HVAC · CHEAT SHEET

HVAC duct *sizing reference*.

CFM capacity vs round duct diameter, friction loss reference, and round-to-rectangular equivalent sizing. The reference for **residential and light-commercial** duct selection at typical design conditions.

The chart

ROUND DUCT (IN)	TYPICAL CFM AT 0.08" WC/100FT	EQUIVALENT RECTANGULAR (IN)	NOTES
4"	~50 CFM	6 × 3	Bath fan branch
5"	~85 CFM	6 × 4	Small return / bath fan
6"	~110 CFM	8 × 4	Standard supply branch to one room
7"	~170 CFM	10 × 4	Larger supply branch
8"	~240 CFM	10 × 5	Trunk to multiple branches
9"	~340 CFM	12 × 6	Small main trunk
10"	~450 CFM	14 × 6	Main trunk (small home)
12"	~720 CFM	16 × 8	Main trunk (medium home)
14"	~1050 CFM	18 × 10	Main trunk (larger home)
16"	~1450 CFM	20 × 12	Light-commercial main
18"	~1950 CFM	24 × 12	Light-commercial main

ROUND DUCT (IN)	TYPICAL CFM AT 0.08" WC/100FT	EQUIVALENT RECTANGULAR (IN)	NOTES
20"	~2520 CFM	26 × 14	Commercial main
24"	~4000 CFM	30 × 18	Commercial main

About these numbers. CFM values are at **0.08 inches water column friction per 100 feet** and approximately **700-1000 ft/min velocity** — the standard residential design point. Higher CFM in the same duct = higher velocity = more friction = more noise. Always design to the actual layout.

Common applications

APPLICATION	TYPICAL CFM	WHY
Bathroom exhaust fan	50-110 CFM	Code minimum 50 CFM (intermittent) or 20 CFM (continuous, per ASHRAE 62.2)
Kitchen range hood (over electric)	100-300 CFM	Higher for gas or high-output ranges
Kitchen range hood (commercial / pro)	600-1200 CFM	Make-up air may be required by code above 400 CFM
Whole-house ventilation (ASHRAE 62.2)	30-100 CFM	Continuous, based on floor area and bedroom count
Room supply (single bedroom)	60-100 CFM	Heating-dominated climate; ~1 CFM per ft² of floor area
Room supply (large living area)	200-400 CFM	Open floor plan; ~1.5 CFM per ft²
Total house airflow (typical)	350-1200 CFM	1-3 ton residential system
1 ton air conditioning	400 CFM nominal	Rule of thumb: 400 CFM per ton (12,000 BTU/h cooling)
2 ton AC	800 CFM	Larger residential

APPLICATION	TYPICAL CFM	WHY
3 ton AC	1200 CFM	Average residential
5 ton AC (max residential)	2000 CFM	Larger homes; above this typically commercial

Common pitfalls

- **1 ton of AC ≠ 1 ton of refrigerant.** A ton of cooling capacity = 12,000 BTU/h = the heat needed to melt 1 short ton of ice in 24 hours. Has nothing to do with refrigerant mass or duct weight. AC equipment is sized in tons.
- **Round ducts are more efficient than rectangular.** A round duct has less surface area (and friction) per unit of CFM than a rectangular equivalent. Always specify round when there's space. Rectangular is used when the available height is constrained.
- **Flexible duct adds 50% to friction.** A 6" rigid duct flows ~110 CFM; a 6" flex duct flows ~70-80 CFM at the same friction loss. Stretched flex performs much better than compressed or sagging flex.
- **Duct sizing affects equipment sizing.** An undersized duct system can't deliver the airflow the equipment is designed for, leading to overheating, short cycling, and reduced efficiency. The duct system and the equipment must match.
- **Static pressure budget matters more than CFM alone.** A typical residential system has ~0.5" wc total external static pressure available. The supply trunk, return, filter, and coil all eat into that. Sizing the trunk for 0.08" per 100 ft is the common rule, but real layouts often need bigger ducts to meet the pressure budget.

- **Long return ducts are often undersized.** Returns typically need to be larger than supplies because they handle the full system flow at lower available pressure. A 14" supply trunk often needs a 16" or 18" return.

Common questions

What's the rule of thumb for sizing supply ducts?

Friction-rate method: target around 0.08-0.10 in.wg per 100 ft for residential, 0.10 for light commercial. Use a ductulator (chart or app) to find the diameter that gives your target CFM at that friction. For round ducts: 4" handles ~50 CFM, 6" ~120, 8" ~250, 10" ~450, 12" ~700 at 0.10 in.wg/100ft.

Why does duct shape matter if the cross-section is the same?

Friction loss depends on hydraulic diameter (4 × area / perimeter), not area. A 12×12 square duct has the same area as a 12×24 rectangular but much higher friction at the same CFM. Round ducts have the lowest friction for a given cross-section; rectangular ducts get worse as the aspect ratio increases. Use round when possible; if rectangular, keep aspect ratio under 3:1.

How many CFM do I need per square foot?

Rough sizing for residential: 1 CFM per square foot for general living spaces, 1.5 for kitchens, 0.5-1 for bedrooms. A 2000 sq ft home typically needs around 2000 CFM total. This is a starting point — a Manual J load calculation gives a much better number, especially for older or unusually configured homes.

What's 'static pressure' and why does it limit my system?

Static pressure is the duct system's resistance to airflow, measured in inches of water column (in.wg). Residential air handlers are typically rated 0.5-0.8 in.wg total external static pressure. If your duct design produces more resistance than that, the blower can't move design CFM — you'll get poor airflow and short equipment life. Long runs, sharp turns, and undersized ducts all increase static.

Should return ducts be the same size as supply?

Often larger. Return ducts typically operate at lower velocity (500-700 fpm vs 800-1000 fpm for supply) for noise reasons. A common rule: returns should be ~1.5× the supply duct cross-sectional area. Inadequate returns are the most common HVAC mistake — they create negative pressure, cause door-slamming, and reduce system capacity.

Sources

- **Residential duct design:** ACCA Manual D — Residential Duct Systems. The industry standard for sizing.
- **Equipment sizing:** ACCA Manual J — Residential Load Calculation, followed by Manual S (equipment selection) and Manual D (duct design).
- **Commercial:** ASHRAE Fundamentals Handbook, Chapter 21 (Duct Design).
- **Equivalent diameter formula:** ASHRAE rectangular-to-round equivalent diameter is approximately $D_e = 1.30 \times (a \times b)^{0.625} / (a + b)^{0.25}$, where a and b are rectangular dimensions.

Disclaimer. Duct sizing depends on the specific equipment, load calculation, layout, and pressure budget. This reference is for context and rough sizing — actual residential design should follow ACCA Manual D; commercial work should follow ASHRAE methods or local code.