



PHIUS 2021
MECHANICAL
SUMMIT

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summit.phius.org

**Moving Air Efficiently &
Quietly Through Ducts**



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propellerconsulting.com



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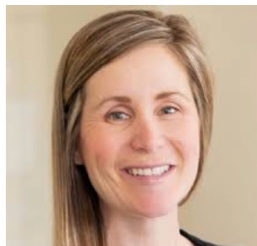
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Method #1

**Pick any contractor &
let them decide
everything**















AFLEX

AFLEX
FLEXIBLE AIR DUCT COMPANY

Class 1 Air Duct

7 1/2"

Codes and Approvals:

- MEETS NFPA 94 and 98
- COMPLIES WITH UMC 10-1
- THERMAL CONDUCTANCE 0.020 MAX.
- MEETS MIN. PROPERTY ST. 578A HUD





DO NOT PRESSURE















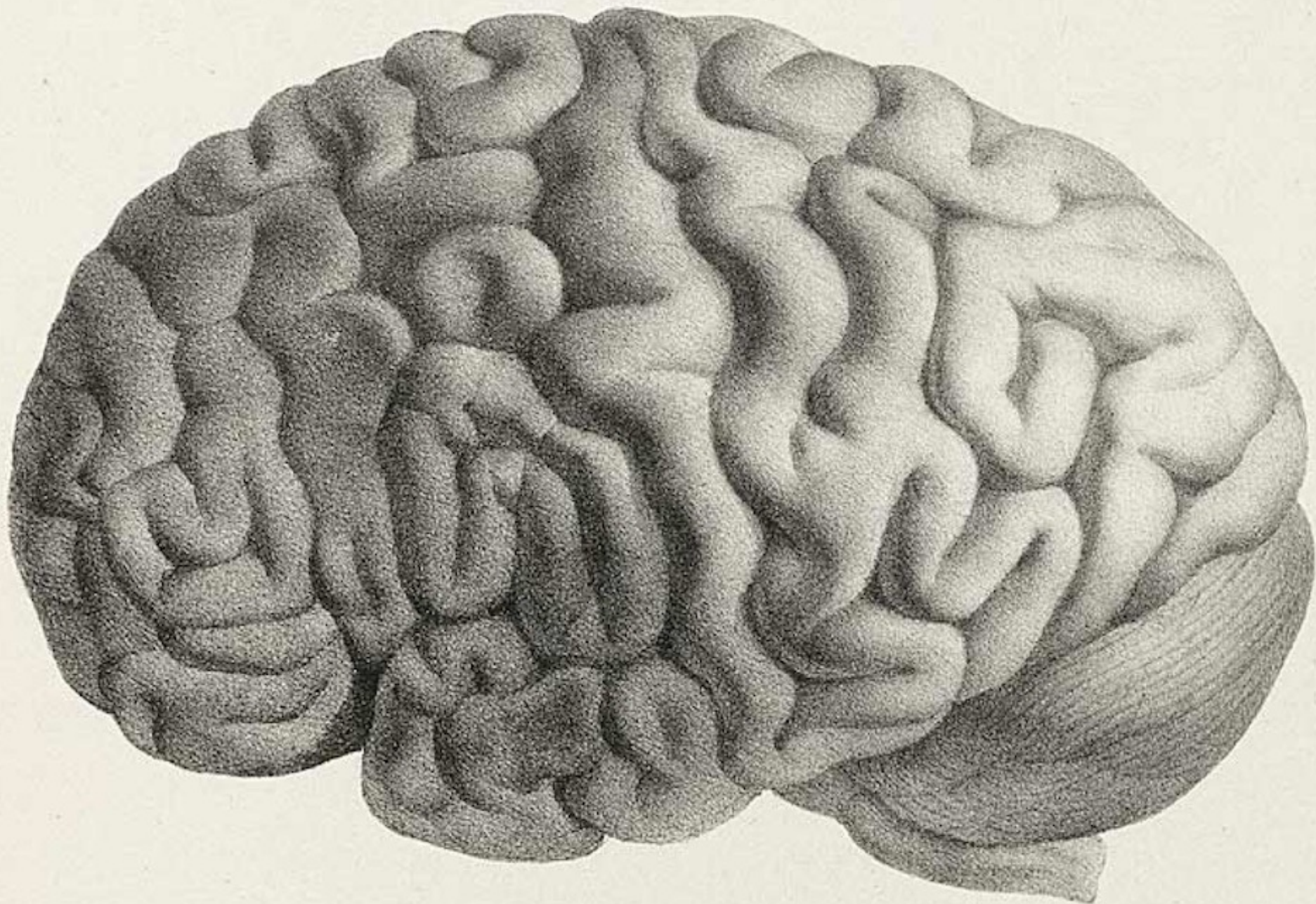




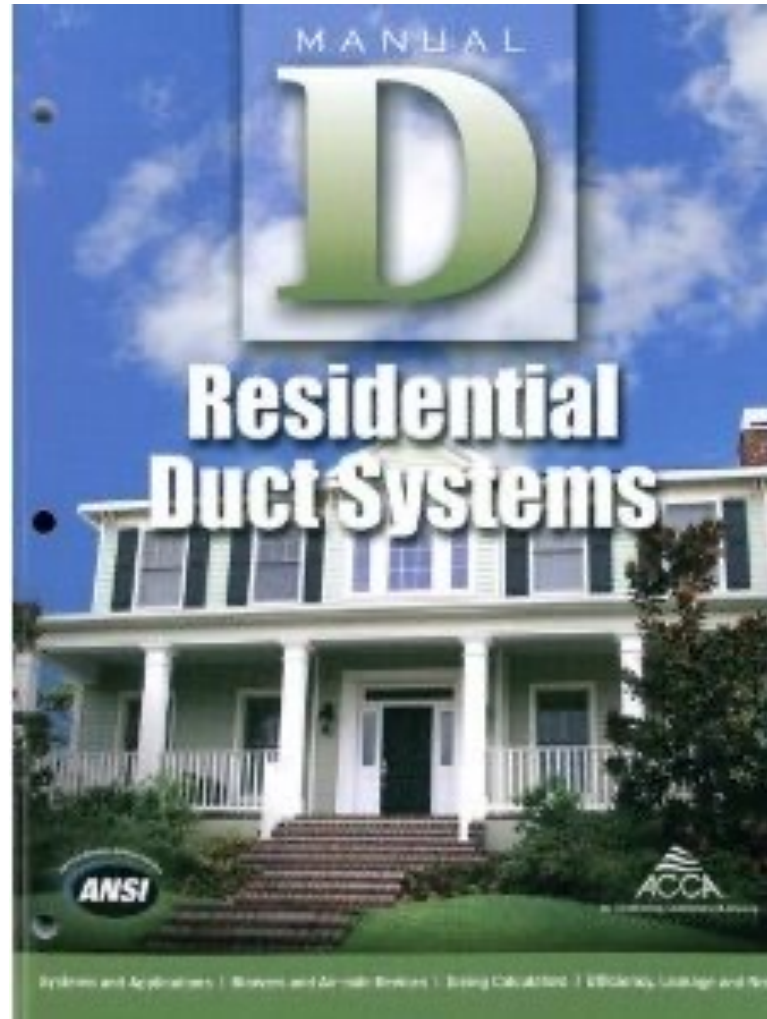
Method #2

Use ACCA Manual D

Fig. 1.



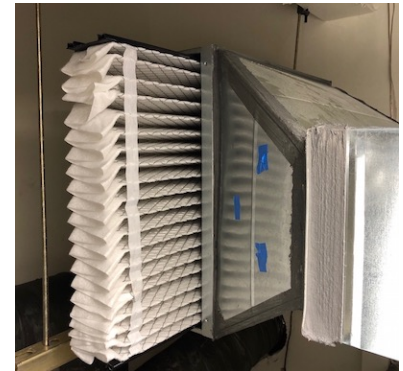
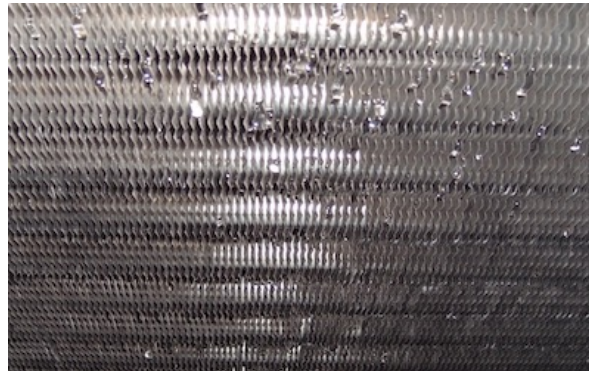
ACCA Manual D



Available static pressure

Available static pressure - the rated pressure difference across the furnace or air handler minus the pressure drops across the external, non-duct components

- Coil
- Filter
- Balancing dampers
- Registers & grilles



Available static pressure is the pressure available for the ducts after accounting for all other pressure changes.

Static Pressure for Entire House



External static pressure

Pressure losses

Coil

Heat exchanger

Supply diffusers

Return grilles

Filter

Humidifier

Balancing damper

Other device

Available static pressure

Heating

(in H₂O)

<0.60>

Cooling

(in H₂O)

[0.50]

0	0
0	0
0.03	0.03
0.03	0.03
0.10	0.10
0	0
0.03	0.03
0	0

0.41

0.31

Equivalent length of fittings

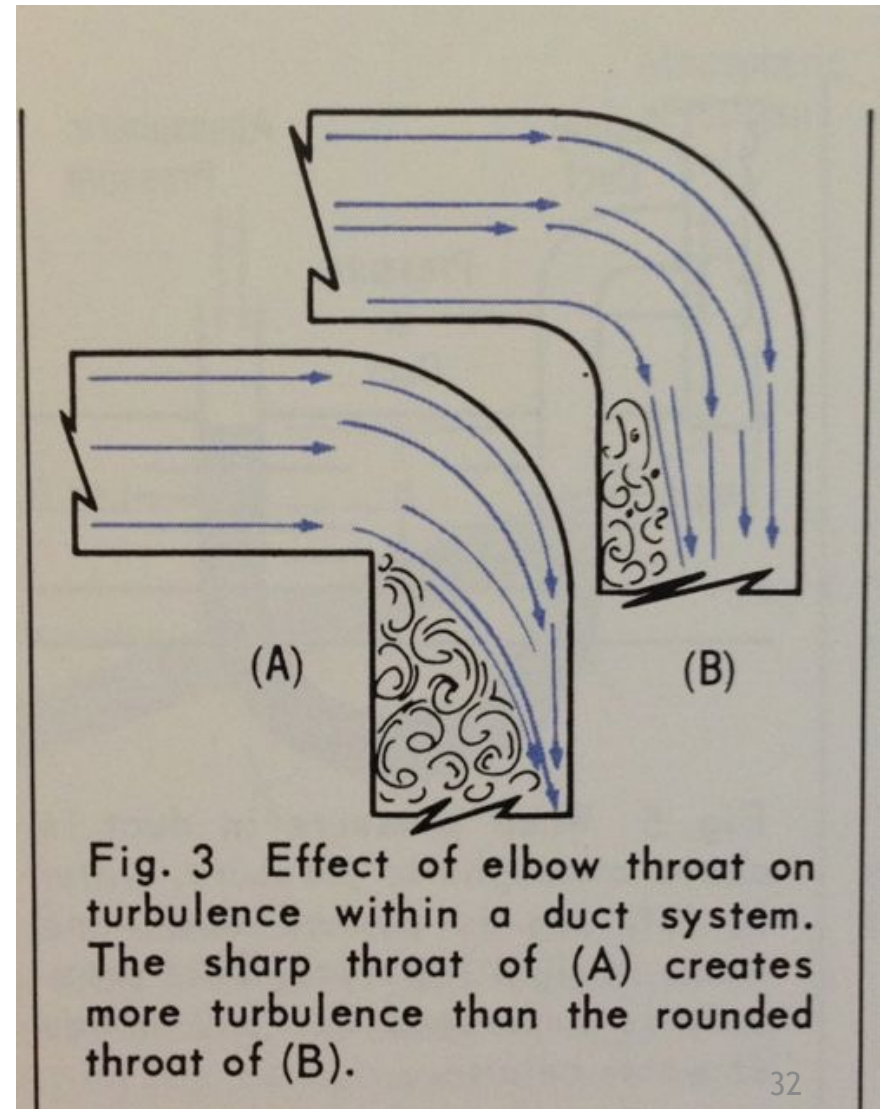
2 causes of air resistance



1. Friction

2 causes of air resistance

2. Turbulence

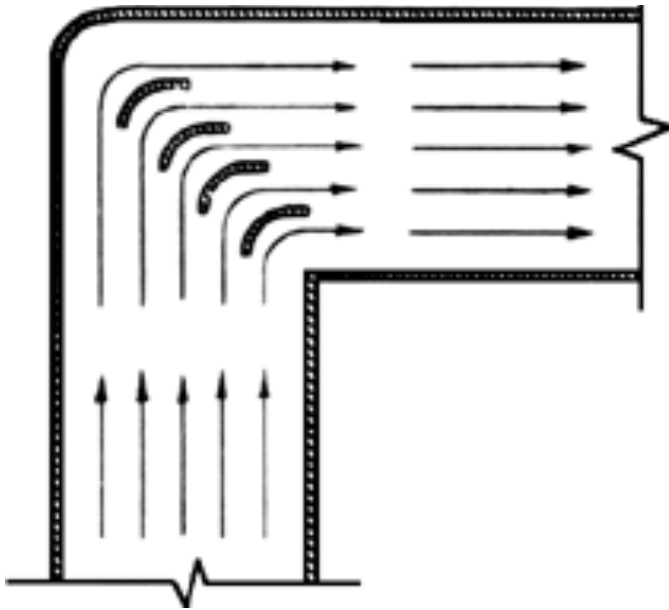




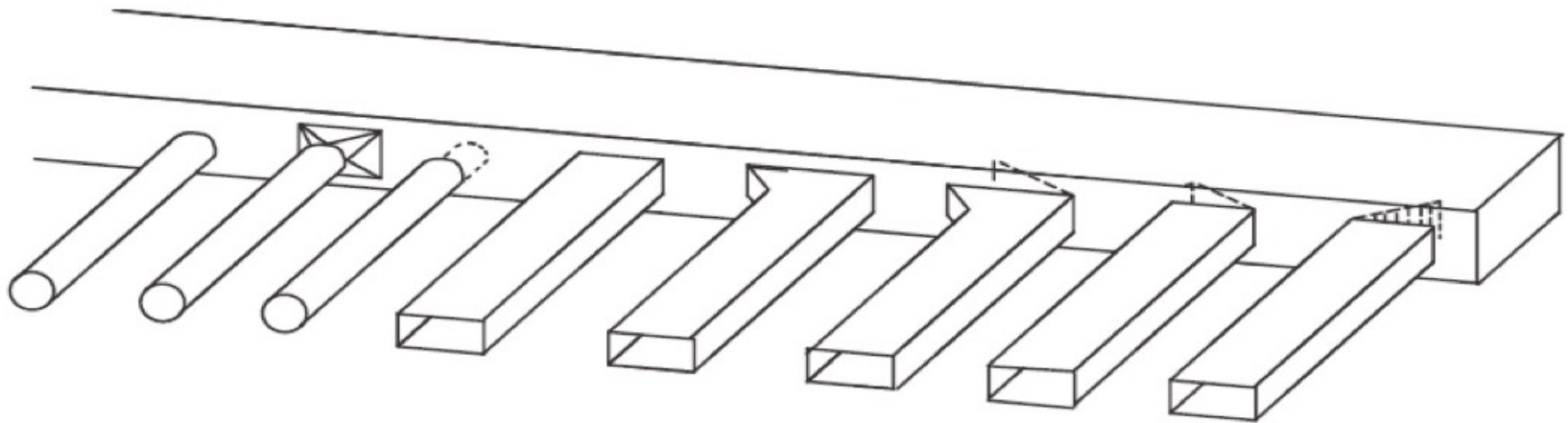












Turning Vanes

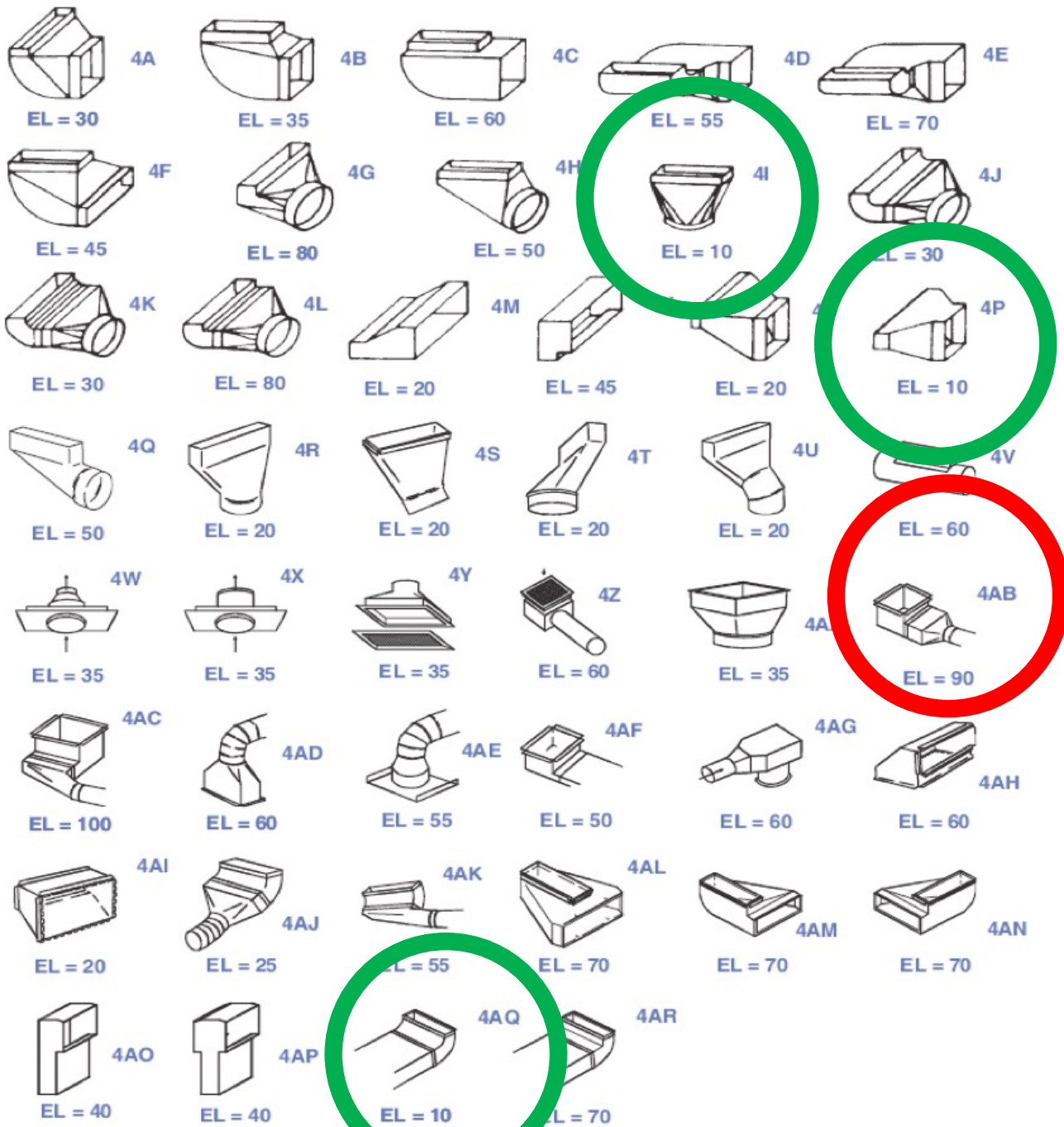


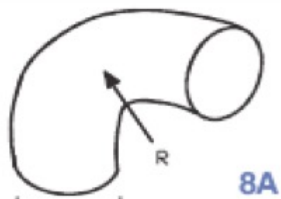
Equivalent length - the length of straight duct that would yield the same pressure drop as the fitting



EL Values		Number of Downstream Branches to End of Trunk Duct or Number of Downstream Branches to a Trunk Reducer					
		0	1	2	3	4	5 or More
Fitting							
	2A	35	45	55	65	70	80
	2B	20	30	35	40	45	50
	2C	65	65	65	65	70	80
	2D	40	50	60	65	75	85
	2E	25	30	35	40	45	50
	2F	20	20	20	20	25	25
	2G	65	65	65	70	80	90
	2H	70	70	70	75	85	95

Note: If the trunk has a reducer, count down to the reducer; then begin a new count after the reducer.





8A

R/D

Round and Oval Elbow EL Values



Smooth	4 or 5 Piece	3 Piece	Smooth Mitered	Easy Bend	Hard Bend	3-Piece 45°	2-Piece 45°
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Mitered (R = 0)	—	—	—	75	4-Piece 25	4-Piece 30	10	15
0.75	20	30	35	—				
1.0	15	20	25	—	3-Piece 30	3-Piece 35		
1.5 or Larger	10	15	20	—				





Total effective length of the
critical path

Equivalent length - just the fittings

Total effective length - equivalent length of the fittings plus the actual lengths of the straight runs

Supply Equivalent Length of Fittings

Manual D-Fittings

Fitting ID	Angle	Eq. length (ft)
...		
4AD	90	60
8A8	90	35
2P3	90	65
9I1	90	85
1A	90	35
	90	0
	90	0
	90	0
	90	0
	90	0
	90	0
	90	0
	90	0

User Defined Fittings

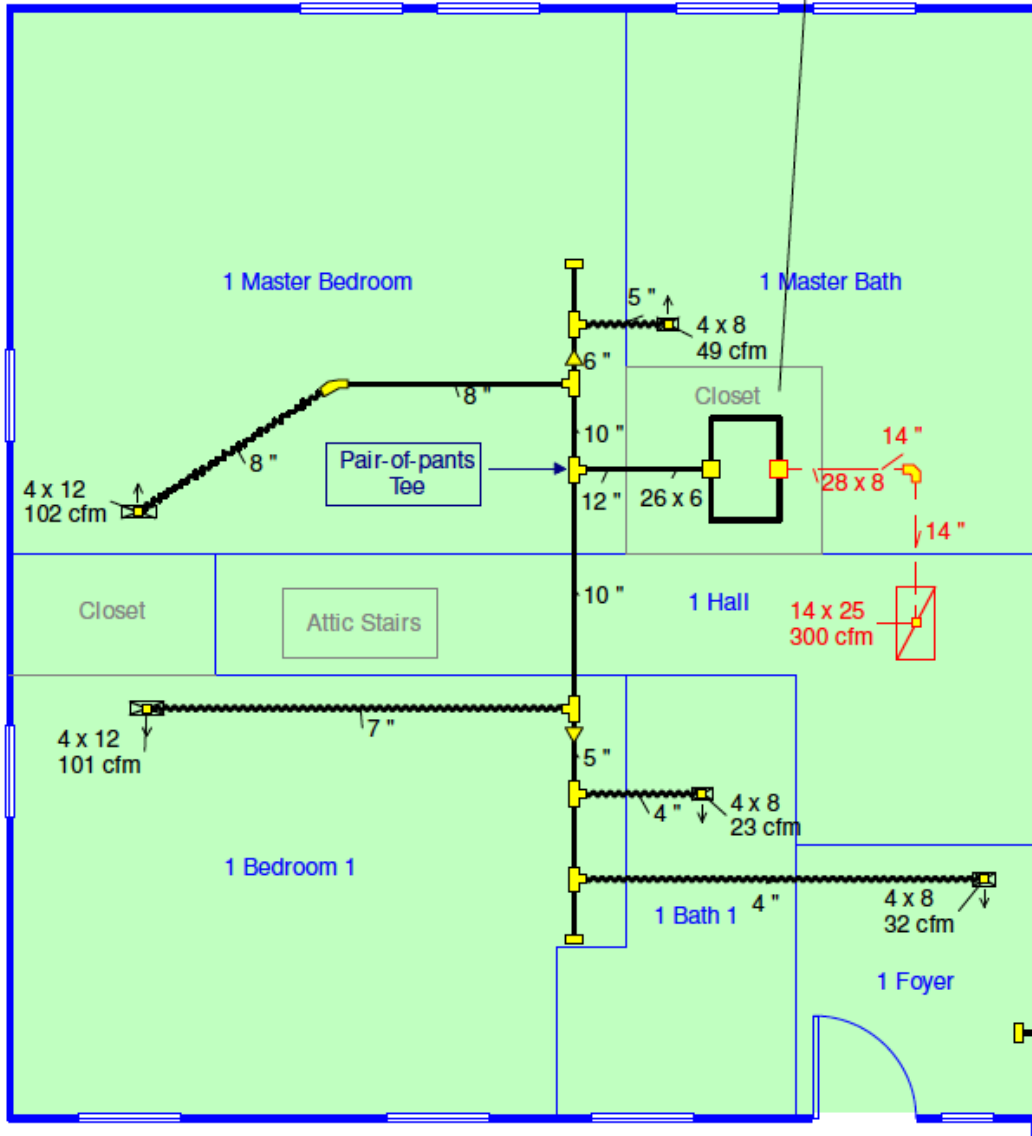
Fitting ID	Eq. length (ft)
USR1	0
USR2	0
USR3	0

Total Equivalent Length

280 ft

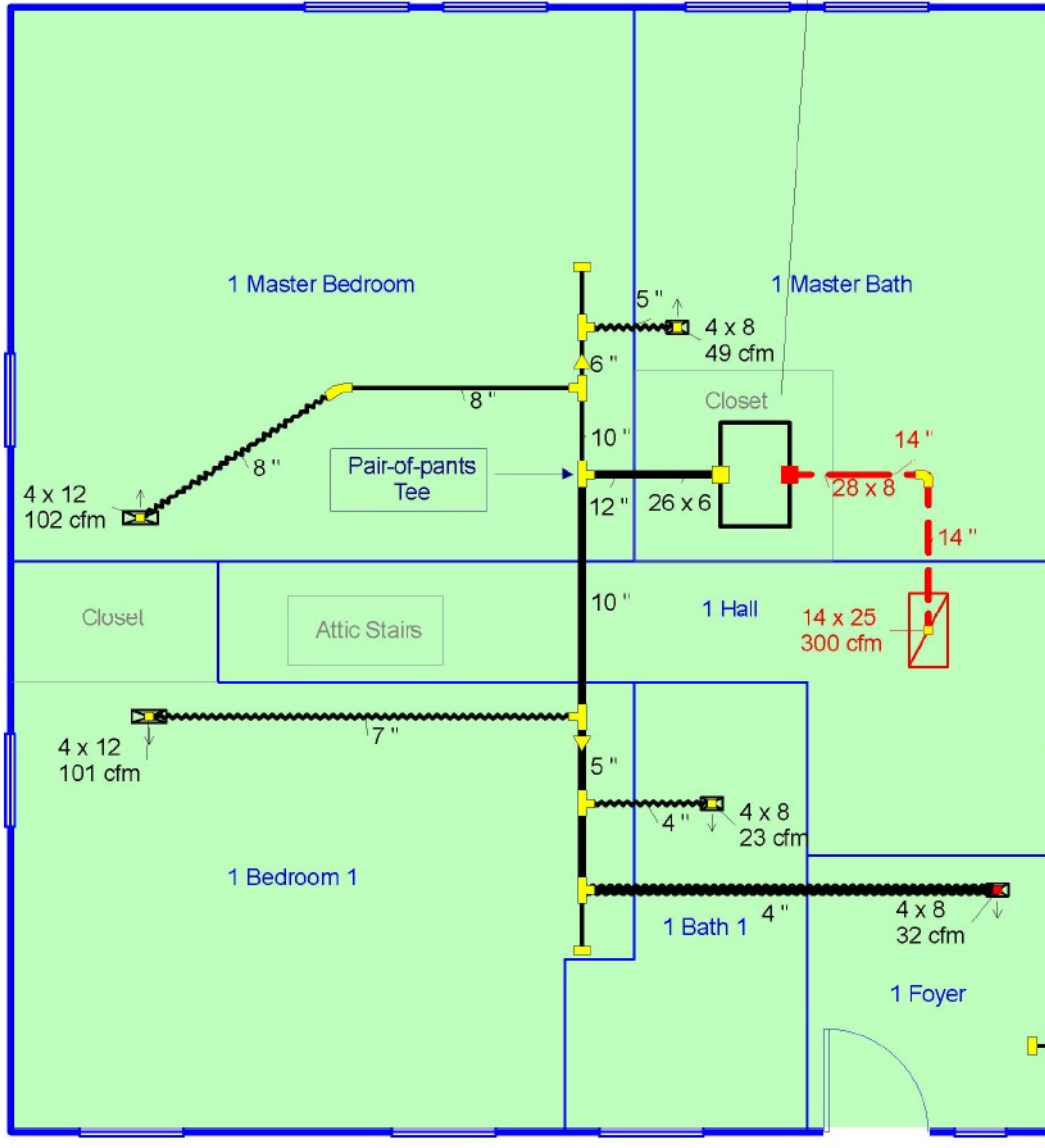
Close

AH1 Mitsubishi
Outdoor Unit: MXZ-3C24NAHZ2-U1
Indoor Unit: SEZ-KD09NA4R1.TH
Type: Horizontal ducted
TESP: 0.2" w.c.
Location: Encapsulated attic



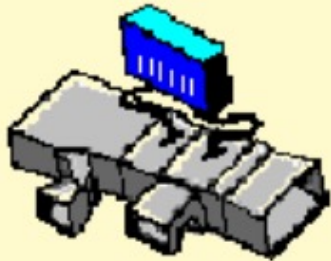
The critical path is the path from return to supply with the highest pressure drop

AH1 Mitsubishi
Outdoor Unit: MXZ-3C24NAHZ2-U1
Indoor Unit: SEZ-KD09NA4R1.TH
Type: Horizontal ducted
TESP: 0.2" w.c.
Location: Encapsulated attic



Critical path:

Hall return grille
to foyer supply
vent



Measured length of run-out
 Measured length of trunk
 Equivalent length of fittings

Supply (ft)	Return (ft)
2	13
34	0
290 ...	85 ...
<hr/>	
326	98
<hr/>	
Rectangular Snip	424

Total length
 Total effective length

Fittings dominate pressure drops...









Friction rate

$$FR = \frac{ASP}{TEL} \times 100$$

$$FR = \frac{0.31}{424} \times 100 = 0.073 \text{ iwc}/100 \text{ feet}$$

Static Pressure for Entire House



External static pressure

Pressure losses

Coil

Heat exchanger

Supply diffusers

Return grilles

Filter

Humidifier

Balancing damper

Other device

Available static pressure

Heating

(in H2O)

<0.60>

Cooling

(in H2O)

[0.50]

0

0

0.03

0.03

0.10

0

0.03

0

0.41

0

0

0.03

0.03

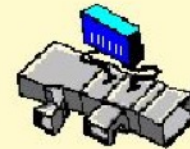
0.10

0

0.03

0

0.31



Measured length of run-out

Measured length of trunk

Equivalent length of fittings

Total length

Total effective length

Supply

(ft)

6

3

280 ...

289

Return

(ft)

3

0

50 ...

53

341

Friction Rate

Heating

(in/100ft)

Supply

[0.120]

OK

Return

[0.120]

OK

Cooling

(in/100ft)

[0.091]

OK

[0.091]

OK

The friction rate calculated here is used to size all duct runs

Most duct runs will be oversized using critical path method.

→ Must use balancing dampers





Friction Rate Chart

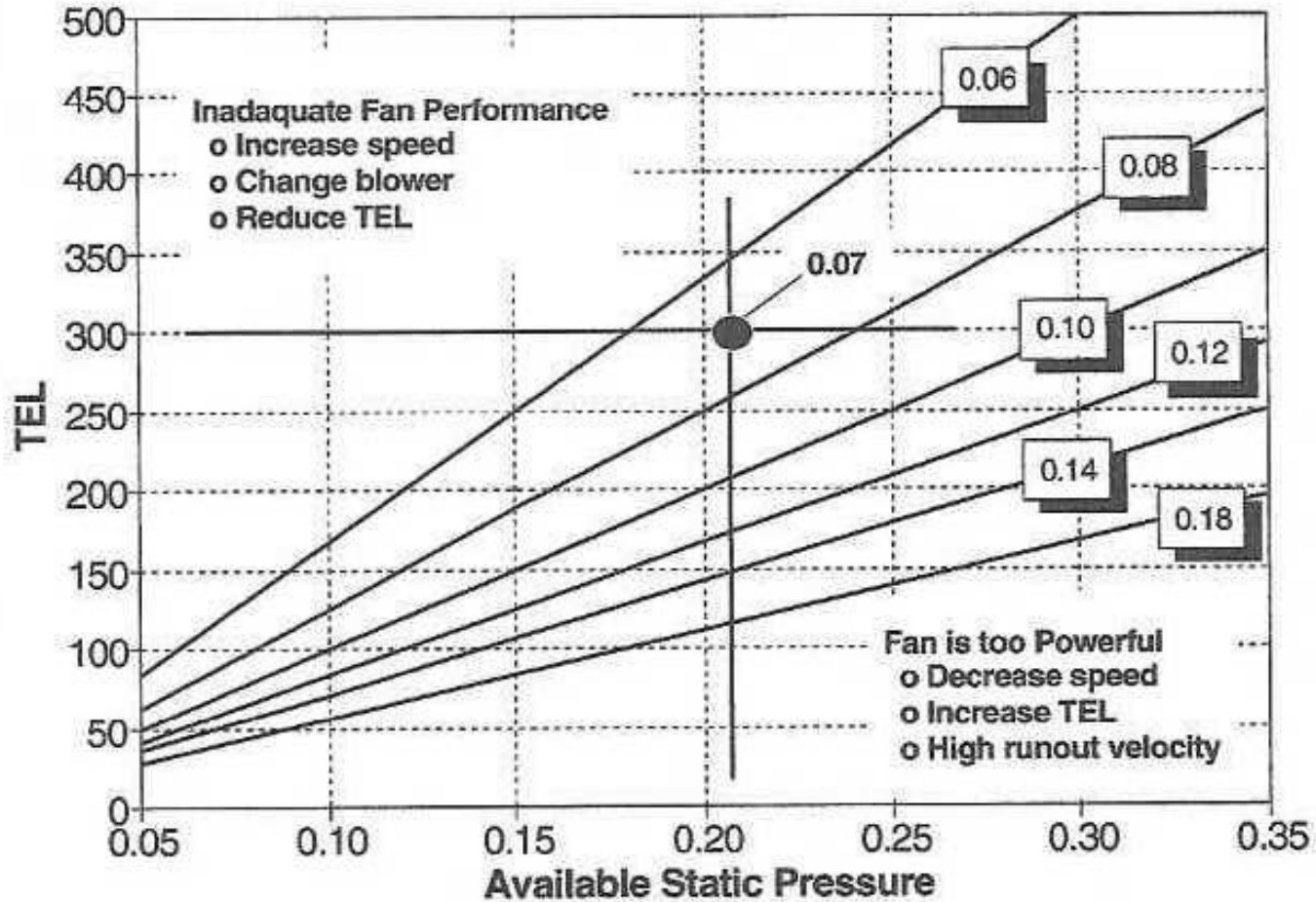


Figure 6-5

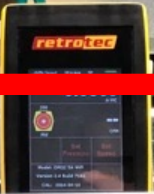
Key Variables to Juggle

- Blower power
- Non-duct pressure drops (filter mainly)
- Fitting quality
- Number of fittings
- Size of ducts

**The proof
is in the pressure**

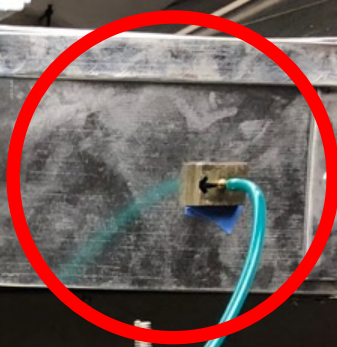
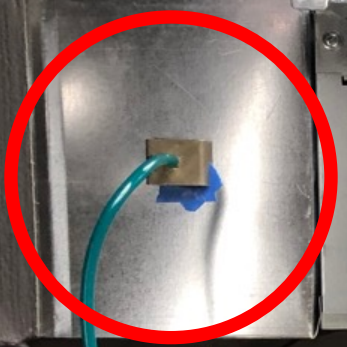






Return

Supply



Calculating Total External Static Pressure (TESP)

- Measure static pressure on return side
- Measure static pressure on supply side
- Add the two numbers – without negative sign!

Example:

$$SP_{\text{ret}} = -0.06 \text{ i.w.c.}$$

$$SP_{\text{sup}} = +0.09 \text{ i.w.c.}$$

$$TESP = 0.06 + 0.09 = 0.15 \text{ i.w.c.}$$



retrotec

0.0% Speed 10 s avg

0.0869
n WC

200



Mid

CFM

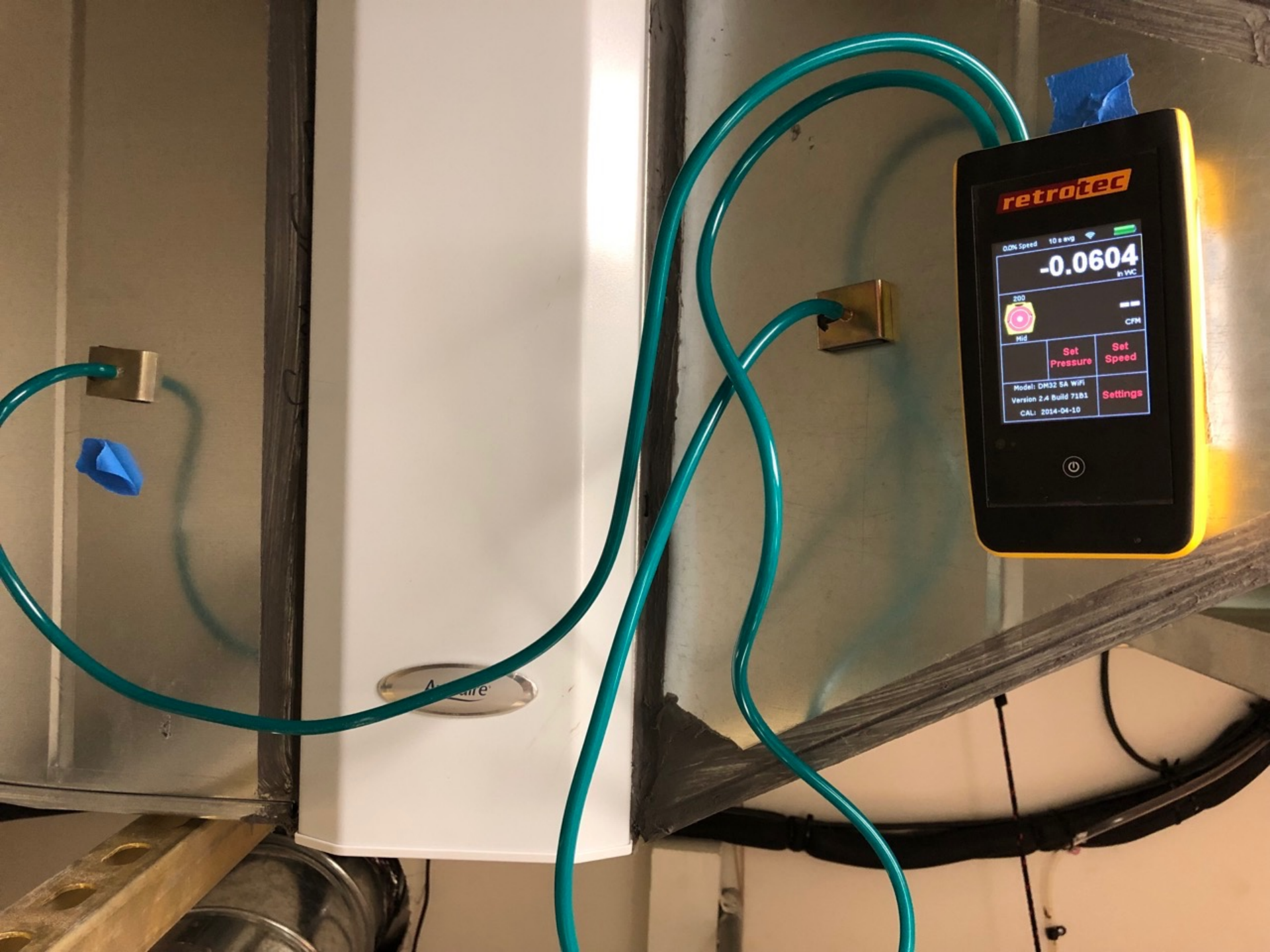
Set Pressure

Set Speed

Model: DM32 5A WiFi
Version 2.4 Build 7181
CAL: 2014-04-10

Settings

High-MERV filtration at a low cost



retrotec

0.0% Speed 10 s avg

-0.0604
in WC

200



CFM

Mid

Set
Pressure

Set
Speed

Model: DH32 5A WiFi
Version 2.4 Build 71B1
CAL: 2014-04-10

Settings



Aireaire



Sizing high-MERV filters

Minimum:
2 square feet of filter area*
per
400 cfm of air flow

**Not including pleats
Length x width*

2 sf/ton → 200 fpm face velocity

Before



After



30% less
pressure
drop

Ducting an ERV or HRV





BRAN

HE Series

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water

DOW Styrofoam Superior Water



EV Premium Medium - Ventilation Performance

Ext. Static Pressure		Net Supply Airflow		Gross Airflow			
				Supply		Exhaust	
Pa	in. wg	L/S	CFM	L/S	CFM	L/S	CFM
25	0.1	110	233	113	239	111	235
50	0.2	106	225	109	231	107	227
75	0.3	102	216	105	222	103	218
100	0.4	99	210	102	216	99	210
125	0.5	95	201	98	208	95	201
150	0.6	91	193	94	199	90	191
175	0.7	87	184	90	191	86	182
200	0.8	83	176	85	180	81	172
225	0.9	77	163	80	170	75	159
250	1	71	150	73	155	69	146

Resistive ducts → Higher pressure → Lower air flow



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