Rules and *Rules of Thumb for Duct Systems

Educated guesses and past experience with trial and error apply when using rules of thumb. For the same temperature in all rooms upstairs and down, equipment that can last 30+ years, and performs at its rated efficiency and capacity, then follow the procedures in the ACCA Manuals: J, S, D and T. Otherwise read on…

Designing Heat Pump duct systems with correct velocity and low restriction

AHU Supply & Return connection - *properly sized; minimize the System Effect, assure Static Regain and allow even airflow thru coils*

- Size the 1st supply fitting or duct to the dimensions of the blower outlet, not to the extents of the AHU or fan/coil cabinet.
- 1st supply fitting or duct's length should be 2.5 times the blower outlet's equivalent diameter minus the heater section, or *24".
- Size the 1st return fitting or duct to a length *at least as long, if not longer, than the width of the AHU or fan/coil base.

Metal Supply Trunks - *properly sized supply trunks allow the rated airflow and reduce the power consumed by the blower*

- Use a sheet metal duct calculator at a friction rate of *0.1"wc or ***less*** to size each metal trunk duct. (0.06"wc to be safe)
- Check the velocity of the air and increase the duct size if the velocity is greater than 900 fpm. 700 fpm is recommended for low restriction and noise. Size for *400 cfm per nominal ton, convert round sizes to their rectangular equivalent as needed.
- *Use long and radiused fittings instead of short or mitered fittings wherever possible.

- 8up to 245 cfm
- 10" up to 440 cfm
- 12" up to 715 cfm
- 14" up to 975 cfm
- 16" up to 1270 cfm
- 1.5 ton - 12" *or* 10" and an 8"
- 2 ton - 14" *or* two 10"
- 2.5 ton - 16" *or* 12" and 10"
- 3 ton - 16" *or* two 12" *or* three 10"
- 3.5 ton - 18" *or* 12" and 14" *or* two 10" and one 12"
- 4 ton - 18" *or* two 14" *or* two 12" and one 10"
- 5 ton - 20" *or* two 16" *or* two 12" and one 14"

Flexible Supply Runs & Registers – *properly sized with adjustable dampers; allow quiet draftless airflow that can be balanced*

- Use a flex duct calculator at a friction rate of *0.1"wc or ***less*** (or a metal ductulator at *0.05"wc or ***less***) to size flex duct.
- *Assume 66 cfm for 6" flex runs, at 4% compression, with a 4x10 floor or a 6x10 ceiling register. A nominal 2 ton system would have 12 to 13 outlets. Use straight boots with an elbow wherever possible. Choose registers over diffusers with heat pumps.
- *Assume 21 cfm for 4" flex runs. Use in bathrooms, large closets etc. that have an exterior wall and minimal window area.
- Flexible duct should be stretched tight and supported to prevent future sagging. Avoid crimping and sharp turns.
- *Distribute one for each exterior opening and/or outside wall. *1 or *2 per room unless very large or more than 3 exposures. *4 or more for sunrooms and rooms over garages. Allow access for an additional run just in case.
- Avoid take-offs within *18" downstream of elbows, transitions etc. they cause uneven air pressures in the trunk.
- Use take off dampers to control the amount of airflow. Adjusting the register may increase noise and reduce room air mixing.
- Use the manufactures engineering data to size registers for an unobtrusive throw without stratification. 700 fpm max.

Flexible Return Runs - *properly sized flex ducts allow the rated airflow and may reduce blower power consumption, stretch it tight!*

- Use a flex duct calculator at a friction rate of *0.1"wc or ***less*** (or a metal ductulator at *0.05"wc or ***less***) to size flex duct.
- Use the duct calculator to find the velocity of the air at the size determined by the friction rate and increase the size if the velocity is greater than 700 fpm. 600 fpm is recommended for low restriction and noise.
- Size to *400 cfm per nominal ton. The following sizes assume no more than 4% flexible duct compression.

- 8" up to 157 cfm
- 10" up to 297 cfm
- 12" up to 502 cfm
- 14" up to 781 cfm
- 16" up to 1015 cfm
- 1.5 ton - 14" *or* 12" and a 8"
- 2 ton - 16" *or* 12" and a 10"
- 2.5 ton - 16" *or* 14" and a 10"
- 3 ton - 14" and a 12" *or* three 12"
- 3.5 ton - 16" and a 12" *or* two 14" *or* three 12"
- 4 ton - 16" and a 14" *or* two 14" and one 8"
- 5 ton - two 16" *or* *two 14" and one 12*"

Filter Grilles - *properly sized filter grilles are quiet, permit rated airflow, and allow standard disposable filters to trap small particulate*

- Size Filter Grilles to a face velocity no greater than 400 fpm. Standard air filters lose effectiveness over 400 fpm.
- Use the equation; CFM ÷ FPM = Ak to find the required effective area and match it to the Ak rating of the grille.

- 10x6 (Ak 0.28†) up to 111 cfm
- 12x12 (Ak 0.66†) up to 263 cfm
- 14x14 (Ak 0.89†) up to 357 cfm
- 12x18 (Ak 0.98†) up to 392 cfm
- 14x16 (Ak 1.02†) up to 407 cfm
- 20x12 (Ak 1.10†) up to 440 cfm
- 14x18 (Ak 1.14†) up to 457
- 14x20 (Ak 1.27†) up to 507 cfm
- 18x18 (Ak 1.46†) up to 585 cfm
- 20x16 (Ak 1.46†) up to 585 cfm
- 24x14 (Ak 1.52†) up to 607 cfm
- 16x24 (Ak 1.73†) up to 692 cfm
- 16x25 (Ak 1.80†) up to 720 cfm
- 20x20 (Ak 1.80†) up to 720 cfm
- 14x30 (Ak 1.89†) up to 756 cfm
- 24x20 (Ak 2.16†) up to 862 cfm
- 25x20 (Ak 2.24†) up to 898 cfm
- 20x30 (Ak 2.96†) up to 1074 cfm

Flat Grilles - *properly sized flat grilles are quiet, allow the rated airflow and may reduce the power consumed by the blower*

- Size Flat Return Air Grilles to a face velocity no greater than 500 fpm. Orient grille to minimize view of duct interior.

- 8x8 (Ak 0.30†) up to 148 cfm
- 12x8 (Ak 0.44†) up to 221 cfm
- 10x10 (Ak 0.46†) up to 230 cfm
- 12x12 (Ak 0.66†) up to 329 cfm
- 12x20 (Ak 1.09†) up to 544 cfm
- 14x18 (Ak 1.14†) up to 571 cfm
- 6x16 (Ak 1.16†) up to 580 cfm
- 8x18 (Ak 1.46†) up to 732 cfm
- 20x20 (Ak 1.80†) up to 900 cfm
- 30x14 (Ak 1.89†) up to 945 cfm
- 20x24 (Ak 2.16†) up to 1078 cfm
- 16x30 (Ak 2.18†) up to 1088 cfm

†Effective Area data for Hart & Cooley model 673 Return Air Filter Grille and 672 Flat Return Air Grille. Supply registers are model 682.

WaynePendergast@comcast.net

10/19/2014