

Ventilation Systems for Swine Barns & New Technologies

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Key Lessons

- **Fans** determine ‘**how much**’ air is exchanged
 - Sized at construction
 - Determine winter fuel usage
- **Inlets** determine ‘**where**’ the air goes
 - Managed 24/7 in response to controller staging of fans
- **Controllers** are the brains of the system
 - Determines temperature at which fans/furnaces turn on/off



Air Inlets

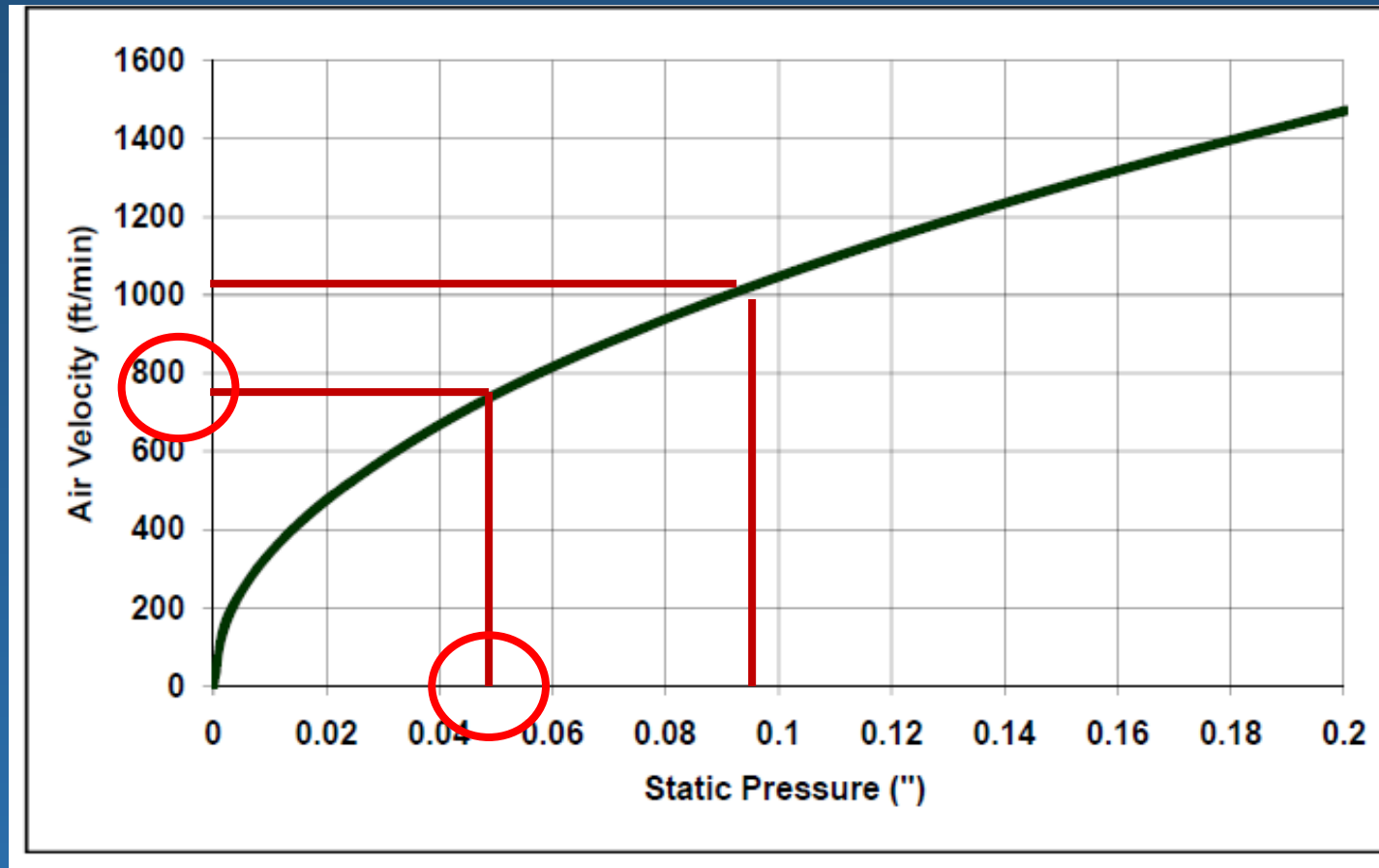


Inlet management is THE most common mistake I see!

- Room inlets
 - Adjust in response to fans to maintain same static pressure
 - Ensure they are matched to fan capacity
- Attic/building air intake
 - Ensure there is enough!

Relationship of pressure and velocity

fpm	meter/s
1600	8
1400	7
1200	6
1000	5
800	4
600	3
400	2
200	1

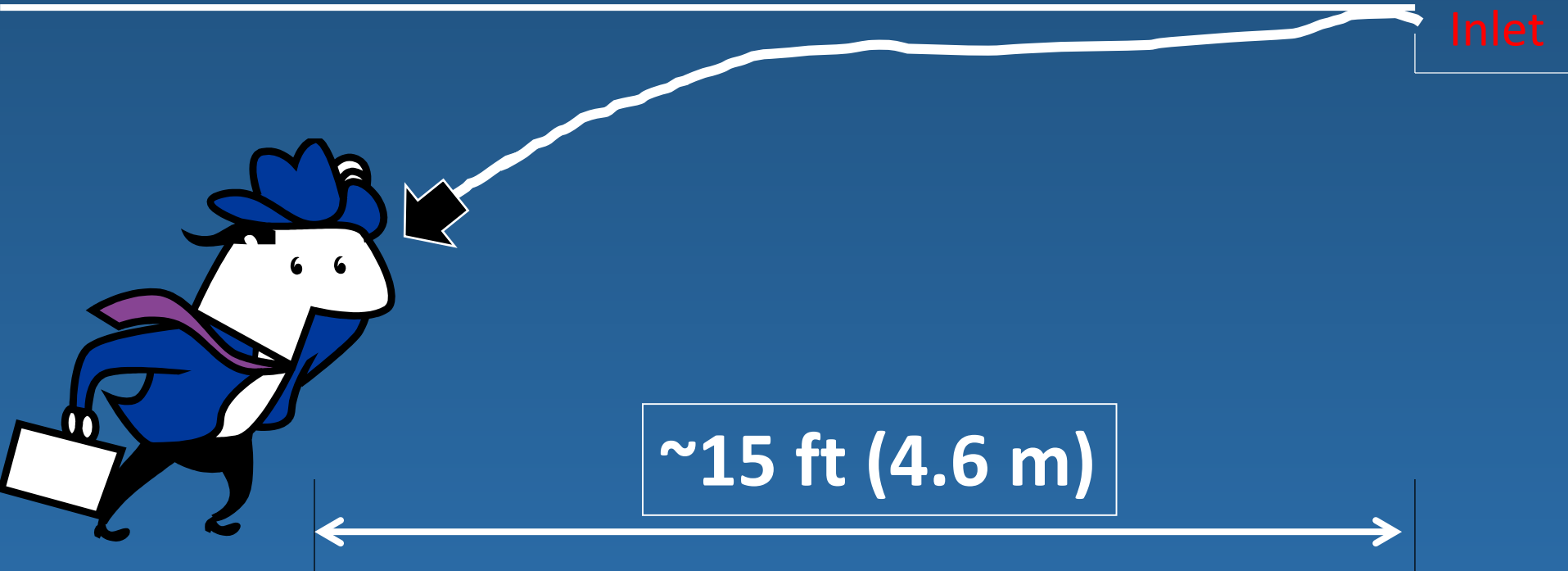


Inches	Pa	mBar
0.05	12.5	0.125
0.1	25	.25

Goal: 800 to 1000 fpm



The 'Forehead' Rule



Correct Inlet Setting with 8 ft (2.4 m) Ceiling

How Big should the 'hole' be?

- 1200 hd single stock g-finish at placement
 - 5500 cfm (2- 24" variable speed pit fans @ 50%)
 - 5500 cfm / 800 fpm = 6.9 sq ft – sum of all holes into the room

How Big should the 'hole' be?

- 1200 hd single stock wean-finish at placement
 - 6.9 sq ft – sum of all holes into the room
- 16 AP ACI-4000P2 inlets
 - 45"/side x 2 sides/inlet x 16 inlets = 120 ln ft of opening
 - 6.9 sqft / 120 ln ft = **0.7" wide**
 - Full open = 8.5"
 - 0.7" wide / 8.5" = **8.0%**



All inlets are equal



All inlets are equal

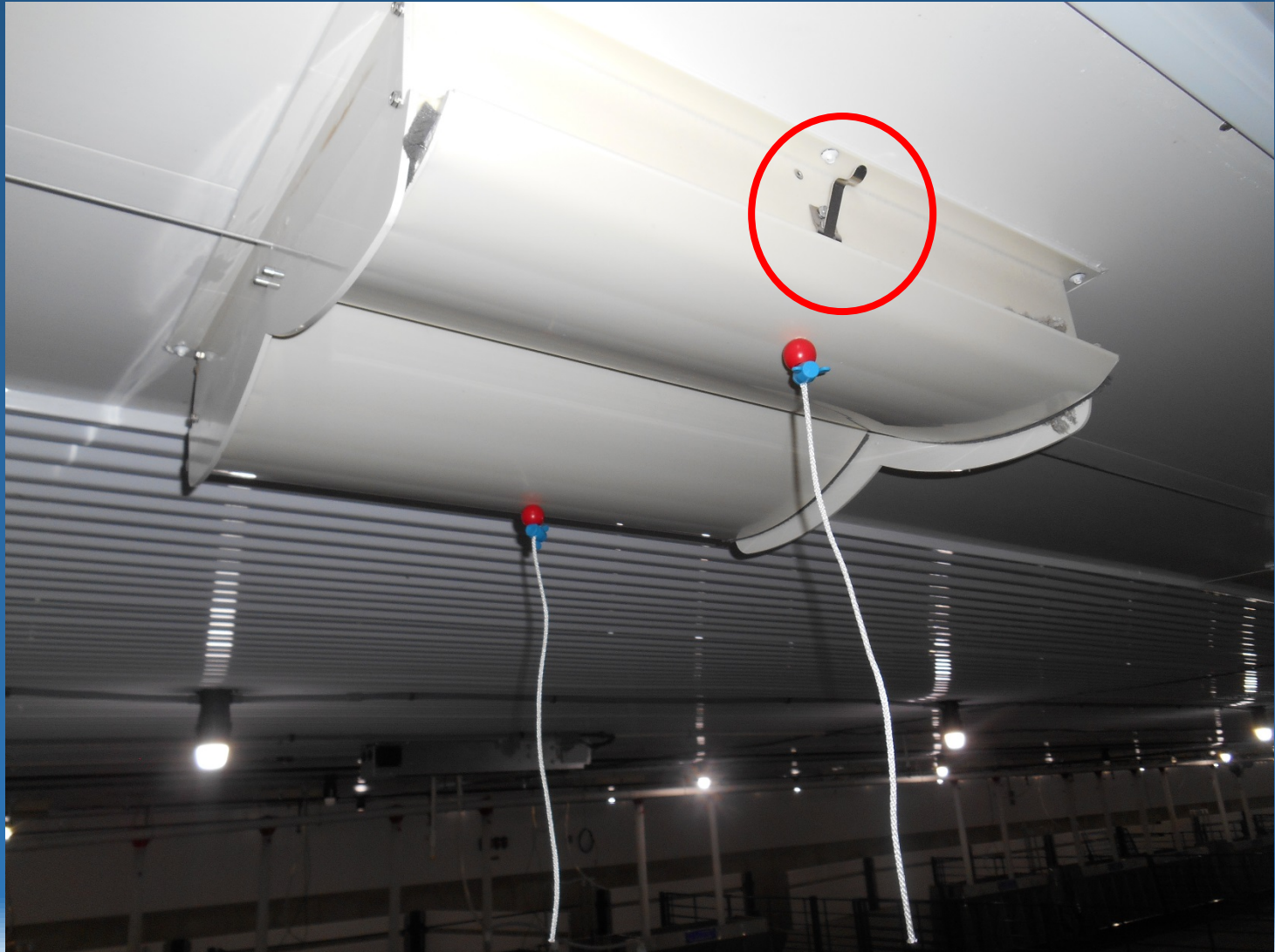


All inlets are equal

- 36" shutters - leak $\sim$ 250 cfm
- 52" shutters - leak $\sim$ 550 cfm



Locking Inlets (faster air) vs Increasing Minimum (more fuel use)



Attic Inlet Area

- 1 sq ft for every 400 cfm of fan capacity
- If less than this
 - add static pressure to fans
 - electric bills go up
 - Doors slam

Double wide
east soffit – west closed



Variable Speed Fans and Controllers



Controller Settings for Variable Speed Fans

- Minimum speed (%)
- Bandwidth
 - Temperature difference between minimum and maximum speed
 - **1.5 – 2 F** for variable stage 1
 - **1.0 - 1.5 F** for variable stage 2

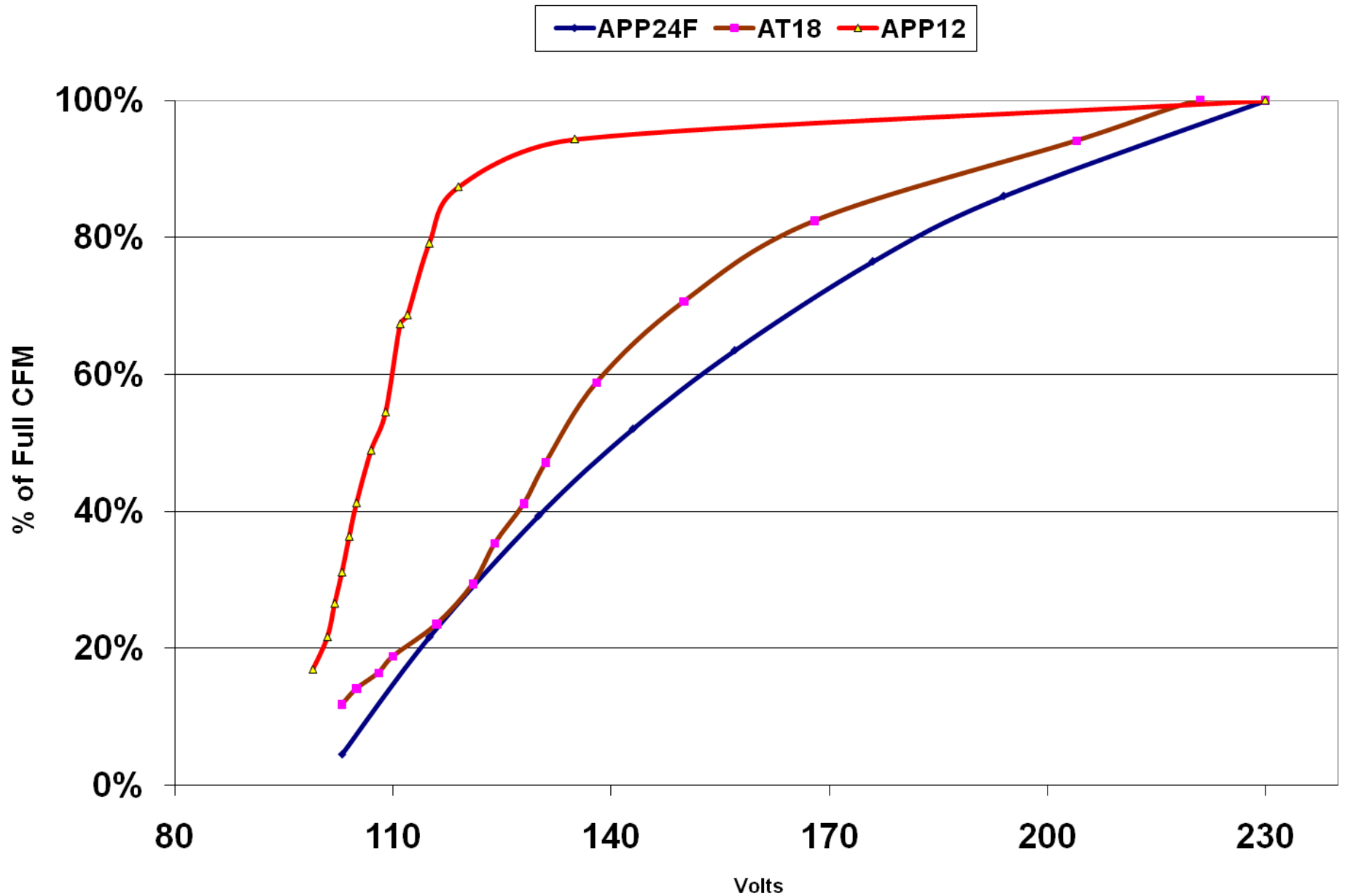
Variable speed fan control

- What does 50% minimum speed mean on a controller?
 - 50% of cfm?
 - 50% of rpm?
 - 50% of voltage?
 - 50% of a funny number?

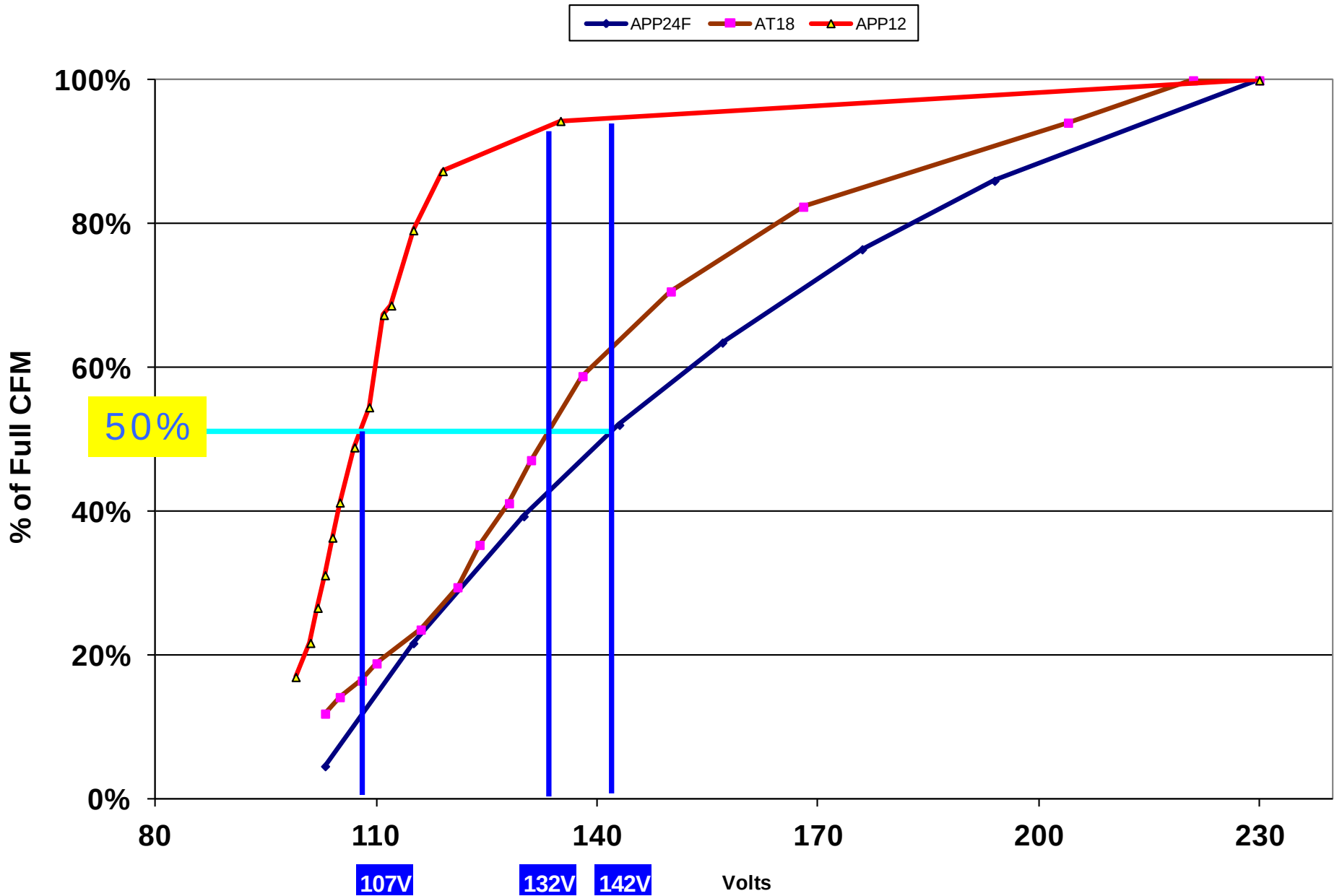
Variable speed fan control

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Fan Response To Voltage



Fan Response To Voltage

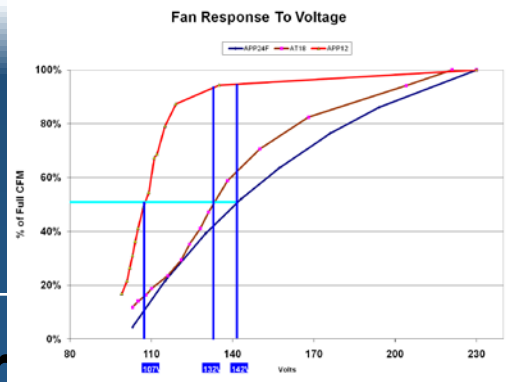


Acme, Aerotech, Airstream, Norsol and Ovation Thevco (Now GSI-Electronics)



Airstream Expert Motor Curves

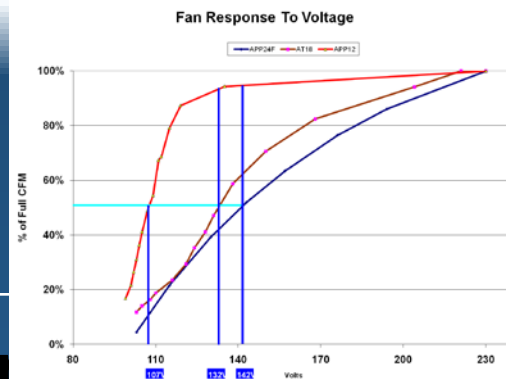
Laboratory Conditions



% Min Speed	Motor Curve Number									
	1	2	3	4	5	6	7	8	9	10
	<u>Voltage</u>									
100	230	230	230	230	230	230	230	230	230	230
90	169	183	187	205	205	191	174	154	123	126
80	152	166	174	190	192	177	159	146	119	113
70	143	152	164	175	182	170	150	139	116	107
60	133	141	153	160	172	164	140	131	113	99
50	125	130	140	146	161	157	132	123	111	92
40	114	116	128	128	146	151	126	115	107	86

Airstream Expert Motor Curves

Laboratory Conditions



% Min Speed	Motor Curve Number									
	1	2	3	4	5	6	7	8	9	10
	<u>Voltage</u>									
100	230	230	230	230	230	230	230	230	230	230
90	169	183	187	205	205	191	174	154	123	126
80	152	166	174	190	192	177	159	146	119	113
70	143	152	164	175	182	170	150	139	116	107
60	133	141	153	160	172	164	140	131	113	99
50	125	130	140	146	161	157	132	123	111	92
40	114	116	128	128	146	151	126	115	107	86

Motor curve recommendations for various fans from Thevco controllers

— 18 —
Motor curves
Courbes moteur
Curva de motor
Мотора кривые
モーターカーブ

60 HZ

Motor Curve
Moteur Courbe
Motor Curva
Мотора Кривые
モーター カーブ

9" AT09Z2 3350 RPM.....	1
9" PLF9 1/5HP.....	5
9" PLF9 1/6HP.....	6
10" Franklin 1/6 Hp 3450 RPM.....	1
10" Exafan 1/4HP 1700RPM.....	1
10" MultiMax 0.09HP 1670 RPM.....	7
12" Airstream APP 12F.....	9
12" Bas SS-12VS.....	10
12" Canarm.....	10
12" Emerson 1/6 Hp 3400 RPM.....	2
12" Exafan 1/4HP 1700RPM.....	4
12" Magnetek 1/6 HP 1725 RPM.....	2
12" MultiMax 0.09HP 1670 RPM.....	3
12" Magnetek 1/6 HP 3300 RPM.....	2
12" Multifan 2E30.....	6
12" Multifan 4E30.....	6
12" PLF12.....	1
12" Ziehl-Abegg.....	5
14" Airstream APP 14F.....	9
14" Baldor 1/4 1700 RPM.....	5
14" Canarm.....	9
14" Exafan 1/4HP 1700RPM.....	2
14" Leeson 1/4 HP 1625 RPM.....	1
14" Multifan 4E25.....	7
14" Multifan 4E35.....	4
14" MultiMax 0.21HP 1570 RPM.....	3
14" PLF 14.....	1
16" AT16Z 1625 RPM.....	3
16" Canarm.....	8
16" Exafan 1/3HP 1700RPM.....	2
16" Exafan 1100RPM.....	4
16" Multifan 4E40.....	5
16" MultiMax 0.21HP 1570 RPM.....	3
16" MultiMax 0.26HP 1040 RPM.....	8
16" PLF 16 1/4HP.....	1
18" Airstream APP 18F.....	8
18" Baldor 1/3 Hp 1700 RPM.....	5
18" Canarm.....	2
18" Exafan 1/3HP 1700RPM.....	2
18" Exafan 1100RPM.....	4

60 HZ (...)

Motor Curve
Moteur Courbe
Motor Curva
Мотора Кривые
モーター カーブ

18" Leeson 1/3 HP 1625 RPM.....	1
18" Magnetek 1/3 HP 1725 RPM.....	3
18" Marathon 1/3 HP 1625 RPM.....	3
18" Multifan 4E45.....	5
18" MultiMax 0.26HP 1040 RPM.....	3
18" MultiMax 0.36HP 1570 RPM.....	8
18" PLF 18.....	8
18" Ziehl-Abegg.....	4
20" Canarm.....	4
20" Exafan 0.53HP 1700RPM.....	2
20" Exafan 1100RPM.....	4
20" Magnetek 1/3 HP 1040 RPM.....	4
20" Multifan 4E50.....	5
20" MultiMax 0.36HP 1570 RPM.....	4
20" MultiMax 0.62HP 1080 RPM.....	2
20" Ziehl-Abegg.....	4
21" Raydot 1/5 HP 1690RPM.....	1
22" MultiMax 0.67HP 1660 RPM.....	7
24" Airstream APP24 F.....	4
24" AT24Z 1075 RPM.....	4
24" Baldor 1/3 HP 1140 RPM.....	5
24" Canarm.....	3
24" Exafan 0.63HP 1700RPM.....	2
24" Exafan 1100RPM.....	4
24" Leeson 1/2 HP 1625 RPM.....	2
24" Marathon 1/2 HP 1625 RPM.....	2
24" MultiMax 0.62HP 1080 RPM.....	3
24" MultiMax 0.67HP 1690 RPM.....	7
24" PLF 24.....	8
24" Raydot 1/5 HP 1100 RPM.....	2
26" Vortex VX26F 0.375HP 1075 RPM.....	6
36" Airstream APP 36F.....	5
36" AT36Z1.....	5
36" Leeson 3/4 HP 1625 RPM.....	2
36" Magnetek 1/2 HP 840 RPM.....	5
36" Marathon 3/4 HP 1040 RPM.....	4

50 HZ

Motor Curve
Moteur Courbe
Motor Curva
Мотора Кривые
モーター カーブ

14" EMY WLA4 / 350.....	1
14" EMY WLV4 / 350.....	2
14" Victoria Classic ABB.....	7
16" EMY WLV4 / 400.....	3
16" Multifan 4E40.....	2
16" Victoria Classic ABB.....	4
18" EMY WLV4 / 450.....	2
18" Multifan 4E45.....	2
18" Victoria Classic ABB.....	3
20" Victoria Classic ABB.....	7
32" Multifan 6E82.....	2

En - Installation Guide
Fr - Guide d'installation
Es - Guía de instalación
Pt - Guia de instalação
Ru - Руководство по установке контроллера
Ja - 導入ガイド

— 1 —
Voltage Selection
Sélection de la tension
Selector de tensión
Selector de tensão
Напряжение
電圧選択



En If a voltage switch is located on the electronic circuit board of the controller, set it to the corresponding power supply (115 or 230 V).

Fr Si un sélecteur de tension se trouve sur la carte de circuit imprimé de votre contrôleur, ajustez-le selon la source d'alimentation utilisée (115 ou 230 V).

Es Si existe un selector de voltaje dentro del controlador, colóquelo en la posición correcta, según la red de alimentación eléctrica disponible (115 o 230V).

Pt Se existir um selector de tensão o unidade do controlador, coloque o selector na posição correcta (115 o 230V).

Ru Если на плате электрической цепи контроллера имеется переключатель напряжения, поставьте его в соответствующее положение (115 или 230 V).

Ja 電圧スイッチがコントローラーの電子回路ボードにある場合、そのスイッチを対応する電源（115Vまたは230V）にセレクトしてください。

— 2 —
Operating Temperature
Temp. de fonctionnement
Temperatura de operación
Temperatura operacional
Рабочая температура
作業温度



En Install the controller in a room where the ambient temperature always remains between 35 and 104 °F (2 and 40 °C).

Fr Installer le contrôleur dans un endroit chauffé où la température ambiante est toujours située entre 2 et 40 °C (35 et 104 °F).

Es Instale el controlador en una habitación donde la temperatura ambiente permanezca siempre entre 2 y 40 °C (35 y 104 °F).

Pt A temperatura ambiente onde o controlador está instalado deve sempre permanecer entre 0 °C e 40 °C (35 e 104 °F).

Ru Рабочая температура Установите контроллер в помещении, в котором постоянно поддерживается температура от 2 до 40 °C.

Ja 室温が常に2℃から40℃に保たれている部屋に、コントローラーを設置してください。

— 3 —
High Voltage
Haute tension
Alto voltaje
Alta tensão
Высокое напряжение
高電圧



En Install the controller as far as possible from high voltage sources (min 12 inches (300 mm)).

Fr Installer le contrôleur le plus loin possible de toute source de haute tension importante (min 300 mm (12")).

Es Instale el controlador lo más lejos posible de las fuentes de alto voltaje (min 300 mm (12")).

Pt Instale o controlador o mais longe possível de fontes de alta tensão (min 300 mm (12")).

Ru Установите контроллер как можно дальше от возможных источников высокого напряжения (Минимум 300 мм).

Ja 高電圧源からできるだけ離れた場所に、コントローラーを設置してください。

Where to set Motor Curves on Airstream or Aerotech



typ





MOTOR COMPATIBILITY TABLE

CURVE	BRAND	MODEL	VOLT	SIZE
1	Multifan	4E40	230 v.	16"
2	Multifan	2E20	230	8"
2	Multifan	4E35	230 v.	14"
2	Multifan	4E40	115 v.	16"
2	Multifan	4E45	115 v.	18"
2	Multifan	4E50	115 v.	20"
2	Multifan	4E50	230 v.	20"
2	Multifan	AF24M'E	230 v.	24"
2	Multifan	6E63	230 v.	24"
2	Multifan	6E71	230 v.	26"
2	Multifan	8E92	230 v.	36"
2	Ziehl		115/230v	
3	Multifan	2E30	230 v.	12"
3	Multifan	4E30	115 v.	18"
3	Multifan	4E45	230 v.	18"
3	Multifan	6E56	230 v.	22"
3	Multifan/AF	AF36M	230 v.	36"
3	Leeson 1/2H	PAF20L	115 v.	20"
3	Leeson 1/2HP	AF24L	115 v.	24"
3	Aerotech-F	AT242	230 v.	24"
4	Multifan	2E25	230 v.	10"
4	Leeson 1/4HP	AF14L	115 v.	14"
4	Leeson 1/4HP	AF16L	115 v.	16"
4	Marathon 1/4HP		230 v.	16"
4	Marathon 1/3HP		230 v.	18"
4	Leeson 1/3HP	AF18L	115 v.	18"
5	GE Motor	5KCP39...	230 v.	12"
5	Leeson 1/4HP	AF12L	230 v.	12"
5	GE Motor	5KCP39...	230 v.	14"
5	Emerson	K55HXJ...	230 v.	14"
6	Oversized motors			
7	Multifan	4E30	230 v.	12"
7	Multifan	2E35	230 v.	14"
8	Multifan	4E25	230 v.	10"

Minimum speed

- Most fan motors are TEAO (totally enclosed air over)
- Never go under **40% minimum speed** when motor curve is correct
- Minimum speed impacts response to static pressure
- If choice is 1 fan at 80% or 2 fans at 40%, always go with 1 fan at higher speed

What about 'New' Technology?

What about 'New' Technology?

- Controllers – Maximus vs EDGE
- Furnaces – SmartSense vs VariFlame
- Remote sensing

Controller Technology



Variable Output Furnaces

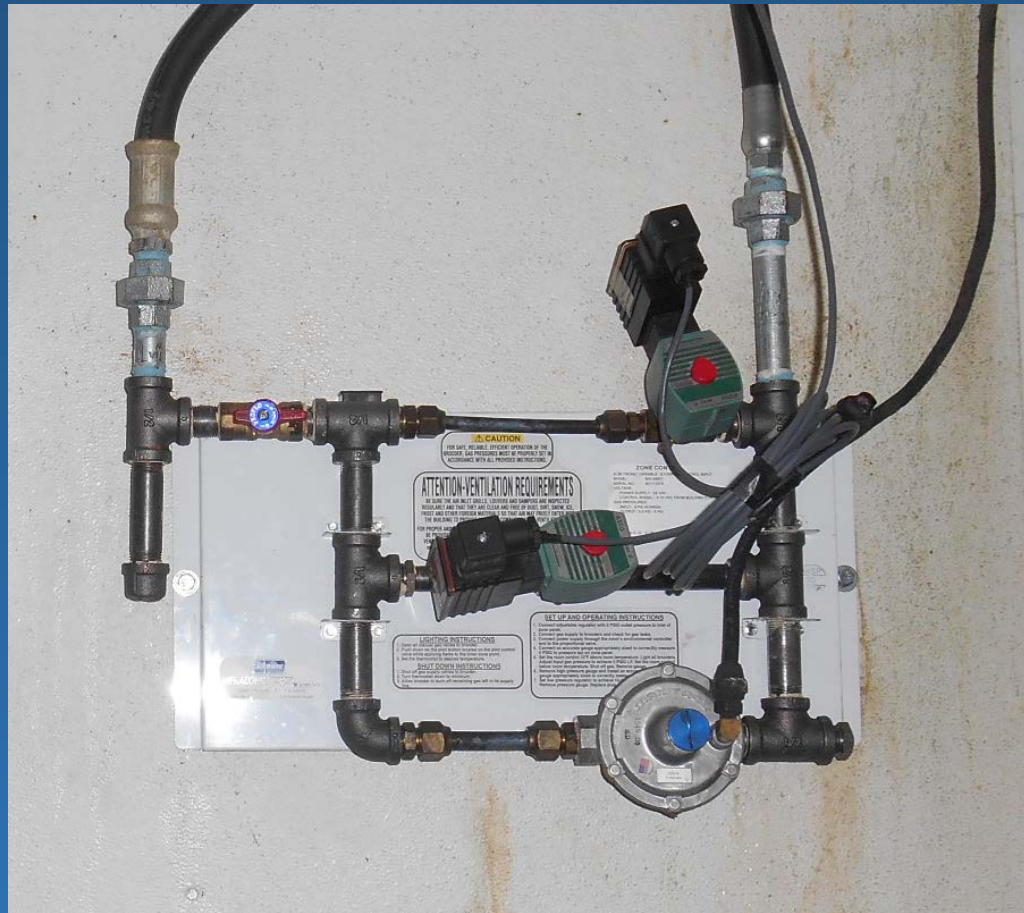
LB White Guardian
PSI
New HiredHand



Variable Rate Heaters



Variable output brooder controls



What is 'normal' energy expense?

Table 1. Data summary from various swine farms.

Description	Electrical usage/year	Range	Propane usage/year	Range
	kWh/pig space		Gallons/pig space	
Finishing				
Curtain barn	22.6	19.0 – 26.8	< 0.67	0.5 – 1.0
Tunnel barn	25.9	20.5 – 30.7	< 0.67	0.5 – 1.25
Wean-finish				
Tunnel barn	31.3	27.5 – 35.1	2.6	1.8 – 3.3
Sow farms	240	282 – 225	6.1	12.3 – 1.2

Table 2. Suggested goals for swine facilities in the upper Midwest.

Description	Goal for electrical usage	Goal for propane usage
Finishing (Curtain barn)	< 20 kWh/space-yr	< 0.5 gal/space-yr
Finishing (Tunnel barn)	< 25 kWh/space-yr	< 0.5 gal/space-yr
Wean-finish (Curtain barn)	< 25 kWh/space-yr	< 3 gal/space-yr
Wean-finish (Tunnel barn)	< 35 kWh/space-yr	< 2.5 gal/space-yr
Sow farms	< 240 kWh/sow-yr	< 6 gal/sow-yr

30 farms in Iowa, Minnesota and Missouri
Iowa State University PM 3063E, February, 2016

Remote Sensing



Some of us learn from the
mistakes of others

The rest of us have to BE
the others.

Anonymous

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