksheet - Depressurization - MCH24a - Single Point Air Tightness Test With Manual Meter**

01	Time Average Period of Meter	
02	Test Methodology	Depressurization
03	Baseline Building Pressure Reading #1	
04	Baseline Building Pressure Reading #2	
05	Baseline Building Pressure Reading #3	
06	Baseline Building Pressure Reading #4	
07	Baseline Building Pressure Reading #5	
08	Baseline Range	
09	Accuracy Level	
10	Average Baseline Building Pressure Reading	
11	Pre-test Baseline Building Pressure	
12	Unadjusted Building Pressure Target	
13	Unadjusted Building Pressure Measured	
14	Induced Building Pressure Check	
15	Nominal Fan Flow at Above Fan Pressure	
16	Nominal CFM50	

Note:

- For multifamily, each dwelling unit must be tested individually and shown to meet the leakage requirements. Depressurization of the adjacent dwelling units while conducting this test is not allowed.

**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 Depressurization (measured air leakage rate)	

Registration Number:

Registration Date/Time:

HERS Provider:

CA Building Energy Efficiency Standards - 2013 Residential Compliance

June 2016

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Dwelling Address:	City:	Zip Code:

**F. Envelope Leakage Worksheet - Pressurization - MCH24a – Single Point Air Tightness Test With Manual Meter**

01	Time Average Period of Meter	
02	Test Methodology	Pressurization
03	Baseline Building Pressure Reading #1	
04	Baseline Building Pressure Reading #2	
05	Baseline Building Pressure Reading #3	
06	Baseline Building Pressure Reading #4	
07	Baseline Building Pressure Reading #5	
08	Baseline Range	
09	Accuracy Level	
10	Average Baseline Building Pressure Reading	
11	Pre-test Baseline Building Pressure	
12	Unadjusted Building Pressure Target	
13	Unadjusted Building Pressure Measured	
14	Induced Building Pressure Check	
15	Nominal Fan flow at Above Fan Pressure	
16	Nominal CFM50	
<p>Note:</p> <ul style="list-style-type: none"> <li>For 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.</li> </ul>		

**G. Altitude and Temperature Correction**

01	Altitude Correction Factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

**H. Accuracy Adjustment**

01	Accuracy Adjustment Factor	
02	Adjusted CFM50 Pressurization (measured air leakage rate)	

**BUILDING LEAKAGE WORKSHEET**

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Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

**DOCUMENTATION AUTHOR'S DECLARATION STATEMENT**

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

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

**RESPONSIBLE PERSON'S DECLARATION STATEMENT**

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

- The information provided on this Certificate of Installation is true and correct.
- I am eligible under Division 3 of the Business and Professions Code in the applicable classification to accept responsibility for the system design, construction, or installation of features, materials, components, or manufactured devices for the scope of work identified on this Certificate of Installation and attest to the declarations in this statement (responsible builder/installer), otherwise I am an authorized representative of the responsible builder/installer.
- The constructed or installed features, materials, components or manufactured devices (the installation) identified on this Certificate of Installation conforms to all applicable codes and regulations, and the installation conforms to the requirements given on the plans and specifications approved by the enforcement agency.
- I understand that a HERS rater will check the installation to verify compliance, and that if such checking identifies defects; I am required to take corrective action at my expense. I understand that Energy Commission and HERS Provider representatives will also perform quality assurance checking of installations, including those approved as part of a sample group but not checked by a HERS rater, and if those installations fail to meet the requirements of such quality assurance checking, the required corrective action and additional checking/testing of other installations in that HERS sample group will be performed at my expense.
- I reviewed a copy of the Certificate of Compliance approved by the enforcement agency that identifies the specific requirements for the scope of construction or installation identified on this Certificate of Installation, and I have ensured that the requirements that apply to the construction or installation have been met.
- I will ensure that a registered copy of this Certificate of Installation 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 Installation is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Builder/Installer Name:	Responsible Builder/Installer Signature:	
Company Name: (Installing Subcontractor or General Contractor or Builder/Owner)	Position With Company (Title):	
Address:	CSLB License:	
City/State/Zip:	Phone:	Date Signed:
Third Party Quality Control Program (TPQCP) Status:	Name of TPQCP (if applicable):	

**CF2R-MCH-24a-H User Instructions****Section A. Building Air Leakage – General Information**

1. Enter the indoor temperature measured at the time that the building air leakage test was performed.
2. Enter the outdoor temperature measured at the time that the building air leakage test was performed.
3. 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”)
4. Enter the building elevation; use the value for the closest city found in Joint Appendix JA2.2. Only elevations higher than 5000 feet require an adjustment to the calculations.
5. This number is automatically pulled from the performance approach Certificate of Compliance. It is used to calculate air changes.
6. Enter the date that the building leakage test data was collected.

**Section B. Diagnostic Equipment Information**

1. Enter the number of manometers used to measure the home pressurization. If more than one system is used, the fan flow numbers need to be manually added together, unless blower door software is used that will accommodate multiple fan systems running simultaneously.
2. Enter the make (brand) of the manometer used to collect the building air leakage data. (Examples: Retrotec, Energy Conservatory)
3. Enter the model of the manometer used to collect the building air leakage data. (Examples: DM-2 Mark II, DG700)
4. Enter the serial number of the manometer used to collect the building air leakage data.
5. Enter the most recent date that the manometer was calibrated by following manufacturer’s calibration specifications.
6. This field is automatically filled. If the calibration date was more than 12 months prior to the test date entered in Row A.6 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 (MCH24a) – Depressurization**

1. Enter the Time Average Period used on the manometer during the DEPRESSURIZATION test. Must be at least 10 seconds.
2. Type of test being performed: Depressurization (air blowing out of house). All blower door induced pressures are to be negative relative to outside.
3. Enter the first of five baseline building pressure readings (Resolution of 0.1 Pa).
4. Enter the second of five baseline building pressure readings (Resolution of 0.1 Pa).
5. Enter the third of five baseline building pressure readings (Resolution of 0.1 Pa).
6. Enter the fourth of five baseline building pressure readings (Resolution of 0.1 Pa).
7. Enter the fifth of five baseline building pressure readings (Resolution of 0.1 Pa).
8. This field is automatically calculated when using the online form. The Baseline Range is the largest value of the five baseline readings minus the smallest value of the five baseline readings.
9. This field is automatically calculated when using the online form. “Standard” is when the baseline range is less than 5 Pa; “Reduced” is when the baseline range is between 5 and 10 Pa (inclusive). If the baseline range is greater than 10 you must use a multi-point procedure.
10. This field is automatically calculated when using the online form. Average Baseline Building Pressure Reading is simply the average of the five baseline readings.
11. Enter the Pre-test Baseline Building Pressure. The protocols allow the average to be used or a newly measured number can be used.
12. This field is automatically calculated when using the online form. The Unadjusted Building Pressure Target is the Pre-test Baseline Building Pressure plus the target building pressure (-50 Pa).
13. Enter the Measured Unadjusted Building Pressure straight from the manometer. It should be as close to the Unadjusted Building Pressure Target as possible. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
14. This field is automatically calculated when using the online form. A check is performed to make sure that a pressure of at least -15 Pa was achieved. If not, the Single Point Test may not be used.
15. Enter the fan flow from the manometer that corresponds to the Measured Unadjusted Building Pressure. All blower door induced pressures for the depressurization tests are to be negative relative to outside.
16. This field is automatically calculated when using the online form. The Measured Unadjusted Building Pressure is automatically adjusted for a target pressure of -50 Pa.

**Section D. Altitude and Temperature Correction**

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
  - a. If the elevation less than or equal to 5,000 ft, the Altitude Correction Factor is 1 (no adjustment).
  - b. If the elevation is greater than 5,000 ft, the Altitude Correction equation equals  $1 + (0.000006 * \text{elevation in feet})$
2. Enter the Temperature Correction Factor from Table RA3.8-2 using the indoor and outdoor temperatures entered in Section A.

**Table RA3.8-2 Temperature Correction Factors for Depressurization Testing- Calculated according to ASTM E779-10**

Outside Temp (F)	Inside Temperature (F)									
	50	55	60	65	70	75	80	85	90	95
-20	1.062	1.072	1.081	1.090	1.099	1.108	1.117	1.127	1.136	1.145
-15	1.056	1.066	1.075	1.084	1.093	1.102	1.111	1.120	1.129	1.138
-10	1.051	1.060	1.069	1.078	1.087	1.096	1.105	1.114	1.123	1.132
-5	1.045	1.054	1.063	1.072	1.081	1.090	1.099	1.108	1.117	1.126
0	1.039	1.048	1.057	1.066	1.075	1.084	1.093	1.102	1.111	1.120
5	1.033	1.042	1.051	1.060	1.069	1.078	1.087	1.096	1.105	1.114
10	1.028	1.037	1.046	1.055	1.064	1.072	1.081	1.090	1.099	1.108
15	1.023	1.031	1.040	1.049	1.058	1.067	1.076	1.084	1.093	1.102
20	1.017	1.026	1.035	1.044	1.052	1.061	1.070	1.079	1.087	1.096
25	1.012	1.021	1.029	1.038	1.047	1.056	1.064	1.073	1.082	1.091
30	1.007	1.015	1.024	1.033	1.041	1.050	1.059	1.067	1.076	1.085
35	1.002	1.010	1.019	1.028	1.036	1.045	1.054	1.062	1.071	1.080
40	0.997	1.005	1.014	1.023	1.031	1.040	1.048	1.057	1.065	1.074
45	0.992	1.000	1.009	1.017	1.026	1.035	1.043	1.051	1.060	1.069
50	0.987	0.995	1.004	1.012	1.021	1.029	1.038	1.046	1.055	1.064
55	0.982	0.990	0.999	1.008	1.016	1.024	1.033	1.041	1.050	1.059
60	0.977	0.986	0.994	1.003	1.011	1.019	1.028	1.036	1.045	1.054
65	0.973	0.981	0.989	0.998	1.006	1.015	1.023	1.031	1.040	1.049
70	0.968	0.976	0.985	0.993	1.001	1.010	1.018	1.026	1.035	1.044
75	0.963	0.972	0.980	0.988	0.997	1.005	1.013	1.022	1.030	1.039
80	0.959	0.967	0.976	0.984	0.992	1.000	1.009	1.017	1.025	1.034
85	0.955	0.963	0.971	0.979	0.988	0.996	1.004	1.012	1.020	1.029
90	0.950	0.958	0.967	0.975	0.983	0.991	0.999	1.008	1.016	1.025
95	0.946	0.954	0.962	0.970	0.979	0.987	0.995	1.003	1.011	1.020
100	0.942	0.950	0.958	0.966	0.974	0.982	0.990	0.998	1.007	1.015
105	0.938	0.946	0.954	0.962	0.970	0.978	0.986	0.994	1.002	1.011
110	0.933	0.942	0.950	0.952	0.966	0.974	0.982	0.990	0.998	1.007

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section C multiplied by the Altitude and Temperature Correction Factors.

**Section E. Accuracy Adjustment**

1. This field is automatically calculated when using the online form:
  - a. If the Accuracy Level from Section C is "Standard", the Accuracy Adjustment will be 1 (no adjustment).
  - b. If the Accuracy Level from Section C is "Reduced", Accuracy Adjustment equation equals  $1 + 0.1 * [50 / (\text{Unadjusted Building Pressure} - \text{Pretest Baseline Building Pressure})]$ .
2. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied by the Accuracy Adjustment Factor.

**Section F. Envelope Leakage (MCH24a) - Pressurization**

1. Enter the time average period used on the manometer during the PRESSURIZATION test. Must be at least 10 seconds.
2. Type of test being performed: Pressurization (air blowing into house). All blower door induced pressures are to be positive relative to outside.
3. Enter the first of five baseline building pressure readings (Resolution of 0.1 Pa).
4. Enter the second of five baseline building pressure readings (Resolution of 0.1 Pa).
5. Enter the third of five baseline building pressure readings (Resolution of 0.1 Pa).
6. Enter the fourth of five baseline building pressure readings (Resolution of 0.1 Pa).
7. Enter the fifth of five baseline building pressure readings (Resolution of 0.1 Pa).
8. This field is automatically calculated when using the online form. The Baseline Range is the largest value of the five baseline readings minus the smallest value of the five baseline readings.
9. This field is automatically calculated when using the online form. "Standard" is when the baseline range is less than 5 Pa; "Reduced" is when the baseline range is between 5 and 10 Pa (inclusive). If the baseline range is greater than 10 you must use a multi-point procedure.
10. This field is automatically calculated when using the online form. Average Baseline Building Pressure Reading is simply the average of the five baseline readings.
11. Enter the Pre-test Baseline Building Pressure. The protocols allow the average to be used or a newly measured number can be used.
12. This field is automatically calculated when using the online form. The Unadjusted Building Pressure Target is the Pre-test Baseline Building Pressure plus the target building pressure (50 Pa).

13. Enter the Measured Unadjusted Building Pressure straight from the manometer. It should be as close to the Unadjusted Building Pressure Target as possible. All blower door induced pressures for the pressurization tests are to be positive relative to outside.
14. This field is automatically calculated when using the online form. A check is performed to make sure that a pressure of at least 15 Pa was achieved. If not, the Single Point Test may not be used.
15. Enter the fan flow from the manometer that corresponds to the Measured Unadjusted Building Pressure. All blower door induced pressures for the pressurization tests are to be positive relative to outside.
16. This field is automatically calculated when using the online form. The Measured Unadjusted Building Pressure is automatically adjusted for a target pressure of 50 Pa.

**Section G. Altitude and Temperature Correction**

1. This field is automatically calculated when using the online form. The equation used to calculate this value in the field equals:
  - c. If the elevation less than or equal to 5,000 ft, the Altitude Correction Factor is 1 (no adjustment).
  - d. 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 RA3.8-3 using the indoor and outdoor temperatures entered in Section A.

**Table RA3.8-3 Temperature Correction Factors for Pressurization Testing- Calculated according to ASTM E779-10**

		Inside Temperature (F)								
		50	55	60	65	70	75	80	85	90
Outside Temp (F)	-20	0.865	0.861	0.857	0.853	0.849	0.845	0.841	0.837	0.833
	-15	0.874	0.870	0.866	0.862	0.858	0.854	0.850	0.846	0.842
	-10	0.883	0.879	0.874	0.870	0.866	0.862	0.858	0.854	0.850
	-5	0.892	0.887	0.883	0.879	0.875	0.871	0.867	0.863	0.859
	0	0.900	0.896	0.892	0.887	0.883	0.879	0.875	0.871	0.867
	5	0.909	0.905	0.900	0.896	0.892	0.888	0.883	0.879	0.875
	10	0.918	0.913	0.909	0.905	0.900	0.896	0.892	0.888	0.884
	15	0.927	0.922	0.918	0.913	0.909	0.905	0.900	0.896	0.892
	20	0.935	0.931	0.926	0.922	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	0.961	0.964	0.960	0.955	0.951	0.946	0.942
	50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955	0.950
	55	0.995	0.990	0.986	0.981	0.976	0.972	0.967	0.963	0.958
	60	1.004	0.999	0.994	0.998	0.985	0.980	0.976	0.971	0.967
	65	1.012	1.008	1.003	0.998	0.993	0.988	0.984	0.979	0.975
	70	1.021	1.016	1.011	1.006	1.001	0.997	0.992	0.988	0.983
	75	1.029	1.024	1.019	1.015	1.010	1.005	1.000	0.996	0.991
80	1.038	1.033	1.028	1.023	1.018	1.013	1.009	1.004	0.999	
85	1.046	1.041	1.036	1.031	1.026	1.022	1.017	1.012	1.008	
90	1.055	1.050	1.045	1.040	1.035	1.030	1.025	1.020	1.016	
95	1.063	1.058	1.053	1.048	1.043	1.038	1.033	1.028	1.024	
100	1.072	1.066	1.061	1.056	1.051	1.046	1.041	1.037	1.032	
105	1.080	1.075	1.070	1.064	1.059	1.054	1.050	1.045	1.040	
110	1.088	1.083	1.078	1.073	1.068	1.063	1.058	1.053	1.048	

3. This field is automatically calculated when using the online form. The Corrected CFM50 is the Nominal CFM50 from Section F multiplied by the Altitude and Temperature Correction Factor.

**Section H. Accuracy Adjustment**

1. This field is automatically calculated when using the online form:
  - c. If the Accuracy Level from Section F is "Standard", the Accuracy Adjustment will be 1 (no adjustment).
  - d. If the Accuracy Level from Section F is "Reduced", Accuracy Adjustment equation equals  $1 + 0.1 * [50 / (\text{Unadjusted Building Pressure} - \text{Pretest Baseline Building Pressure})]$ .
2. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied by the Accuracy Adjustment Factor.