ENERGY STAR Certified Homes

Under Pressure:
Understanding & Using Static Pressure

March 1, 2016

- Under Pressure
- You're My Best Friend
- The Show Must Go On
- Another One Bites the Dust
- I Want it All

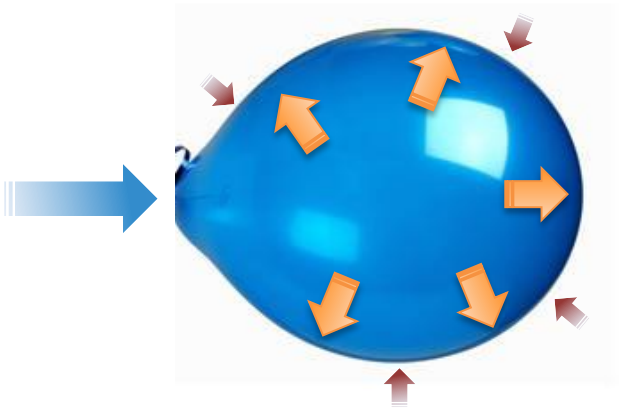
Agenda

- What is static pressure?
- Why is it important in design & commissioning?
- How do you measure it & determine the fan-speed setting?
- **Live demos!**
- How does this relate to ENERGY STAR & HERS Ratings?
- Question and answer session

What is Static Pressure?

What is static pressure?

A fan uses energy to push air



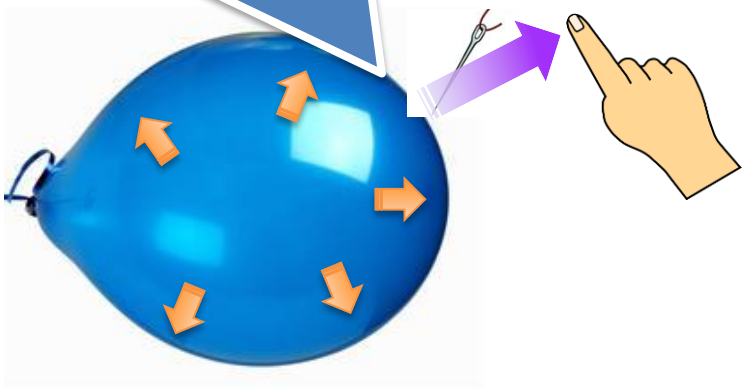
Like we use energy to push air into a plastic bag

What is static pressure?

Sealed bag

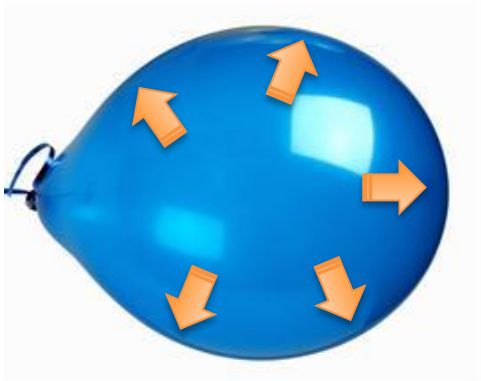
What is static pressure?

The pressure of moving air pushing against your finger is called Velocity Pressure

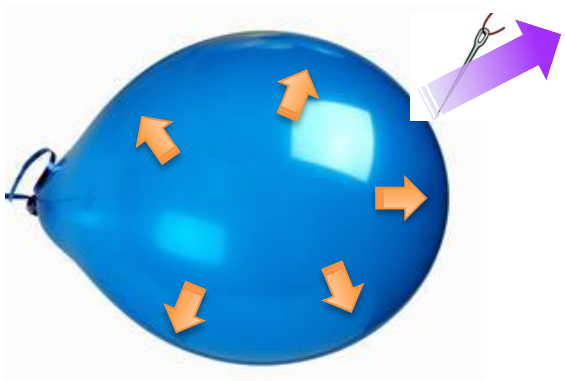


Bag with small hole

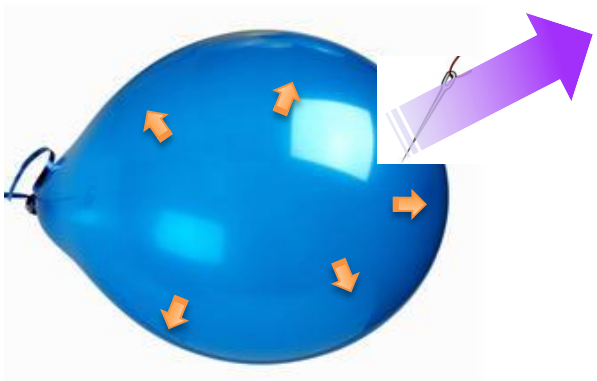
What is static pressure?



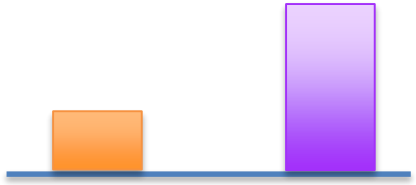
Sealed bag



Bag with small hole



Bag with large hole



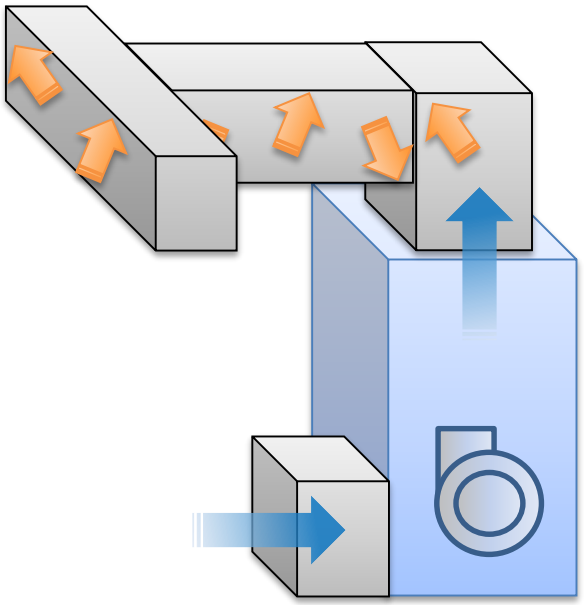
EPA

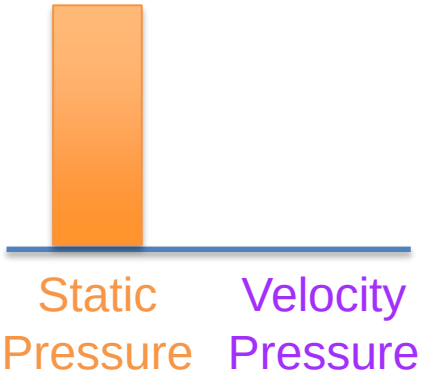
Summary: What is static pressure?

- A force, like your lungs or an HVAC fan, creates two kinds of pressure.
- Static pressure is the pressure of air pushing against all sides of the bag (even when there's no air movement).
- Velocity pressure is the pressure caused by the movement of air leaving the bag.
- The amount of static and velocity pressure is related.
- For a given force, as static pressure goes up, velocity pressure goes down, and vice versa.

Why is it Important in HVAC Design & Commissioning?

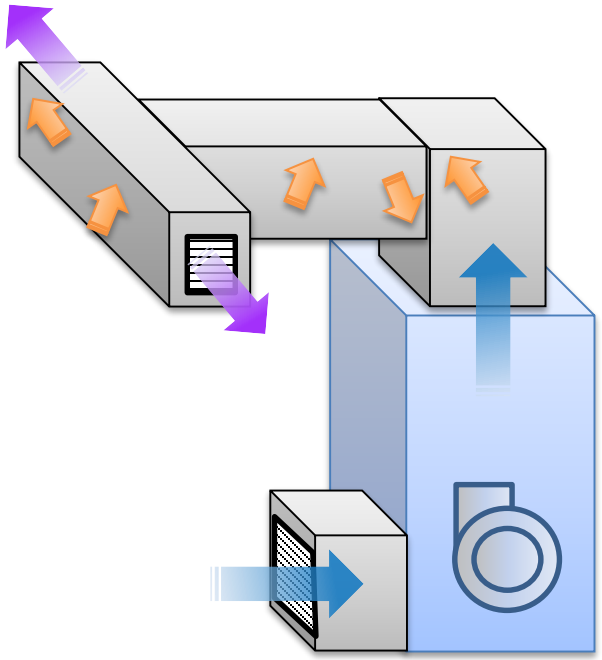
Why is it important?

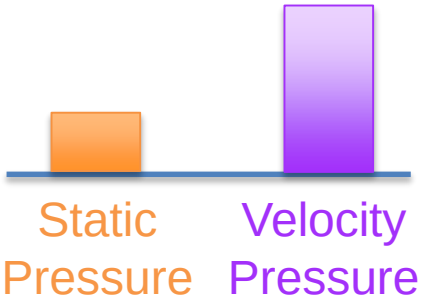




Weird HVAC system with no registers

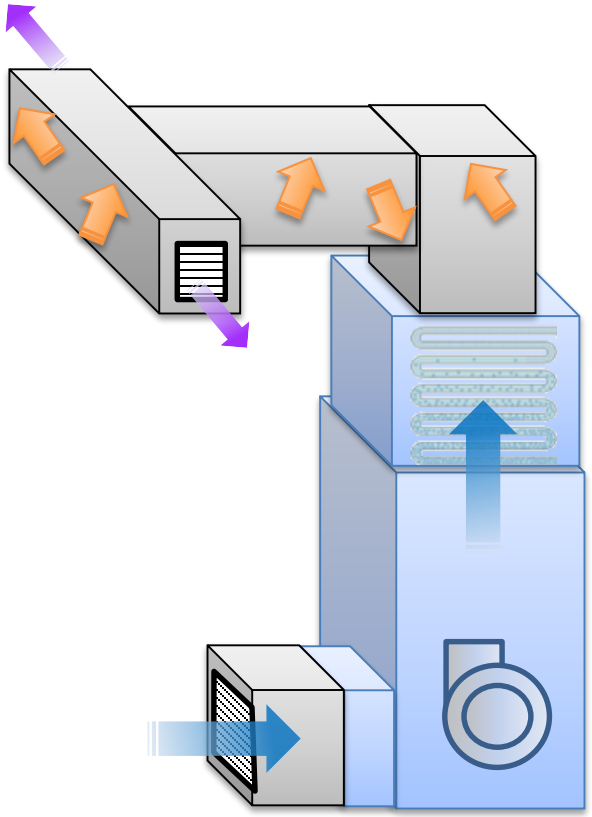
Why is it important?

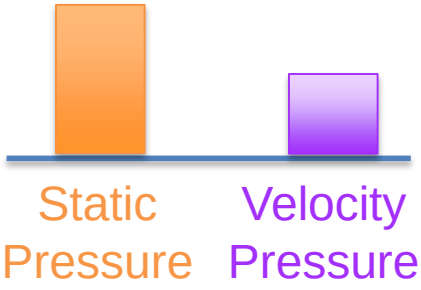




Typical HVAC system with registers

Why is it important?

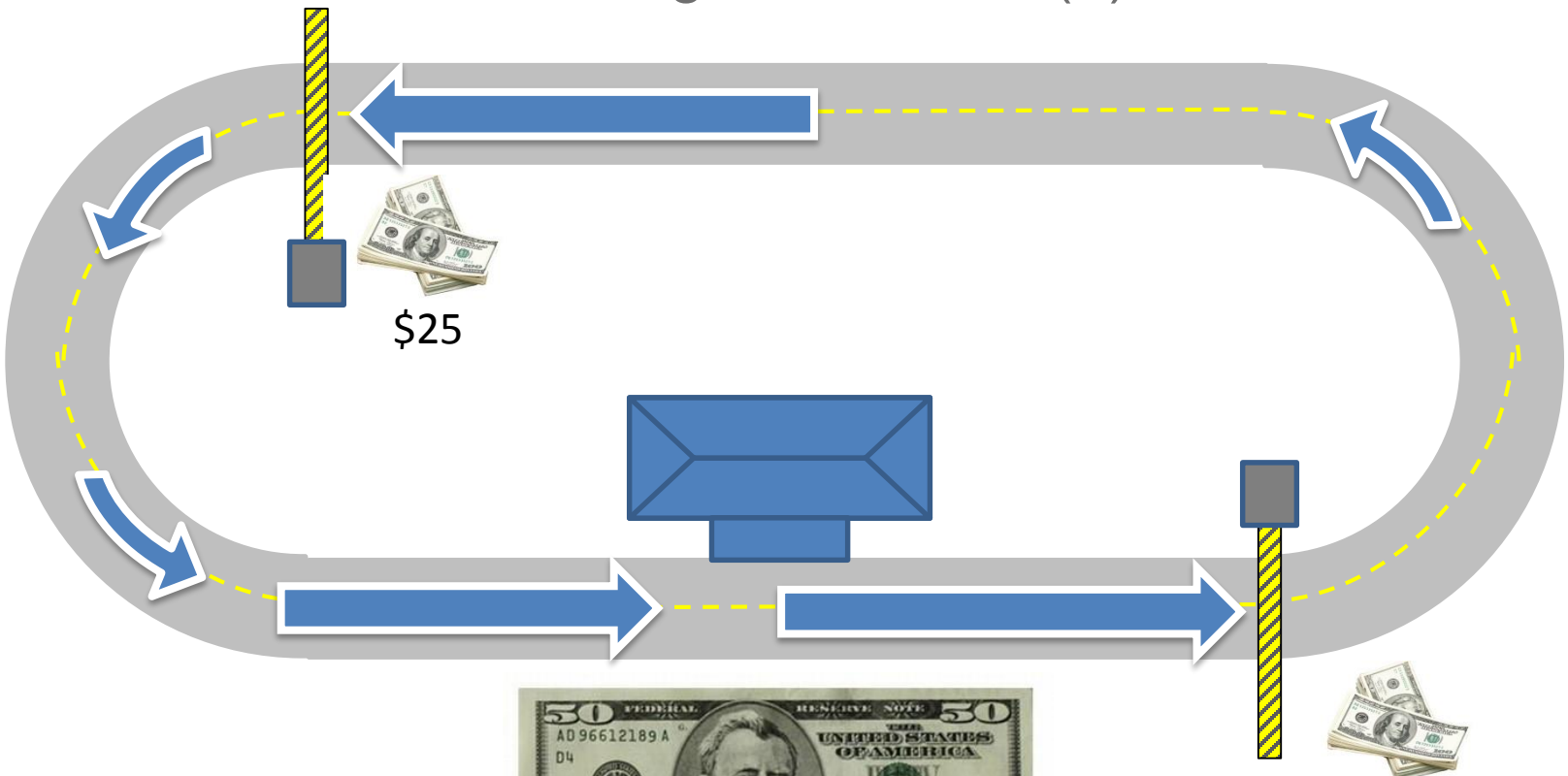




Typical HVAC system with registers, a cooling coil, and a filter

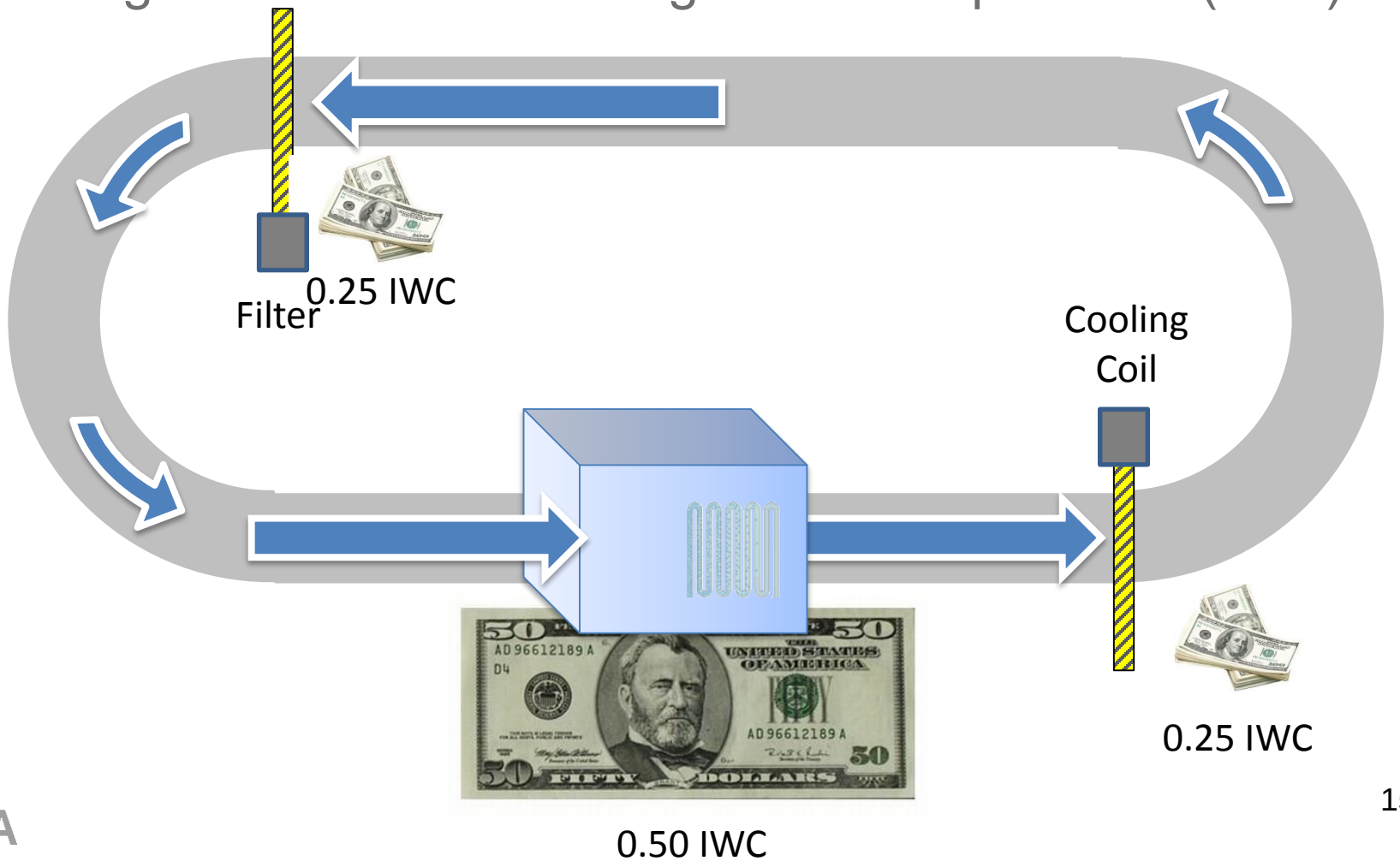
Why is it important?

- Driver must meet a 'budget' in dollars ($).



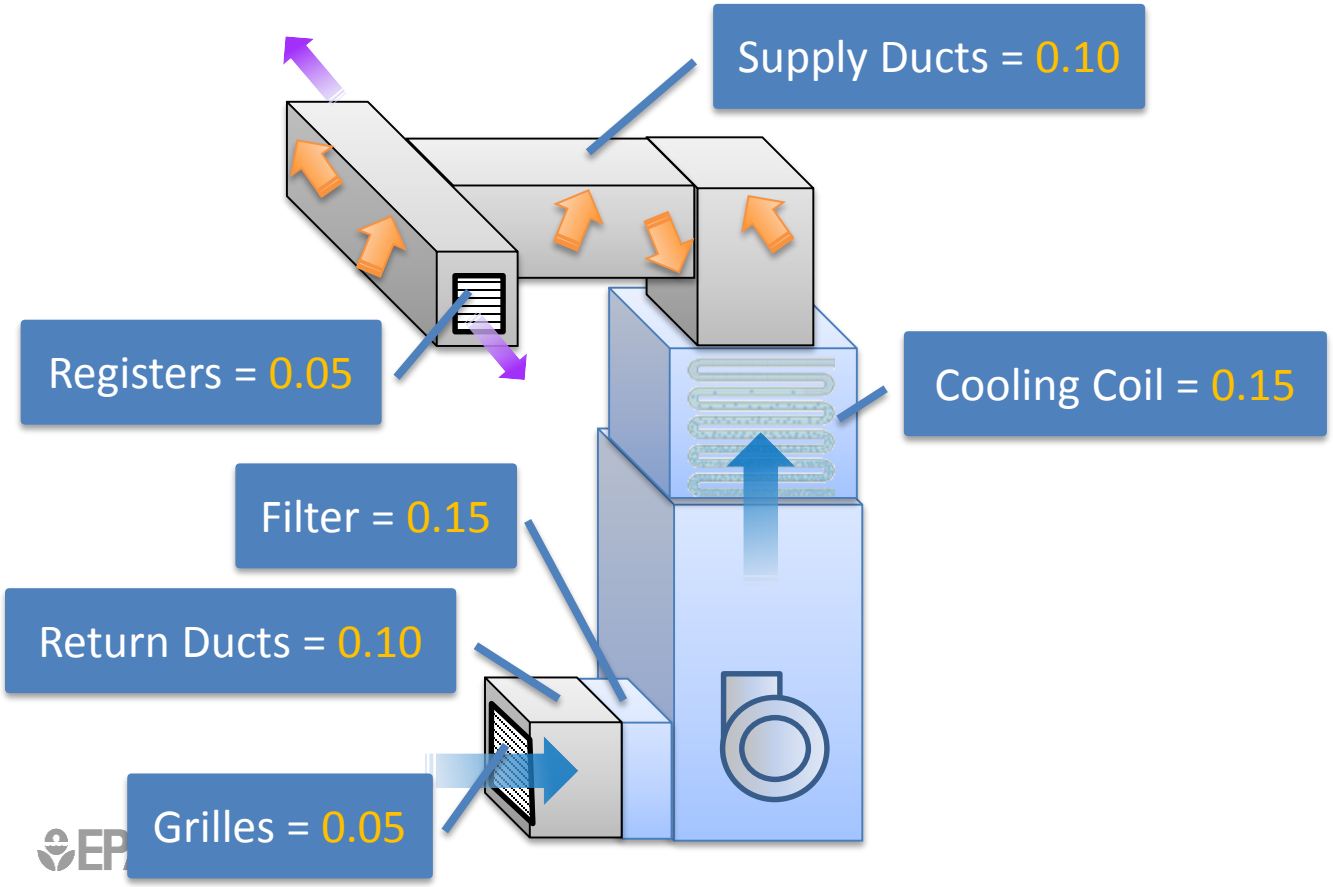
Why is it important?

- Designer must meet a ‘budget’ in static pressure (IWC).



Why is it important?

- Total External Static Pressure (ESP) – The sum of the static pressure that's external to the equipment with the fan.



Component	IWC
Cooling Coil	0.15
Supply Ducts	0.10
Registers	0.05
Grilles	0.05
Return Ducts	0.10
Filter	0.15
Total ESP	**0.60**

Why is it important?

- Designer gets their static pressure budget from HVAC manufacturer's 'blower table'.

G40UH-36A-070 PERFORMANCE

External Static Pressure		Air Volume / Watts at Various Blower Speeds											
		High			Medium-High			Medium-Low			Low		
in. w.g.	Pa	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts	cfm	L/s	Watts
0.00	0	1500	710	705	1290	610	565	985	465	455	830	390	375
0.05	12	1475	695	695	1275	600	555	980	465	445	820	385	365
0.10	25	1450	685	680	1255	590	545	970	460	440	810	380	360
0.15	37	1425	675	670	1240	585	535	965	455	430	805	380	355
0.20	50	1400	660	655	1225	580	525	955	450	425	795	375	350
0.25	62	1370	645	645	1205	570	510	945	445	415	790	375	345
0.30	75	1340	630	630	1180	555	500	930	440	405	780	370	335
0.40	100	1285	605	610	1140	540	475	900	425	390	745	350	325
0.50	125	1215	575	580	1080	510	450	865	410	375	705	335	310
0.60	150	1150	545	560	1015	480	430	810	380	355	655	310	290
0.70	175	1060	500	535	940	445	405	730	345	330	585	275	270
0.80	200	955	450	515	800	375	370	655	310	305	480	225	260
0.90	225	785	370	475	605	285	325	585	275	270	410	195	255

NOTE - All air data is measured external to unit with 1 in. (25 mm) cleanable filter (not furnished - field provided) in place. Also see Filter Air Resistance table.

Why is it important?

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NOTE - All air data is measured external to unit with 1 in. (25 mm) cleanable filter (not furnished - field provided) in place. Also see Filter Air Resistance table.

Why is it important?

- During commissioning, to assess airflow:
  1. Check the fan-speed setting and
  2. Measure the external static pressure

Component	Design (IWC)	Bad Install (IWC)
Total	0.60	0.95

Why is it important?

- During commissioning, to assess airflow:
  1. Check the fan-speed setting and
  2. Measure the external static pressure

Component	Design (IWC)	Bad Install (IWC)
Total	0.60	0.95
Cooling Coil	0.15	0.15
Supply Ducts	0.10	0.20
Registers	0.05	0.05
Grilles	0.05	0.05
Return Ducts	0.10	0.20
Filter	0.15	0.30

Why is it important?

- During commissioning, to assess airflow:
  1. Check the fan-speed setting and
  2. Measure the external static pressure

Component	Design (IWC)	Good Install (IWC)
Total	0.60	0.60

Summary: Why is it Important?

- Each part of the HVAC system costs a static pressure ‘toll’.
- The sum of ‘tolls’ is the total External Static Pressure (ESP).
- The HVAC fan must have the ‘budget’ to pay the ESP ‘toll’.
- Manufacturers publish the ESP ‘budget’ for every HVAC fan.
- Designers use this info so their design stays within ‘budget’.
- During commissioning, the fan-speed setting and measured total ESP can be compared to design to assess airflow.

How to Measure Static Pressure & Determine Fan-Speed Setting

How to Determine Fan-Speed Setting

https://www.youtube.com/watch?v=FkMuYEC6GHs&index=2&list=PLMvJzVnMdhhvhOKDyE_mURr0_JPC277G4

How to Measure Static Pressure

https://www.youtube.com/watch?v=Dbt-gZEACXg&index=3&list=PLMvJzVnMdhhvhOKDyE_mURr0_JPC277G4

LIVE DEMO!

How does this relate to ENERGY STAR & HERS Ratings?

How does this relate to ENERGY STAR?

1. Designer documents key info on HVAC Design Report.

HVAC Design Report [1]
ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 08)

5. Duct Design (Complete if heating or cooling equipment will be installed with ducts; otherwise check "N/A")					☐ N/A
5.1 Duct system designed for the equipment selected in Section 4, per ACCA Manual D					☐
5.2 Design HVAC fan airflow: [23]	Cooling mode	_____ CFM	Heating mode	_____ CFM	-
5.3 Design HVAC fan speed setting (e.g., low, medium, high): [24]	Cooling mode	_____	Heating mode	_____	-
5.4 Design total external static pressure (corresponding to the mode with the higher airflow in Item 5.2): [25]		_____ IWC			-
5.5 Room-by-room design airflows documented below (which must sum to the mode with the higher airflow in Item 5.2) [26, 27]					-

How does this relate to ENERGY STAR?

2. Contractor drills holes, measures ESP, checks fan-speed, and calculates airflow.

HVAC Commissioning Checklist [1, 2]
ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 08)

3. Indoor HVAC Fan Airflow		
3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of HVAC Design Report: ☐ Heating ☐ Cooling	☐	-
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.	☐	-
Test hole location for **return** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
Test hole location for **supply** external static pressure: ☐ Plenum ☐ Cabinet ☐ Transition ☐ Other: _____	-	-
3.3 Measured **return** external static pressure (Enter value only, without negative sign): _____ IWC	-	-
3.4 Measured **supply** external static pressure (Enter value only, without positive sign): _____ IWC	-	-
3.5 Measured **total** external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = _____ IWC	-	-
3.6 **Measured** (Item 3.5) - **Design** (Item 5.4 on HVAC Design Report) total external static pressure = _____ IWC	-	-
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM	-	-
3.8 Measured HVAC fan airflow (Item 3.7) is ± 15% of design HVAC fan airflow (Item 5.2 on HVAC Design Report)	☐	-

How does this relate to ENERGY STAR?

3. Rater measures & documents ESP.

Rater Field Checklist
ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 08)

HVAC System [30] (HVAC Design Report Item # indicated in parenthesis)	Must Correct	Rater Verified [2]	N/A [3]
5. Heating & Cooling Equipment			
5.1 HVAC manufacturer & model number on installed equipment matches either of the following (check box): [31] ☐ HVAC Design Report (4.3, 4.4, & 4.17) ☐ Written approval received from designer	☐	☐	-
5.2 External static pressure measured by Rater at contractor-provided test locations and documented below: [32] Return-Side External Static Pressure: _____IWC Supply-Side External Static Pressure: _____IWC	☐	☐	☐
5.3 Permitted, but not required: HVAC Commissioning Checklist collected, with no items left blank	☐	☐	☐

How does this relate to HERS ratings?

- Today, it doesn't.
- But, EPA is leading a RESNET working group to change that.
- In concept, it could follow the insulation quality-install model:

Grade III	• The default. No verification is done. • No penalty and no credit.
Grade II	• Rater verifies key design and installation parameters. • Verification indicates that the system is good but not great. • Partial credit awarded.
Grade I	• Rater duplicates the tasks in Grade II. • But, the verification indicates that the system is great. • Full credit awarded.

How does this relate to HERS ratings?

- Key benefits of such a standard would include:
  - Ability to gain HERS points for proper design & installation.
  - Standardization of procedures for Raters and contractors.
  - Reward incremental improvement by the industry.
  - Better align ENERGY STAR with HERS ratings.

Summary & Next Steps

Summary

- Designers use total External Static Pressure (ESP) and the fan-speed setting to design a system stays within ‘budget’.
- During commissioning, the fan-speed setting and measured total ESP can be compared to the design to assess airflow.
- This plays an important role in ENERGY STAR today and might play an even more important role in HERS ratings in the future.

ENERGY STAR Certified Homes

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Training: www.energystar.gov/newhomestraining
HVAC: www.energystar.gov/newhomesHVAC

- Click on "Requirements & Resources for Contractors"
- Click on "How to Measure HVAC Fan Airflow"

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