What your HERS QA Provider Wishes You Knew

2014 RESNET Conference - Atlanta

26 February 2014

About Energy Vanguard

- *High-performance homes:*
  Knowledge + Service
- Consulting & Training
- HERS QA provider
- Full HVAC design
  (Manuals J, S, T, & D)
- BPI Test Center
- Industry leading blog
- Allison is member of RESNET QA Committee (and PHIUS Board of Directors)

Topics for Discussion

RESNET REQUIREMENTS

QUALITY ASSURANCE

SOFTWARE

HELPFUL RESOURCES

RESNET Requirements

- Chapter 8
- Correction Factors & Adjustments
- Baseline
- Duct leakage exemption
- Certification/Recertification
- Rating Registry

RESNET Chapter 8 – Testing Standards

Blower Door Setup – Doors Open or Closed?

- Attached Garage-section 802.2.2
  - CLOSED. Unless you have the blower door installed between the house and garage.
- Crawlspace–section 802.2.3
  - If encapsulated, OPEN between house and crawlspace, but vents and external doors CLOSED.
  - If unconditioned, interior doors CLOSED, but vents and exterior doors should be OPEN.

RESNET Chapter 8 – Testing Standards

Blower Door Procedure – Testing Conditions

- Temperature–Section 802.4.3 – Record indoor and outdoor temperature in degrees F°
  - If difference in indoor and outdoor temperature is more than 30 degrees F°, you must calculate the **CORRECTED CFM50** with the formula on the next slide.
- Altitude–Section 802.4.4 – Record if above 5000ft
  - If above 5000 ft, you must calculate the **CORRECTED CFM50**

RESNET Chapter 8 – Testing Standards

Blower Door – Calculating Corrected CFM_{50}

- Formula-Section 802.5.9

Corrected CFM50 = Nominal CFM50 x *Altitude Correction Factor* x *Temperature Correction Factor*, where

Altitude Correction Factor = 1 + (0.000006 x altitude (ft))

Temperature Correction Factor = value in Table 802.1 below.

RESNET Chapter 8 – Testing Standards

Blower Door – Temperature Correction Factors

Chart found in section 802.7.9 of Standards

Table 802.1 Temperature Correction Factors for Pressurization and Depressurization Testing- Calculated according to ASTM E779-10

Correction Factors for Pressurization Testing

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	0.977	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

Correction Factors for Depressurization Testing

OUTSIDE TEMP (F) \ INSIDE TEMPERATURE (F)	50	55	60	65	70	75	80	85	90
-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	0.925
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	0.989	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
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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

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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
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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

Correction Factors for Depressurization Testing

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-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	0.925
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	0.989	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

RESNET Baseline

Sections 802.5.1 – 802.5.2

- Take FIVE separate baselines w/10 seconds or more between samples.
- Press BASELINE. Press START.
- After 10 seconds, RECORD pressure in Pa.
- Press START. After 10 seconds, RECORD pressure.
- Repeat line above 3 more times.
- Calculate the difference between the highest and lowest pressure readings. *(Remember to take the positive and negative signs into account when you calculate!)*

RESNET Baseline

Section 802.5.3

If the difference between the highest and lowest baseline reading is:

- < 5.0Pa – Standard Level of Accuracy *(continue as normal)*
- Between 5.0Pa and 10.0Pa – Reduced Level of Accuracy *(see next slide for action step)*
- > 10.0Pa – TILT… GAME OVER
  - *(cannot use a one-point airtightness test)*

RESNET Baseline

Section A

Pre-Test Baseline Pressure Readings
(include sign of reading)

Time Averaging Period (seconds)

Largest Baseline Reading	
minus	
Smallest Baseline Reading	
Baseline Range	

Check the appropriate accuracy level below, based on the size of the Baseline Range.

- ☐ **Standard Accuracy Test** (Baseline Range less than 5.0 Pa)
- ☐ **Reduced Level of Accuracy Test** (Baseline Range between 5.0 and 10.0 Pa)
- ☐ **Invalid Test** (Baseline Range greater than 10.0 Pa)

** - for one-point airtightness tests*

RESNET Baseline

Section 802.8.1

Adjustment for **Reduced Level of Accuracy**

- Must calculate the **ADJUSTED CFM50** with this formula:

adjusted CFM50 = extending factor x corrected CFM50,

where:

For a One-point Test, classified as Reduced Level of Accuracy:

extending factor = 1 + 0.1 x (50 / the induced pressure)

RESNET Baseline

Blower Door Procedure – Adjusted CFM50

- Ok. So where do I use it?

adjusted CFM50 value shall be used when:

- determining whether or not a building meets an airtightness threshold, and
- conducting a Home Energy Rating for the purpose of compliance with any standard, energy code or program.

adjusted CFM50 value shall NOT be used when:

- calculating the expected energy savings from retrofit,
- conducting an energy audit, or
- assessing the relative airtightness of a group of buildings.

RESNET Baseline

Calculations Recap:

- Corrected CFM50 is calculated when temperature difference is 30 degrees F° or altitude is greater than 5000 ft.

- Adjusted CFM50 is calculated when the baseline range is greater than 5.0 Pa but less than 10.0Pa.
  - NOTE! – The Adjusted CFM50 formula uses the Corrected CFM50 in its calculation

RESNET Duct Leakage

Duct Leakage Test Setup

- Exempt from testing? – Section 803.2
  - Inside conditioned space AND 100% visible **at time of testing** and fully ducted (no building cavities used)

- Unconditioned Spaces-Section 803.3.5 – If ducts run through unconditioned spaces, then those spaces need to be connected to the outside

RESNET Duct Leakage

Duct Leakage Test Setup

- Duct Tester goes where?-Section 803.4.1
  - Attach fan to:
    - Largest return grille closest to the air handler, OR
    - At air handler cabinet (recommended if 3 or more returns)
- Hose goes where?-Section 803.4.2
  - Duct pressure is measured at:
    - Largest supply register closest to the air handler, OR
    - Main supply trunk line, OR
    - Supply plenum (if tester installed at a central return)

DOCUMENT SETUP LOCATIONS!!

RESNET Certification Requirements

- **Initial certification**
  - Probationary ratings
  - Agreement
- **Recertification**
  - Every 3 years
  - 18 CEUs
  - Or conference
  - Or take the test

RESNET Registry

- Address must be correct
- Provider-Rater relationship must be correct

Quality Assurance

- The first 60 seconds
- 10% rating data file review definition
- QA when changing providers
- Equipment calibration
- Documentation

In the first 60 seconds

- I hit the analysis button. Errors/Warnings?
- Quickly look at the energy usage and compare to the home size and geography.
- Area Analysis tab – compare floor and ceiling area, check window ratios
- Property address – actual and does it match
- RTIN correct? Rating type?
- Compare climate location to property address
- Divide volume by CFA

QA – 10% rating data file

Rating Data File – The collection of information that makes up a file for Home Energy Ratings projected from plans or confirmed, including take-off forms, field data collection forms, energy simulation software files, RESNET Standard Disclosure Forms, rating certificates, rating reports, QA records (including findings and the resolution of any issues) as well as any documentation required by Third-Party Energy Efficiency Programs (EEP's) such as checklists, copies of labels or third-party certificates.

- **>10% of all ratings are required to have a rating data file review.**
- **Drawings, field notes, checklists, HVAC docs, pictures** (elevations, insulation, and oddities)
- **Standard Disclosure!**

QA – Documentation

- Take pictures of "everything" during site visits
- Standard disclosure. Standard disclosure. Standard disclosure. Standard disclosure.
- Print/Save reports when you get the file back to minimize REM/Rate version issues.

QA – Changing Providers

- RESNET requires that all providers complete 1% field QA for all ratings submitted through them.
- Mid-year transfer will likely require field QA's from old and new provider

QA – Equipment Calibration

- **Calibration CHECK every year**
- **Manometers**
  - Manufacturer
  - RESNET
- **Fans**
  - "Tongue test"
  - Sensor position test
  - Duct blaster calibration plate

Software – REM/Rate

- REM/Rate tricks and tips
- Libraries

REM/Rate Tips

- **Standard Disclosure**
  - Check under the "Extras" menu
- **Logos**
  - Reports Menu: "New Logos…"
- **Templates**
  - Same information over and over… Set to Default Building under the File menu

REM/Rate Tips

- **Making copies**
  - Use a file that doesn't have a registry id
- **Rotating the building**
  - Tools Menu: "Rotate Windows/Skylights"
- **Comparing two files**
  - 2: Building Reports

REM/Rate Tips

Speaking of printing…

- **Old Reports (i.e. Building File Report)**
  - Reports Menu "Old View/Select Reports…"
- **Version 14 printing cautions**
  - Print All
  - Save as PDF

REM/Rate Tips

- **Changing your view**
- **Reset Windows Layout**
- **File Maneuvers**
  - Within REM/Rate
    - Tab
    - Shift Tab
    - Drop down “alphabet-seek”
    - Math in cells
  - Alt Tab (PC only)

REM/Rate Tips

- **Batch changes**
  - Awesome!
  - File Menu or Tools Menu: “Batch File Modification…”
- **Batch printing**
  - Awesome-er!
  - Reports Menu: “Batch…”

Helpful Resources

Various places for information

- **REM/Rate discussion group on Google**
  "REM Software Group"

- **Mechanical equipment resources**
  - AHRI – ahri.org
  - Other methods

- **Lights and Appliances**

AHRI website

- ahridirectory.org
- Best for new equipment
- Use RESIDENTIAL section at top
  (instead of COMMERCIAL)
- Choose correct category
  - Heat pumps are separate from AC and furnaces
  - Water Heaters section is very useful
- Try to use model # data as often as possible
  - For ACs & heat pumps, enter outdoor unit data first
  - Truncate model # when no results are returned

AHRI website

Try these examples

- Heat pump - 25HBC330A300 condenser & FB4CNF030 air handler
- Heat pump – 13PJL24A01 condenser & RHLL-HM2417JA air handler
- AC – GSX130361BA, CAPF3636B6DB
- Furnace – GMS80804BXB
- DHW – 82V52-2

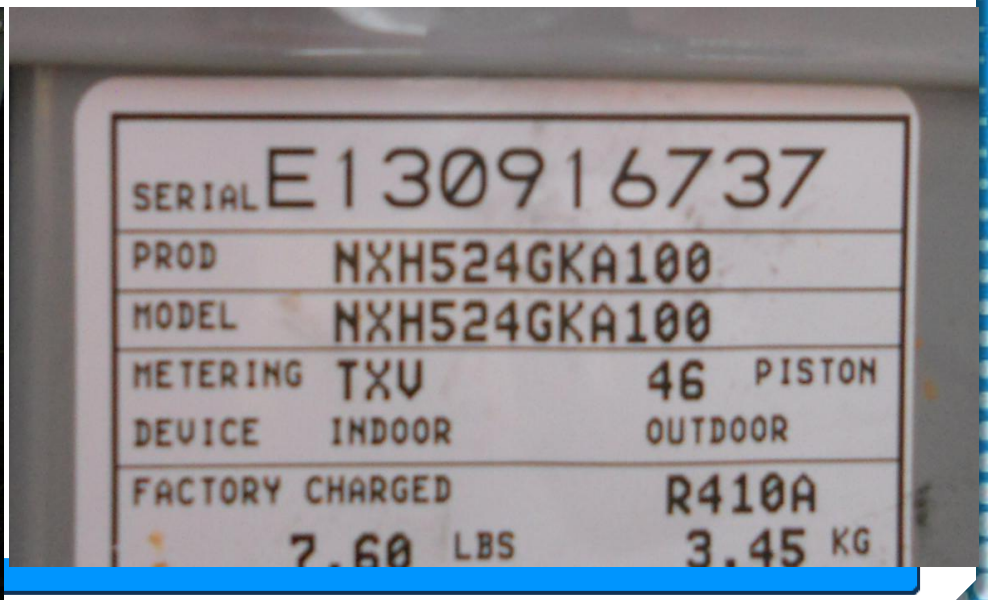
Other Methods

- **Don't solely rely on the yellow Energy Guide label on condenser. It's often incorrect.**

- **Can use Preston's Guide for older furnaces**
  - $125 for print
  - $350 for CD-ROM
  - $125/yr for online access
    ($60 for 3 month trial)

Other Methods – Experience

- **Math for furnaces**
  - Label will often have input and output capacities
- **Model numbers and model names**
  - Good for sizes, not always good for SEER ratings



Other Methods – Defaults

Table 303.8 in Ch 3 of RESNET standards

also in

REM/Rate Help file

Default Equipment Efficiencies

combined forces to create AHRI, the Air-Conditioning, Heating, and Refrigeration Institute.

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Heating Equipment	Units							
Gas Furnace	AFUE	60	60	65	68	68	76	78
Gas Boiler	AFUE	60	60	65	65	70	77	80
Oil Furnace	AFUE	60	65	72	75	80	80	80
Oil Boiler	AFUE	60	65	72	75	80	80	80
Air-Source Heat Pump	HSPF	4.5	4.5	4.7	5.5	6.3	6.8	6.8
Ground-Water Heat Pump	COP	2.7	2.7	2.7	3.0	3.1	3.2	3.5
Ground-Coupled Heat Pump	COP	2.3	2.3	2.3	2.5	2.6	2.7	3.0

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Cooling Equipment	Units							
Air-Source Heat Pump	SEER	5.0	6.1	6.5	7.4	8.7	9.4	10.0
Ground-Water Heat Pump	EER	10.0	10.0	10.0	13.0	13.0	14.0	16.0
Ground-Coupled Heat Pump	EER	8.0	8.0	8.0	11.0	11.0	12.0	14.0
Central Air Conditioner	SEER	5.0	6.1	6.5	7.4	8.7	9.4	10.0
Room Air Conditioner	EER	5.0	6.1	6.1	6.7	7.7	8.1	8.5

Year of Manufacture		Pre-60	60-69	70-74	75-83	84-87	88-91	92-
Water Heating Equipment	Units							
Gas Storage	EF	0.47	0.47	0.47	0.49	0.55	0.56	0.56
Oil Storage	EF	0.47	0.47	0.47	0.48	0.49	0.54	0.56
Electric Storage	EF	0.79	0.80	0.80	0.81	0.83	0.87	0.88

Lights & Appliances

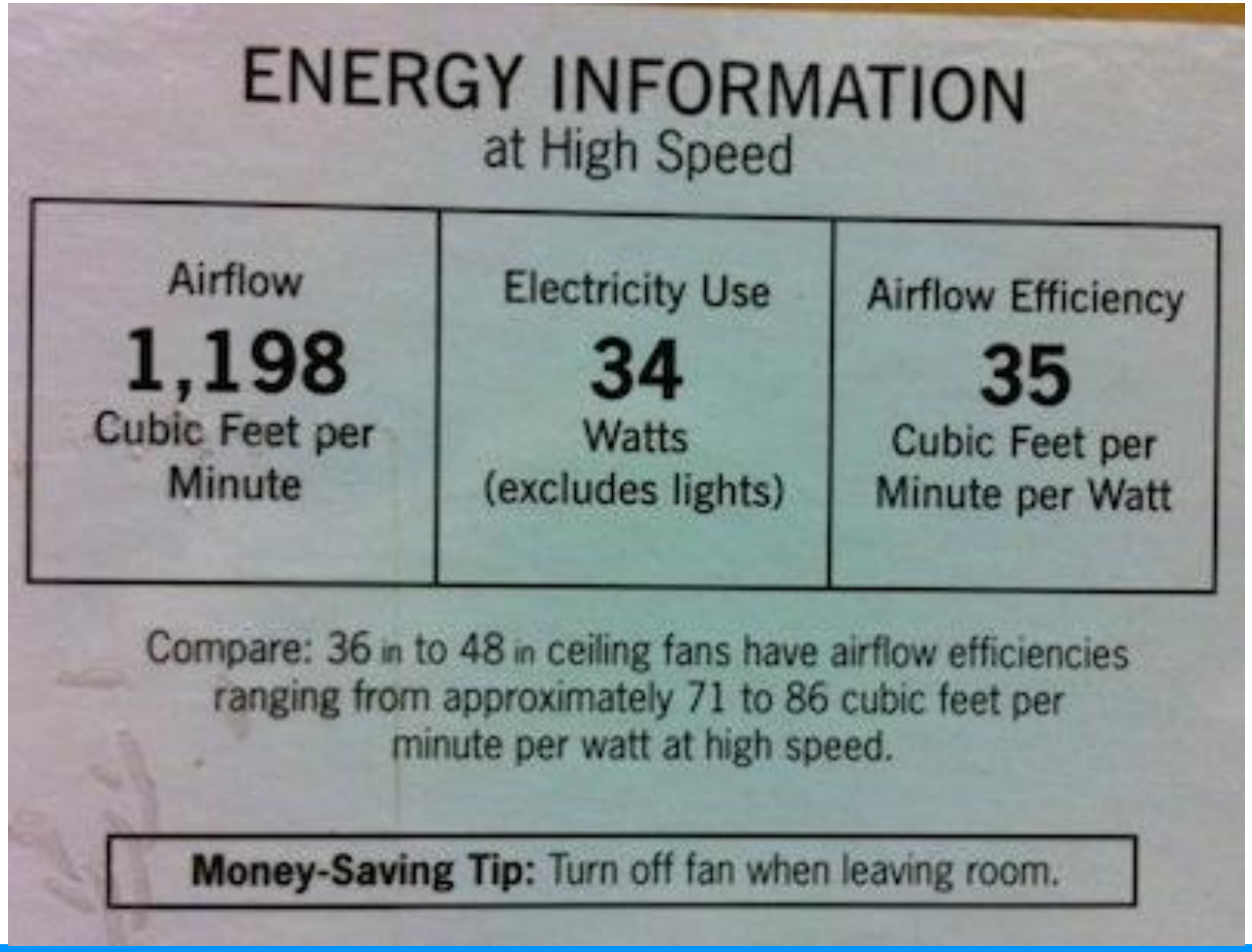
- **Screen Review**

- **Potential Resources for specs:**
  - For new homes, find "the drawer"
  - ENERGY STAR® website (DW, Refrigerators, CW)
  - Google search
  - Manufacturer's website

Lights & Appliances

- **Light % data**
  - CFL & Pin Based are for interior only
  - Exterior is % of exterior fixtures that are efficient
  - Garage is % of garage fixtures that are efficient
- **Fans policy**
  - Can't be zero if any ceiling fans are present
  - REM/Rate asks for cfm/watt at Medium Speed
  - Most labels on boxes state cfm/watt at High Speed
    - But other data is often there

Fan Label



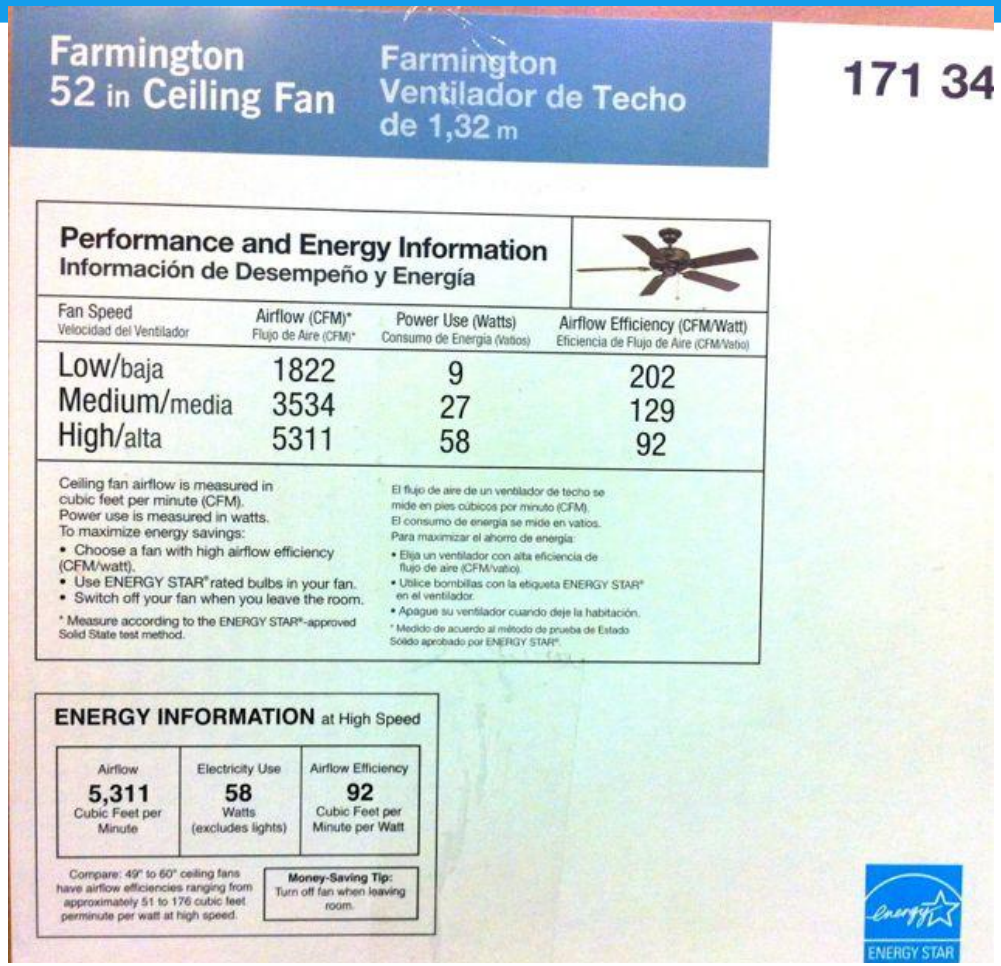
ENERGY INFORMATION
at High Speed

Airflow	Electricity Use	Airflow Efficiency
1,198 Cubic Feet per Minute	**34** Watts (excludes lights)	**35** Cubic Feet per Minute per Watt

Compare: 36 in to 48 in ceiling fans have airflow efficiencies ranging from approximately 71 to 86 cubic feet per minute per watt at high speed.

Money-Saving Tip: Turn off fan when leaving room.

Fan Label



Farmington
52 in Ceiling Fan

Farmington
Ventilador de Techo
de 1,32 m

171 34

Performance and Energy Information
Información de Desempeño y Energía

Fan Speed Velocidad del Ventilador	Airflow (CFM)* Flujo de Aire (CFM)*	Power Use (Watts) Consumo de Energía (Vatios)	Airflow Efficiency (CFM/Watt) Eficiencia de Flujo de Aire (CFM/Vatio)
Low/baja	1822	9	202
Medium/media	3534	27	129
High/alta	5311	58	92

Ceiling fan airflow is measured in cubic feet per minute (CFM).
Power use is measured in watts.
To maximize energy savings:

- Choose a fan with high airflow efficiency (CFM/watt).
- Use ENERGY STAR® rated bulbs in your fan.
- Switch off your fan when you leave the room.

* Measure according to the ENERGY STAR®-approved Solid State test method.

El flujo de aire de un ventilador de techo se mide en pies cúbicos por minuto (CFM).
El consumo de energía se mide en vatios.
Para maximizar el ahorro de energía:

- Elija un ventilador con alta eficiencia de flujo de aire (CFM/vatio).
- Utilice bombillas con la etiqueta ENERGY STAR® en el ventilador.
- Apague su ventilador cuando deje la habitación.

* Medido de acuerdo al método de prueba de Estado Sólido aprobado por ENERGY STAR®.

ENERGY INFORMATION at High Speed

Airflow	Electricity Use	Airflow Efficiency
5,311 Cubic Feet per Minute	**58** Watts (excludes lights)	**92** Cubic Feet per Minute per Watt

Compare: 49" to 60" ceiling fans have airflow efficiencies ranging from approximately 51 to 176 cubic feet perminute per watt at high speed.

Money-Saving Tip:
Turn off fan when leaving room.

ENERGY STAR

Questions?

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