STATE OF CALIFORNIA

# BUILDING LEAKAGE DIAGNOSTIC TEST

CEC-CF3R-ENV-20-H (Revised 03/15) 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 (degreeF) | |
| 04 | Outdoor Temperature During Test (degreeF) | |
| 05 | Blower Door Location | |
| 06 | Building Elevation (ft) | |
| 07 | Building Volume (ft3) | |
| 08 | 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) |
|---|---|---|---|
| | | | |
| | | | |

**ENV20a - Single Point Air Tightness Test With Manual Meter**

| C. Envelope Leakage Diagnostic Test | | |
|---|---|---|
| 01 | Time Average Period of Meter | |
| 02 | Test Methodology | |
| 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 | |

| D. Altitude and Temperature Correction | | |
|---|---|---|
| 01 | Altitude correction factor | |
| 02 | Temperature Correction Factor | |
| 03 | Corrected CFM50 | |

| CERTIFICATE OF VERIFICATION | | CF3R-ENV-20-H |
|---|---|---|
| Building Leakage Diagnostic Test | | (Page 2 of 3) |
| Project Name: | Enforcement Agency: | Permit Number: |
| Dwelling Address: | City | Zip Code |

| **E. Accuracy Adjustment** | | |
|---|---|---|
| 01 | Accuracy Adjustment factor | |
| 02 | Adjusted CFM50 (measured air leakage rate) | |

| **F. Compliance Statement** | |
|---|---|
| 01 | |

| **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: | |
| 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. | |
| 01 | |

| 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:

1. The information provided on this Certificate of Verification is true and correct.
2. I am the certified HERS Rater who performed the verification identified and reported on this Certificate of Verification (responsible rater).
3. 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.
4. 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.
5. 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) |
|---|---|

**HERS RATER INFORMATION**

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

# CF3R-ENV-20a-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 performance approach Certificate of Compliance 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 5000 feet require an adjustment to the calculations.
7. This number is automatically pulled from the performance approach Certificate of Compliance. 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 Row A.8, 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 (ENV20a)**

1. Enter the time average period used on the manometer during the test. Must be at least 10 seconds.
2. Select the type of test being performed: Pressurization (air blowing into house) or Depressurization (air blowing out of house). Note that depressurization is the preferred method.
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); c. 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 * 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 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 |

**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 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/Nominal CFM50)]
2. This field is automatically calculated when using the online form. The Adjusted CFM50 is the Corrected CFM50 multiplied times 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 Row A.2.

**Section F. Compliance Statement**

1. This field is automatically calculated when using the online form. 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**

1. This statement must be true (or not applicable) for the test to conform to the protocols.
2. This statement must be true (or not applicable) for the test to conform to the protocols.
3. This statement must be true (or not applicable) for the test to conform to the protocols.
4. This statement must be true (or not applicable) for the test to conform to the protocols.
5. This statement must be true (or not applicable) for the test to conform to the protocols.