Do not be swayed by misconceptions about air flow in the industry.

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An HVAC system cannot function optimally or properly unless the duct system is properly designed and installed. Too often customers buy “high efficiency” systems that do not deliver the energy-saving performance because of a deficient duct system. This is usually because many contractors “design” systems based on ignorance and superstition instead of correct knowledge of air flow. Following are some of these myths and explanations as to why they are incorrect.

Duct is too big—a.k.a. never let the air velocity get too low. False. The limiting factors on duct size are space and cost. Instead of a complicated technical explanation, imagine a room with 10 ft x 10 ft x 10 ft of air-tight construction except for two 1-sq.-ft openings in opposite walls. One of the openings has a fan blowing 100 cfm at a velocity of 100 fpm. The middle of the room has a velocity of 100 cfm over an area of 100 sq. ft at a velocity of 1 fpm. The air exhausts (exits) through the other opening at a velocity of 100 fpm.

The “rules” of air flow do not apply to a return duct because the air is being pulled instead of being pushed. False. The driving force for the air is the pressure difference between the inlet and outlet of a duct. That force is unrelated to the external pressure. The air itself does not “know” whether it is being pulled or pushed, it only “knows” it is trying to get from one point to another. In the example above, it makes no difference if the fan is pushing air into the room or exhausting air from it. The relative numbers remain the same. Perhaps some numbers might be negative, relative to the air outside the room, but that does not change any of the math.

Any obstruction in a fluid flow stream will add turbulence and restriction (T&R), this includes turning vanes. False. Installing turning vanes can improve the flow around an ell so much that the overall result is much less T&R. The turbulence at the inner corner of a 90-degree ell often results in so much restriction that the static pressure drops from positive to negative. Turning vanes are sometimes used to correct a duct system that has too much resistance due to too many 90-degree ells.

Curving the back of a 90-degree ell or cutting the back at two 45-degree angles will provide the best air flow. False. This will give a slightly improved air flow compared to a 90-degree ell with a square throat and a square back, but only marginally better. It does nothing to decrease

Discerning fact from fiction is half the battle to understanding air flow and HVAC system/duct design.
the turbulence downstream of the inner corner. A much better approach would be to leave the square back and install turning vanes since there will be more area to make the turn. Remember that the hypotenuse of a 90-degree isosceles triangle is 1.4 times the length of either side. Therefore, the diagonal length of a 90-degree ell on a 10 duct will be 14 in.—a lot of extra room to install turning vanes, even double-wall ones.

Return-air filter grilles (RAFG) may be too big. False. This myth is most commonly from an Authority Having Jurisdiction (AHJ) not realizing the difference between a recommended size and a minimum size. This is the same thinking that would have a professional put in a larger fuse because what was installed is smaller than the manufacturers recommended maximum size. The larger the RAFG, the slower the air velocity, the lower the noise level and pressure drop, and the better the filtration. However, there is an exception. Permanent static-electric filters require a minimum air velocity to build the static electrical charge to attract dirt to the filter to give it its higher dirt catching ability. Sizing RAFG is easy—use 1 sq. ft/ton or 100 sq. in./ton. False. All RAFG are not made the same and there can be differences from one brand and from one design to another. The number of blades per inch will make a difference. Do many professionals know how many blades per inch their favorite RAFG has? Most of the people who sell grilles and registers will provide a free copy of their product catalogue, which contains tables for sizing supply and return grilles, registers and diffusers. Technicians should ask the sales reps if they do not know how to read these tables or ask the local RSES Chapter to host an educational program on that topic.

Location and sizing of grilles or registers in a room are not important; getting enough air flow into a room is all that is important. False. Properly located and sized grilles and registers will give a predictable, repeatable and reliable air-flow pattern. Otherwise, there may be a noticeable temperature differences within the house, or even within a large room. Grilles and registers that are too large will not yield the flow pattern they were.
This is an image of a water-table demonstration, where dye and water are used to show how air flow is affected by different duct designs within a home.

It is certainly much better for a company’s image to take care of a problem before anyone else knows there was a problem.

Using 0.1 in. static w.c. on a duct calculator will yield the correct duct size. False. Different AHJ may recommend a different number for design but none of them recommend this high of a number as basic pressure. Many recommend .06 in. w.c. for return ducts and .08 in. w.c. for the supply duct. Follow the guidelines in Manual D and calculate the total pressure drop for the longest run of the system and learn to adjust designs from there.

Sealing an existing duct system will dramatically improve performance and efficiency. Maybe. Nationwide studies have shown that the average duct system has an approximate 25% leakage rate, but there are many variables. If the duct system is in the conditioned area, the leakage is not lost but may not go exactly where it is designed. Take the existing utility bill and calculate the savings. The simplest way to check a return duct for leakage is to cover the RA FG with a newspaper or dry-cleaning bag. Now, check the air flow out of the supply registers. What is coming out is leakage. The HVAC equipment does not create air but it may have severe air leaks in its cabinet. Be warned, very few contractors caulk and seal the RA FG to the wall and/or duct so there may be house air leaking into the return, which does not affect efficiency or utility cost but does affect the efficiency of the air filtration.

Installing new equipment on an old duct system is plug-and-play and does not require new measurements, calculations, etc. False. Wisdom is what requires...
new measurements, calculations, etc. How else will a technician know if the original installation was optimal?

The newer equipment is more efficient so an upsized (larger) replacement unit will operate successfully on the original duct system. False. That would be true if the original duct system were oversized and there are plenty of oversized duct systems in the field. The ECM blower motor can do a great job of matching the air flow to the needed performance if that is less than the capacity of the equipment, but not more. A 1/2-hp ECM will not deliver any more air than a 1/2-hp PSC motor, just more efficiently.

Cutting down or off grilles, registers, or rooms will save on the utility bill with no damage to the equipment. False. This could be true if the duct system were oversized for the equipment. The average systems will allow a decrease of no more than 10% of the air flow before it has a detrimental effect on the equipment—such as liquid refrigerant floodback or even freezing indoor coils on an air-conditioning unit; high head pressure and temperatures on a heat pump on heating cycle; or an overheating heat exchanger on a furnace. It might save a little on the utilities, but usually not enough to pay for the repairs that will be required because of it.

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