Dynamic Ductwork:
From Design to Installation

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Tennessee Association of PHCC

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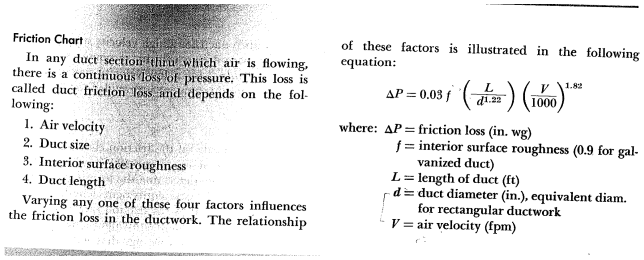
Duct Sizing

Concept of Friction Drop

- Surface Friction
- Turning Friction

Equation



Friction Chart

In any duct section thru which air is flowing, there is a continuous loss of pressure. This loss is called duct friction loss and depends on the following:

1. Air velocity
2. Duct size
3. Interior surface roughness
4. Duct length

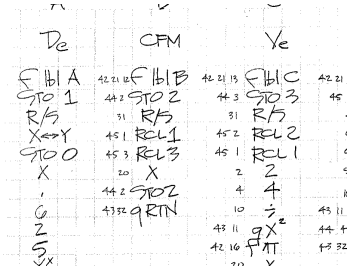
Varying any one of these four factors influences the friction loss in the ductwork. The relationship of these factors is illustrated in the following equation:

$$\Delta P = 0.03\, f \left(\frac{L}{d^{1.22}}\right)\left(\frac{V}{1000}\right)^{1.82}$$

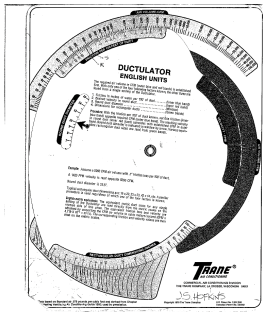
where: ΔP = friction loss (in. wg)
f = interior surface roughness (0.9 for galvanized duct)
L = length of duct (ft)
d = duct diameter (in.), equivalent diam. for rectangular ductwork
V = air velocity (fpm)

Source: Carrier Design Manual, 1960

Program



Ductulator



Equal Friction Method

- 0.1 inches △P / 100 feet – supply ductwork
- 0.08 inches △P / 100 feet – return ductwork
- What is pressure drop?
- Alternate interpretation of equal friction method

Equal Velocity Method

- 2000 to 2500 fpm: VAV upstream of box (this is "medium pressure."
- 2400 fpm: fumes/mist/very light particulate
- 3500 fpm: dust collection / small particulate
- 5000 fpm: heavy particulate (metals)

No Friction Method (Plenum)

- Oversize duct for little to no drop over length of duct trunk
- All takeoffs should now deliver equal flow if same size branch and length
- Adjust branch size for larger or smaller rooms
- Residential / Light Commercial
- Swimming Pools

Balancing

- Volume dampers in diffusers?
- Volume dampers in final branches?
- Advantages / Disadvantages?
- Volume dampers in trunk branches

Duct Accessories

- Diffusers: Round Neck/Square Neck
- Final Flex Length: 4 feet? 40 feet?
- Final Branch Balancing Damper
  - Extended Quadrant Preferred

Calculating Friction Drop

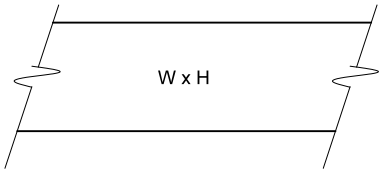
- Units: Inches Water Gage
- Ductwork: Length of Duct x Friction Factor/100 feet
- Fittings: Low pressure, usually about 50% of duct loss
- Fittings: Medium and high pressure, calculate with ASHRAE tables. This is important!

Typical System Pressure Loss

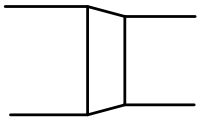
- Supply Diffuser: 0.08 inches (from catalog)
- Supply Duct: 0.15 inches (about 100 feet)
- Loss at unit (system effect): 0.1 inches
- Return Duct: 0.12 inches (about 100 feet)
- Return Register: (0.08 inches)
- Total: 0.53 inches

Duct Design

Straight Duct

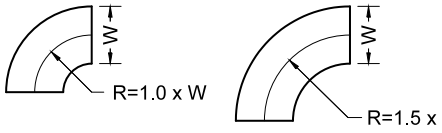


Transition



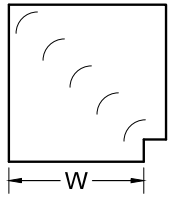
- Transition in one direction only (lowest cost)
- Fixed Distance
- Fixed Angle

Radiused 90 Elbow



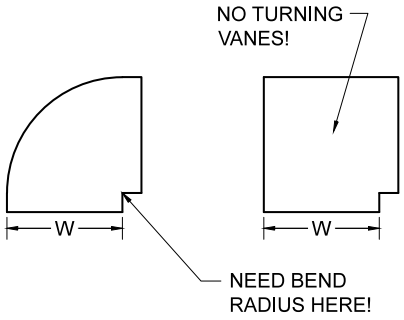
For low pressure duct, R = 1.0 is adequate and lowest cost.
For medium pressure duct, R = 1.5 is preferred.

Rectangular Elbow

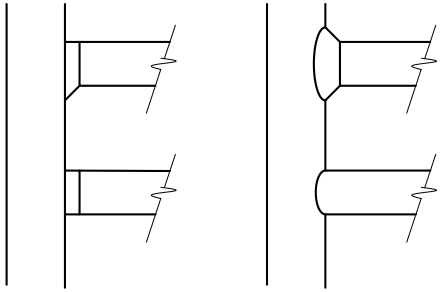


- Most expensive
- Requires least space to turn
- Can be poor if turning vanes not installed correctly!

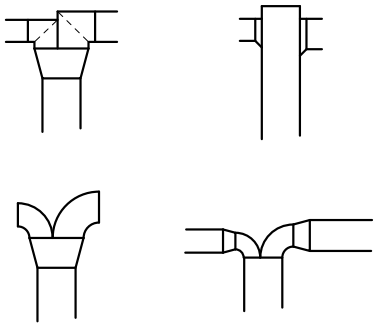
Bad Turns



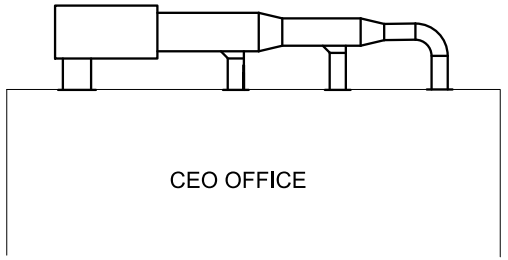
Branches



End of Trunk Branches



System Design



Cook Video

Drafting Ductwork

- Single-line vs. Double-line
- Single-line: Fitting design left to contractor
- Double-line: Fitting design by designer, but will it be built that way?
- Low Pressure: Somewhat forgiving
- Medium and High Pressure: Needs detailed double-lined drafting.

Duct Fabrication

Fabrication Methods

- Use of Computer Program
- Sheet Metal Cutting
  - Hand
  - Machine

Locks / Seams

- Pittsburg
- Acme
- Snap-lock
- Others

Joining

- Slip and Drive
- Ductmate (or equal)

Hanging

- Support
  - Trapeze
  - Straps
  - Wire
  - Others

Discussion

Topics

- Contractors comments on engineer's drawings
- Engineer's comments on contractor's installation
- Others...