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STATE OF CALIFORNIA

BUILDING LEAKAGE WORKSHEET

CEC-CF2R-MCH-24-H (Revised 10/16) 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 (°F)	
02	Outdoor Temperature During Test (°F)	
03	Blower Door Location	
04	Building Elevation (ft)	
05	Building Volume (ft^3)	
06	Date of the Diagnostic Test for this Dwelling	

B. Diagnostic Equipment Information

01	Number of Manometers Used to Measure Home Pressurization	

02 Manometer Make	03 Manometer Model	04 Manometer Serial Number	05 Manometer Calibration Date	06 Manometer Calibration Status

07	Number of Fans Used to Pressurize Home	

08 Fan Make	09 Fan Model	10 Fan Serial Number	11 Fan Configuration (rings)

C. Envelope Leakage Worksheet - Depressurization - MCH24e - Repeated Single Point Air Tightness Test With Automatic Meter

01	Time Average Period of Meter	
02	Blower Door Software Used for Calculations?	

03 Induced Building Pressure	04 Nominal CFM50

05	Average 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	

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CERTIFICATE OF INSTALLATION		CF2R-MCH-24-H
Building Leakage Worksheet		(Page 2 of 3)
Project Name:	Enforcement Agency:	Permit Number:
Dwelling Address:	City:	Zip Code:

E. Accuracy Adjustment		
01	Standard Deviation of Nominal CFM 50 Values Above	
02	Percent Uncertainty	
03	Accuracy Level	
04	Accuracy Adjustment Factor	
05	Adjusted CFM50 Depressurization (measured air leakage rate)	
06	Corrected CFM50 (from software)	
07	Percent Uncertainty @ 95% Confidence Level (from software)	

F. Envelope Leakage Worksheet - Pressurization - MCH24e - Repeated Single Point Air Tightness Test With Automatic Meter

01	Time Average Period of Meter	
02	Blower Door Software Used for Calculations?	

03 Induced Building Pressure	04 Nominal CFM50

05	Average Nominal CFM50	

Note:

- 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.

G. Altitude and Temperature Correction		
01	Altitude Correction Factor	
02	Temperature Correction Factor	
03	Corrected CFM50	

H. Accuracy Adjustment		
01	Standard Deviation of Nominal CFM 50 Values Above	
02	Percent Uncertainty	
03	Accuracy Level	
04	Accuracy Adjustment Factor	
05	Adjusted CFM50 Pressurization (measured air leakage rate)	
06	Corrected CFM50 (from software)	
07	Percent Uncertainty @ 95% Confidence Level (from software)	

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STATE OF CALIFORNIA

BUILDING LEAKAGE WORKSHEET

CEC-CF2R-MCH-24-H (Revised 10/16) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF INSTALLATION	CF2R-MCH-24-H
Building Leakage Worksheet	(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 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:

1. The information provided on this Certificate of Installation is true and correct.
2. I am either: a) a responsible person 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, or b) I am an authorized representative of the responsible person and attest to the declarations in this statement on the responsible person's behalf.
3. 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 Certificate of Compliance, plans, and specifications approved by the enforcement agency.
4. I understand that a HERS rater will check the installation to verify compliance and if such checking determines the installation fails to comply, I am required to offer any necessary corrective action at no charge to the building owner.
5. 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):	

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CF2R-MCH-24e-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 5,000 feet require an adjustment to the calculations.
5. This number is automatically pulled from the CF1R. 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 (MCH24e) - Depressurization

1. Enter the Time Average Period used on the manometer during the DEPRESSURIZATION test. Must be at least 10 seconds.
2. If ASTM E779-10 compliant software is being used for the calculations, enter "yes" here. Otherwise, choose "no".

Note: A minimum of five and a maximum of nine data points are required for items C.3 and C.4 for this test.

3. Enter 5-9 Induced Building Pressure readings from the manometer (automatic baseline feature turned on). It should be close to -50 Pa, but no greater than -15 Pa.
4. Enter 5-9 Nominal CFM50 readings from the manometer.
5. This field is automatically calculated. The equation used to calculate this value in the field equals ($C.4_1$+$C.4_2$+ $C.4_3$+ $C.4_4$+ $C.4_5$+$C.4_6$+ $C.4_7$+ $C.4_8$+ $C.4_9$)/N or the number of tests = Average Nominal CFM50

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, then enter 1 as Altitude Correction in box D. 1.
   b. If the elevation is greater than 5,000 ft, the Altitude Correction equation equals 1 + (0.000006 * elevation in feet).
2. Enter the Temperature Correction Factor from Table RA3.8-2 using the indoor and outdoor temperatures entered in Section A.

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

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

3. This field is automatically calculated. The equation used to calculate this value in the field equals to the product of C.5 * D.1 * D.2.

Section E. Accuracy Adjustment

1. This field is automatically calculated. It is the Standard Deviation of the Nominal CFM50 values from Rows $C.4_1$ through $C.4_9$. The equation used to calculate this value in the field equals the square root of {[(C.5- $C.4_1$)^2+(C.5- $C.4_2$)^2+(C.5- $C.4_3$)^2+(C.5- $C.4_4$)^2+(C.5- $C.4_5$)^2+(C.5- $C.4_6$)^2+(C.5- $C.4_7$)^2+(C.5- $C.4_8$)^2+(C.5- $C.4_9$)^2]/N-1 or the number of tests minus one} = Standard Deviation of the Nominal CFM50.
2. This field is automatically calculated. It is the Percent Uncertainty and the equation used to calculate this value in the field equals {[(E.1/ square root N or the number of tests)x t-statistic look up from table RA 3.8-1]/D.3 Corrected CFM50} = Percent Uncertainty.

Table 3.8-1 Precision Uncertainty: *Values of t-statistic*

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

3. This field is automatically calculated. The equation used to calculate this value in the field equals:
   a. If the Percent Uncertainty in E.2 ≤ 10, then enter "standard" as Accuracy Level in box E. 3.
   b. If the Percent Uncertainty in E.2 > 10, then enter "reduced" as Accuracy Level in box E. 3.
4. This field is automatically calculated. The equation used to calculate this value in the field equals:
   a. If the Accuracy Level E.3 = Standard, then enter 1 as Accuracy Adjustment Factor in box E.4.
   b. If the Accuracy Level E.3 = Reduced, Accuracy Adjustment Factor equation equals 1+(E.2/100).
5. This field is automatically calculated. The equation used to calculate this value in the field equals the D.3 * E.4 = Adjusted CFM50.
6. Enter the Corrected CFM50 from manometer software.
7. Enter the Percent Uncertainty from manometer software.

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Section F. Envelope Leakage (MCH24e) - Pressurization

1. Enter the Time Average Period used on the manometer during the PRESSURIZATION test. Must be at least 10 seconds.
2. If ASTM E779-10 compliant software is being used for the calculations, enter "yes" here. Otherwise, choose "no".

Note: A minimum of five and a maximum of nine data points are required for items F.3 and F.4 for this test.

3. Enter 5-9 Induced Building Pressure readings from the manometer (automatic baseline feature turned on). It should be close to 50 Pa, but no less than 15 Pa.
4. Enter 5-9 Nominal CFM50 readings from the manometer.
5. This field is automatically calculated. The equation used to calculate this value in the field equals ($F.4_1$+$F.4_2$+ $F.4_3$+ $F.4_4$+ $F.4_5$+$F.4_6$+ $F.4_7$+ $F.4_8$+ $F.4_9$)/N or the number of tests = Average Nominal CFM50.

Section G. Altitude and Temperature Correction

1. This field is automatically calculated. The equation used to calculate this value in the field equals:
   c. If the elevation is less than or equal to 5,000 ft, then enter 1 as Altitude Correction in box G. 1.
   d. If the elevation is greater than 5,000 ft, the Altitude Correction equation equals 1 + (0.000006 * elevation in feet).
2. Enter the Temperature Correction Factor from Table RA3.8-3 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	09.17	0.913	0.909	0.905	0.900
	25	0.944	0.939	0.935	0.930	0.926	0.922	0.917	0.913	0.909
	30	0.952	0.948	0.943	0.939	0.934	0.930	0.926	0.921	0.917
	35	0.961	0.956	0.952	0.947	0.943	0.938	0.934	0.930	0.926
	40	0.970	0.965	0.960	0.956	0.951	0.947	0.942	0.938	0.934
	45	0.978	0.974	0.961	0.964	0.960	0.955	0.951	0.946	0.942
	50	0.987	0.982	0.977	0.973	0.968	0.963	0.959	0.955	0.950
	55	0.995	0.990	0.986	0.981	0.976	0.972	0.967	0.963	0.958
	60	1.004	0.999	0.994	0.998	0.985	0.980	0.976	0.971	0.967
	65	1.012	1.008	1.003	0.998	0.993	0.988	0.984	0.979	0.975
	70	1.021	1.016	1.011	1.006	1.001	0.997	0.992	0.988	0.983
	75	1.029	1.024	1.019	1.015	1.010	1.005	1.000	0.996	0.991
	80	1.038	1.033	1.028	1.023	1.018	1.013	1.009	1.004	0.999
	85	1.046	1.041	1.036	1.031	1.026	1.022	1.017	1.012	1.008
	90	1.055	1.050	1.045	1.040	1.035	1.030	1.025	1.020	1.016
	95	1.063	1.058	1.053	1.048	1.043	1.038	1.033	1.028	1.024
	100	1.072	1.066	1.061	1.056	1.051	1.046	1.041	1.037	1.032
	105	1.080	1.075	1.070	1.064	1.059	1.054	1.050	1.045	1.040
	110	1.088	1.083	1.078	1.073	1.068	1.063	1.058	1.053	1.048

3. This field is automatically calculated. The equation used to calculate this value in the field equals to the product of F.5 * G.1 * G.2.

Section H. Accuracy Adjustment

1. This field is automatically calculated. It is the Standard Deviation of the Nominal CFM50 values from Rows $F.4_1$ through $F.4_9$. The equation used to calculate this value in the field equals the square root of {[(F.5- $F.4_1$)^2+(F.5- $F.4_2$)^2+(F.5- $F.4_3$)^2+(F.5- $F.4_4$)^2+(F.5- $F.4_5$)^2+(F.5- $F.4_6$)^2+(F.5- $F.4_7$)^2+(F.5- $F.4_8$)^2+(F.5- $F.4_9$)^2]/N-1 or the number of tests minus one} = Standard Deviation of the Nominal CFM50.
2. This field is automatically calculated. It is the Percent Uncertainty and the equation used to calculate this value in the field equals {[(H.1/ square root N or the number of tests)x t-statistic look up from table RA 3.8-1]/G.3 Corrected CFM50} = Percent Uncertainty.

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Table 3.8-1 Precision Uncertainty: *Values of t-statistic*

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

3. This field is automatically calculated. The equation used to calculate this value in the field equals:
    c. If the Percent Uncertainty in H.2 ≤ 10, then enter "standard" as Accuracy Level in box H. 3.
    d. If the Percent Uncertainty in H.2 > 10, then enter "reduced" as Accuracy Level in box H. 3.
4. This field is automatically calculated. The equation used to calculate this value in the field equals:
    c. If the Accuracy Level H.3 = Standard, then enter 1 as Accuracy Adjustment Factor in box H.4.
    d. If the Accuracy Level H.3 = Reduced, Accuracy Adjustment equation equals 1+(H.2/100).
5. This field is automatically calculated. The equation used to calculate this value in the field equals the G.3 * H.4 = Adjusted CFM50.
6. Enter the Corrected CFM50 from manometer software.
7. Enter the Percent Uncertainty from manometer software.

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