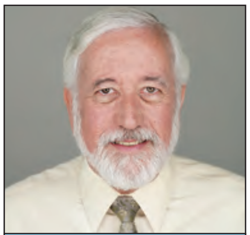
MECHANICAL CODE DISCUSSION

ACCA Manual D – Duct Design – Equivalent Lengths


BRENT URSENBACH

BRENT URSENBACH

HVAC EDUCATOR/ EXPERT WITNESS
bursenbach@gmail.com
801-381-1449

"I have a room in my house which is cold in the winter and hot in the summer, I need a bigger system!"
"My house isn't cooling well so I hired a guy to put in a 5-ton air conditioner."

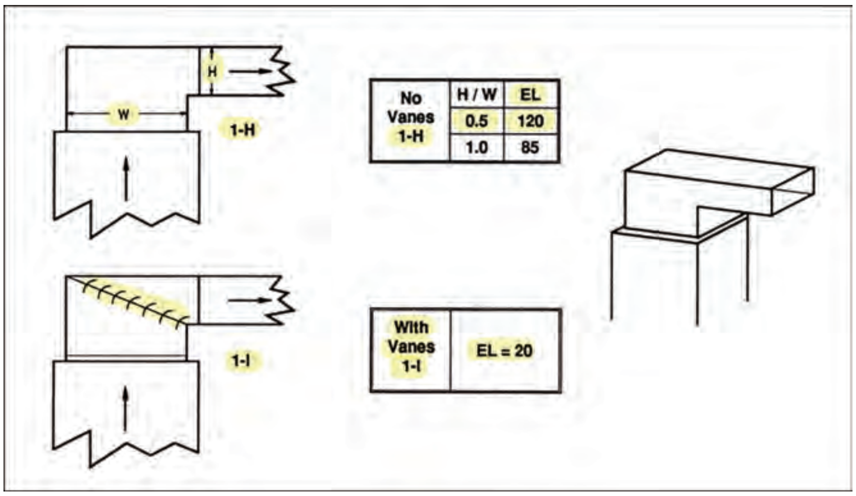
No, No, No, it's an airflow problem.

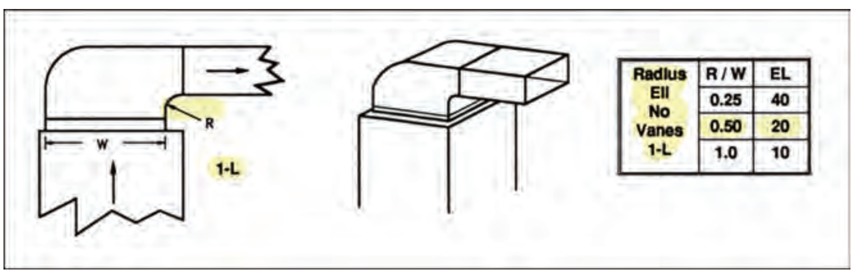
In our RMGA Board Meeting this week, more than an hour was spent discussing the most significant problem found in residential HVAC systems – duct and airflow issues. My favorite simple analogy: You can have great water pressure at the hose bibb, but if the hose is kinked (multiple times), the flow out the end will be low. Raising the pressure creates even higher, increased turbulence, further reducing flow. Applying this to an HVAC system, *an air conditioner will only deliver full capacity when the duct system can deliver the full design airflow*.

I often receive phone calls with questions from system designers, builders, HVAC contractors, and building departments, regarding Manual J, D and S designs submitted for building permits. A common concern centers on the installation not matching the design, especially where the design requires fittings with vanes or radiused throats, but the installation includes all square throats. This is a real problem and the source of many cooling problems – restricted airflow equals reduced capacity and poor comfort.

Last issue we discussed the importance of properly accounting for the pressure drop across devices, specifically coils, providing for sufficient available external static for the duct system. Properly applying the procedures in Manual D will ensure the correct airflow throughout a home. Considering that garden hose again, the longer the hose, the greater the friction, the lower the flow. I have a hose reel on the side of my home with a 100' hose neatly rolled up. If I turn on the water with virtually all the hose rolled on the reel, the flow is much lower than if I roll it out straight, or with smooth gradual bends. For duct systems, in Manual D, we find principles and tables allowing us to identify the pressure loss through the length of the duct, including an equivalent length for each fitting.

Let's consider three plenum elbows, the most critical fitting, with square inside throats, turning vanes, and radiused inside throat. Courtesy Manual D, we have these graphics from Group 1 Supply air fittings at the air handler:





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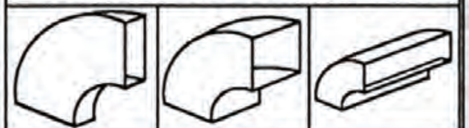
- Please note each fitting style is identified with a Group number and a letter, such as 1-H, 1-I, or 1-L.
- The square throat, H/W ratio of 0.5 is **equivalent** to the friction produced in 120' of straight duct.
- The turning vanes, EL (equivalent length) is 20'.
- The inside radius, R/W ratio of 0.5, EL is 20'.
- The inside radius, R/W ratio of 1.0 EL is 10'.

That square throat used in many new residential systems installed today is at least 6 times as restrictive and turning vanes or radiused throats. Hopefully, those businesses focusing on **retrofits** consider improving the airflow by modifying the plenum elbows and tees. The system performance will undoubtably improve.



R/W	Radius Elbow EL Values		
	Hard Bend	H / W = 1	Easy Bend
Mitered (R = 0)	90	75	65
0.25	35	30	25
0.5 or Larger	20	15	10

Manual D includes guidance on virtually every fitting in a system, identified in Groups 1 to 13; however, as we don't have space to address each, let's consider just one more, Group 8 Elbows and offsets, in the main trunks.

- Mitered (R = 0) represents a square throat. EL = 90' for a hard/horizontal, 65' for an easy/vertical.
- 6" radius on an 8X12 duct, R/W 0.50. EL = 20 for a hard/horizontal, 10' for an easy/vertical.
- 6" radius on an 8X24 duct, R/W 0.25. EL = 35 for a hard/horizontal, 25' for an easy/vertical.

Fitting Equivalent Length Details	
Supply	4G=80, 8A7=30, 8A7=30, 2I4=100, 8E=10, 1C=35: TotalEL=285
Return	7A=25, 7B2=15, 7C2=30, 7C2=30, 12H1=20, 8E=10, 7E3=60, 5N=55, 5H2=30: TotalEL=275

Returning to the earlier discussion on the installation not matching the design. Wrightsoft and maybe others now include a list of the fittings used in the design.

See above for an example ▲

Please note the fitting Group number is called out with its equivalent length (EL). Looking up the highlighted 8E in Manual D, we find the elbow requires turning vanes. Do you think the installation included turning vanes? Realizing how cumbersome it is to identify the fitting group number, I'm contacting Wrightsoft to see if a fitting image report can be generated. Also notice there is a Total EL for the supply and for the return system, combined we have in the example a total EL of 560'. Sadly, when this system is installed with the incorrect fittings, the Total EL may approach and exceed 1000'. Adjusting the charge, increase fan hp, adding frost stats to stop the coil freezing, blaming it on the inspector, or the equipment won't fix it. It's too often an airflow problem.

Please expect to hear more about this subject, including education and possibly some system testing opportunities. If you don't have a copy of Manual D, consider obtaining one.

Please feel welcome to share your thoughts, questions, or concerns. Thanks - Brent ■