

Understanding Energy Conservation in Swine Production

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Jay D. Harmon, Ph.D., P.E.

*Interim Associate Dean for ANR Extension
Professor & Extension Ag Engineer
Agricultural and Biosystems Engineering
Iowa State University
4333 Elings Hall
Ames, IA 50011
jharmon@iastate.edu*

Why is Energy Important?

2013-16 median from: www.finbin.umn.edu

- Sow Farm
 - Fuel, Oil, Utilities \$20.39 per liter produced
 - 5.1% of total expenses
 - 8.4% of non-feed expenses
- Wean-Finish Farm
 - Fuel, Oil, Utilities \$1.98 per head
 - 1.7% of total expenses
 - 6.4% of non-feed expenses

Energy is Important

- Energy is a significant part of expenditures that you CAN do something about
- Many energy savings can be implemented with very little expense and some with NO additional expense.

1st Rule of Energy Conservation

*If you don't keep track of what you use,
it's hard to tell if you're doing great or
have a great opportunity to improve!*

Customize the spreadsheet to reflect your farming operation

The screenshot shows a Microsoft Excel spreadsheet titled 'Pub 3 examples - Microsoft Excel'. The 'View' ribbon is active, showing options like Ruler, Gridlines, and Zoom. The spreadsheet content is as follows:

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Farm Energy Log													
Electricity													
kWh	4750	4314	4980	4780	4700	4600	4865	4900	5020	6000	5600	4900	59409
price per kWh	\$0.1000	\$0.0948	\$0.0900	\$0.1046	\$0.1064	\$0.1087	\$0.1069	\$0.1082	\$0.1195	\$0.1000	\$0.1250	\$0.1429	
Total electric cost	\$475	\$409	\$ 448	\$500	\$500	\$500	\$520	\$530	\$600	\$600	\$700	\$700	\$6,482
Diesel													
gallons		892		900	800			900	780	740			5012
price per gallon		\$2.35		\$2.44	\$3.13			\$2.89	\$3.21	\$2.97			
Total diesel cost		\$2,096		\$2,200	\$2,500			\$2,600	\$2,500	\$2,200			\$14,096
Gasoline													
gallons													
price per gallon													
Total gasoline cost													

Data Summary

Based on small data set from cooperators.

Description	Electric/yr	Range	Propane/yr	Range
	kWh/pig space		Gal/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	0.5-1.3
Wean-Finish				
Tunnel barn	31.3	27.5-35.1	2.6	1.8-3.3
Sow farms	240	282-225	6.1	1.2-12.3

From: Benchmarking energy usage for swine producers. PM3063E. ISU Extension publication

Where do you start?

- Insulation?
- Lighting?
- Ventilation?
- Heating system?

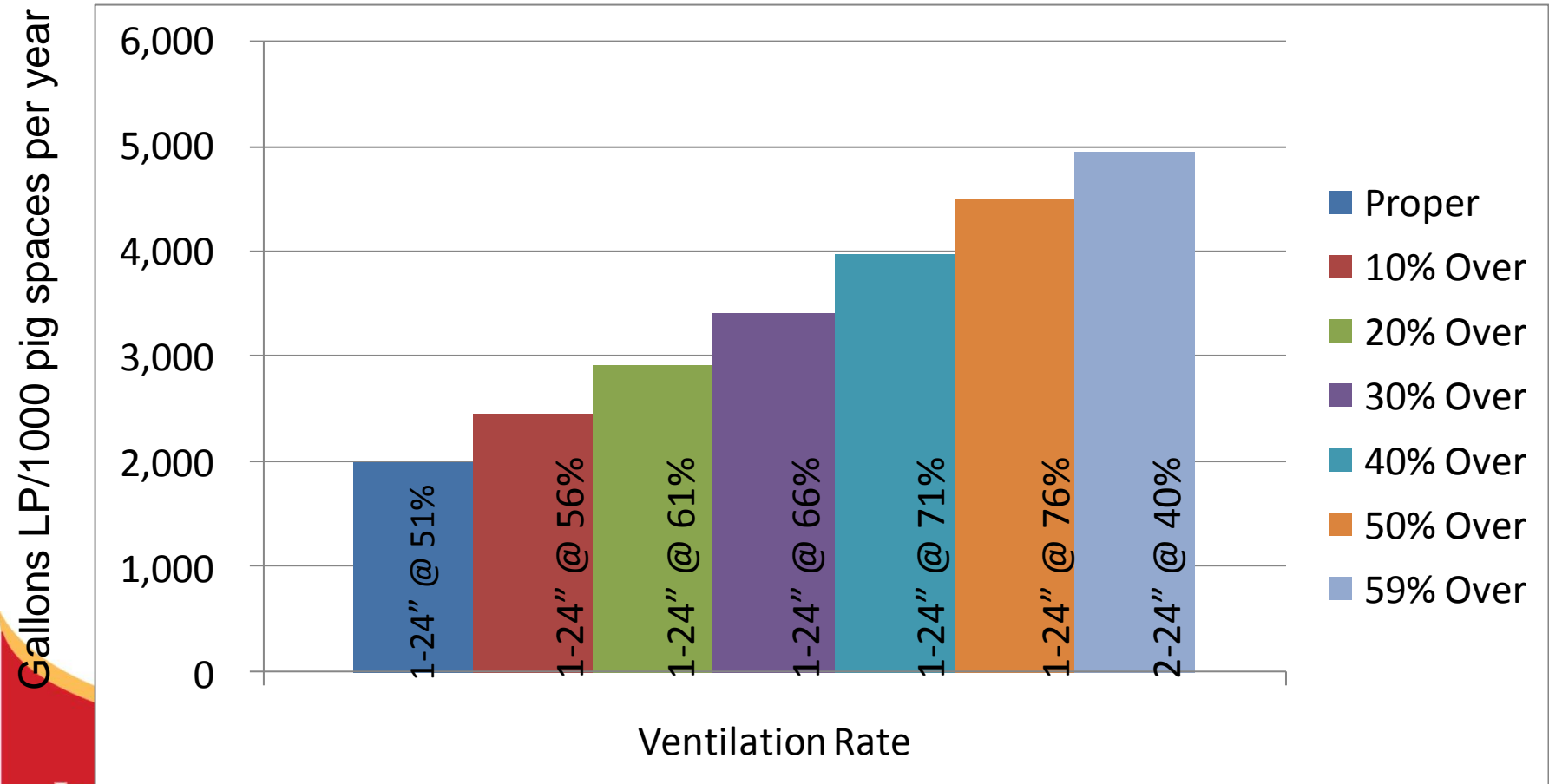
Ventilation

- FAR and AWAY the biggest potential for wasted energy
- 80 to 90% of heating energy lost through ventilation when done properly
- Controller setting and fan selection have a big influence on energy

Proper Ventilation Rate?

- Sample: 1000 head barn, 41 x 200
 - Assume:
 - 50 lb pigs @ 3 cfm/head & 68 F setpoint
 - Mason City, IA
 - Questions:
 - How much does over-ventilating cost?

Annual LP Usage Estimate Wean-to-Finish (annualized)



Why is Proper Rate so Difficult?

- Variable speed fans make delivering a prescribed minimum rate difficult.
 - Too much ventilation = excess LP
 - Too little ventilation = poor air quality
- Proper rate should be based on air quality & moisture, not “rule of thumb”
 - Example: 2 cfm

Fan Selection – Example 24” Fan Data

Static Pressure Inches of water	Speed RPM	Airflow cfm	Efficiency cfm/W
0.00	1101	6490	16.1
0.05	1094	6090	14.7
0.10	1089	5740	13.4
0.15	1083	5250	12.2
0.20	1082	4760	10.8
0.25	1082	3950	9.0
0.30	1082	2330	5.6

Source: BESS (2009) – www.bess.illinois.edu

How Efficient Should You Choose?

Diameter of fan (in)	Efficiency Rating (cfm/W) @ 0.1 inches of water	
	Median Rating	Top ¼ Rating
<16	7.9	8.7
16 to 20	10.3	11.2
22 to 35	13.0	14.6
36 to 46	15.9	17.2
48 to 56	18.9	20.4
>56	20.1	21.5

Look for rebates from your electricity provider

Source: BESS (2009)

Fan Efficiency Comparison

1000 Head Tunnel B&G (250 cfm/head)

- 8 fans – 24" ~ 7000 cfm
- X fans – 50" or 51" – enough to reach 250 cfm/sow

Highest Efficiency

- Uses 33,400 kWh/yr
- ~ \$3300 @ 10 cents/kWh

Lowest Efficiency

- Uses 60,000 kWh/yr
- ~ \$6000 @ 10 cents/kWh

Savings of ~ \$2700/yr (~44%)

Fan Selection

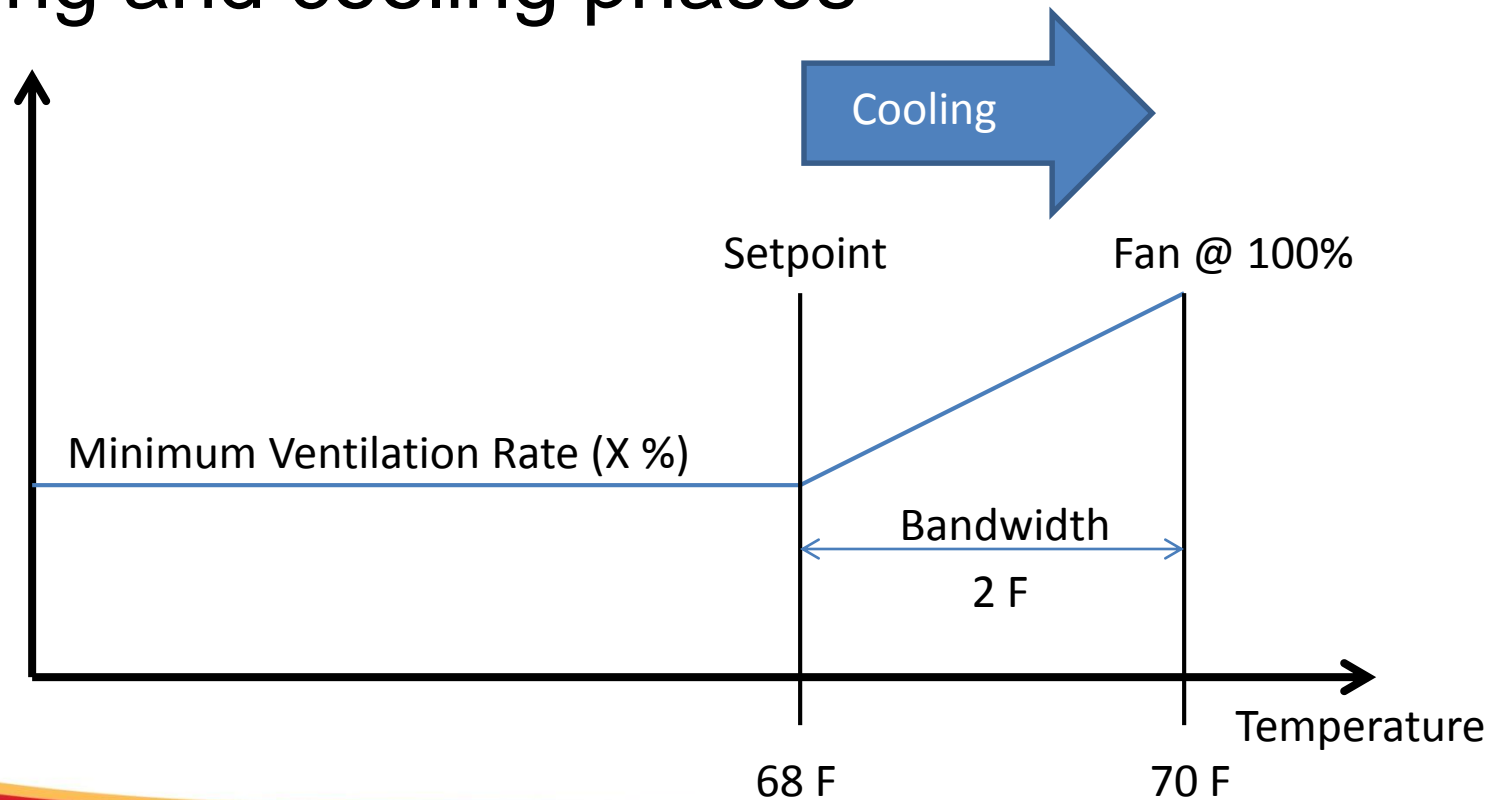
- Smallest fans may run all year (8760 hrs) so look for efficiency
- Largest fans are the most efficient, but do not run as many hours total (~ 1000 hrs?)
- Energy savings strategy
 - some controllers may be capable of turning off smallest fans during higher ventilation stages.

Heaters & Brooders



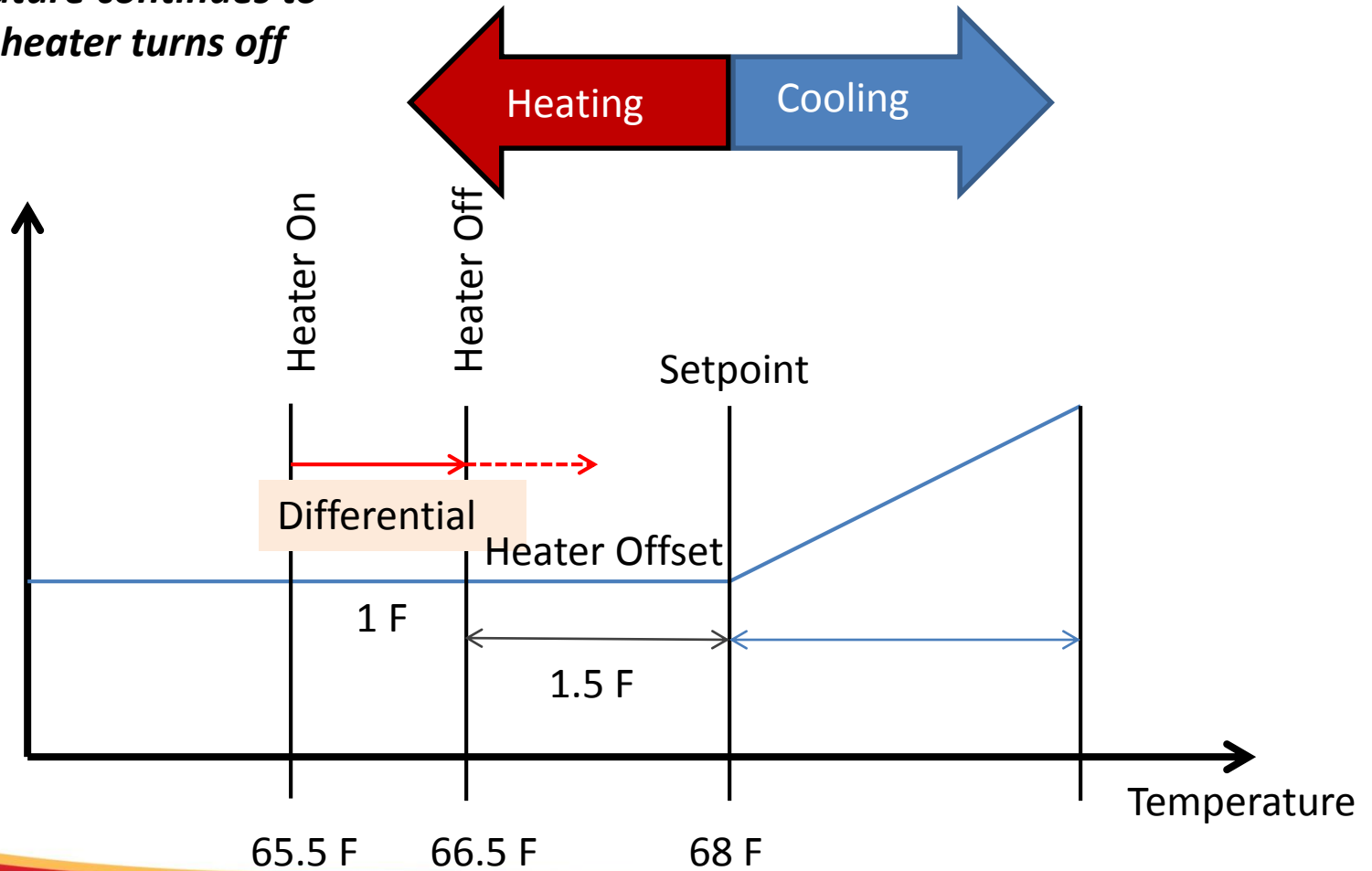
Fan Control

- Setpoint – Temperature that divides the heating and cooling phases



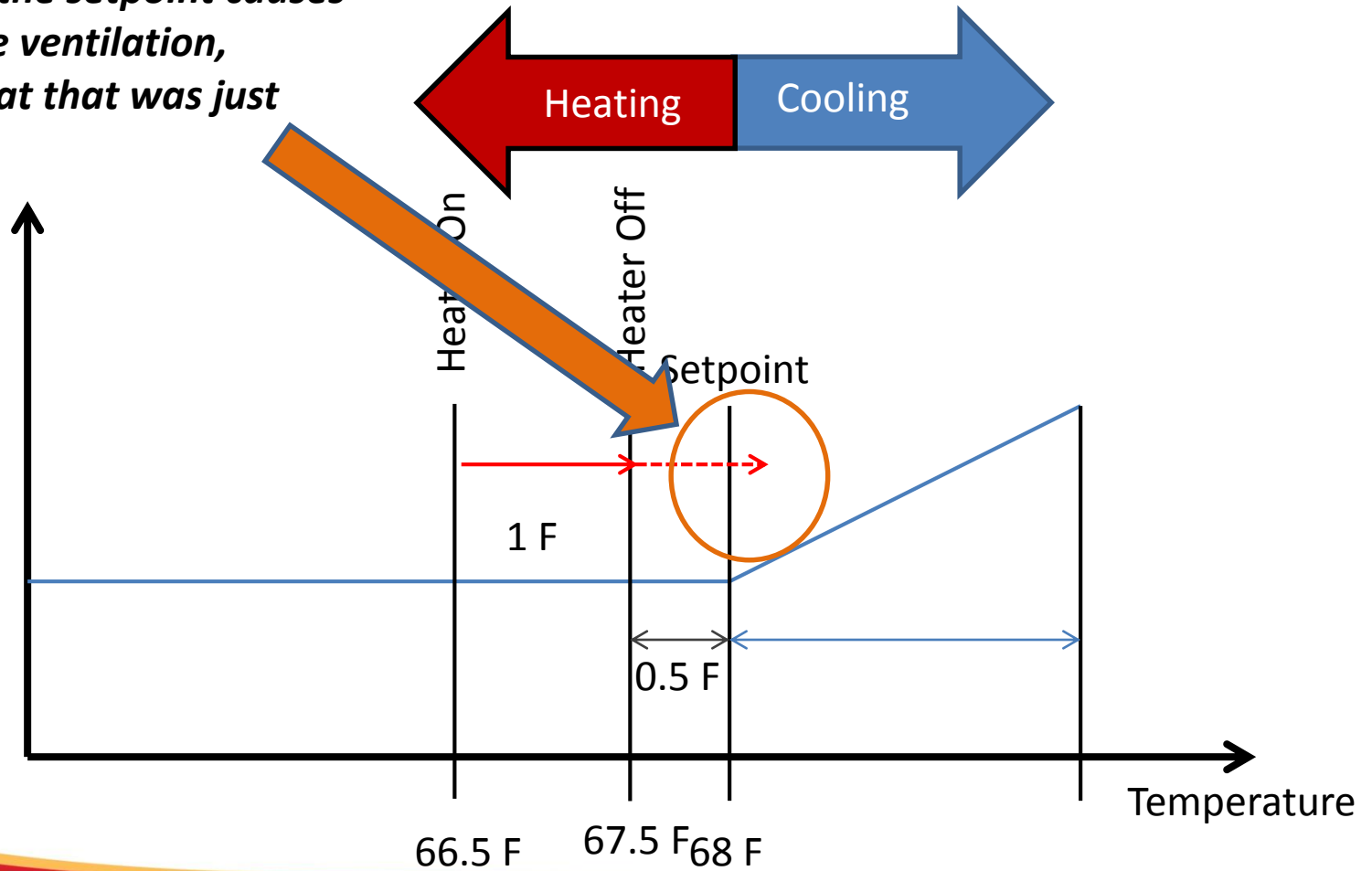
Space Heater Control

Room temperature continues to increase after heater turns off



Space Heater Control

Overshooting the setpoint causes fan to increase ventilation, exhausting heat that was just added.



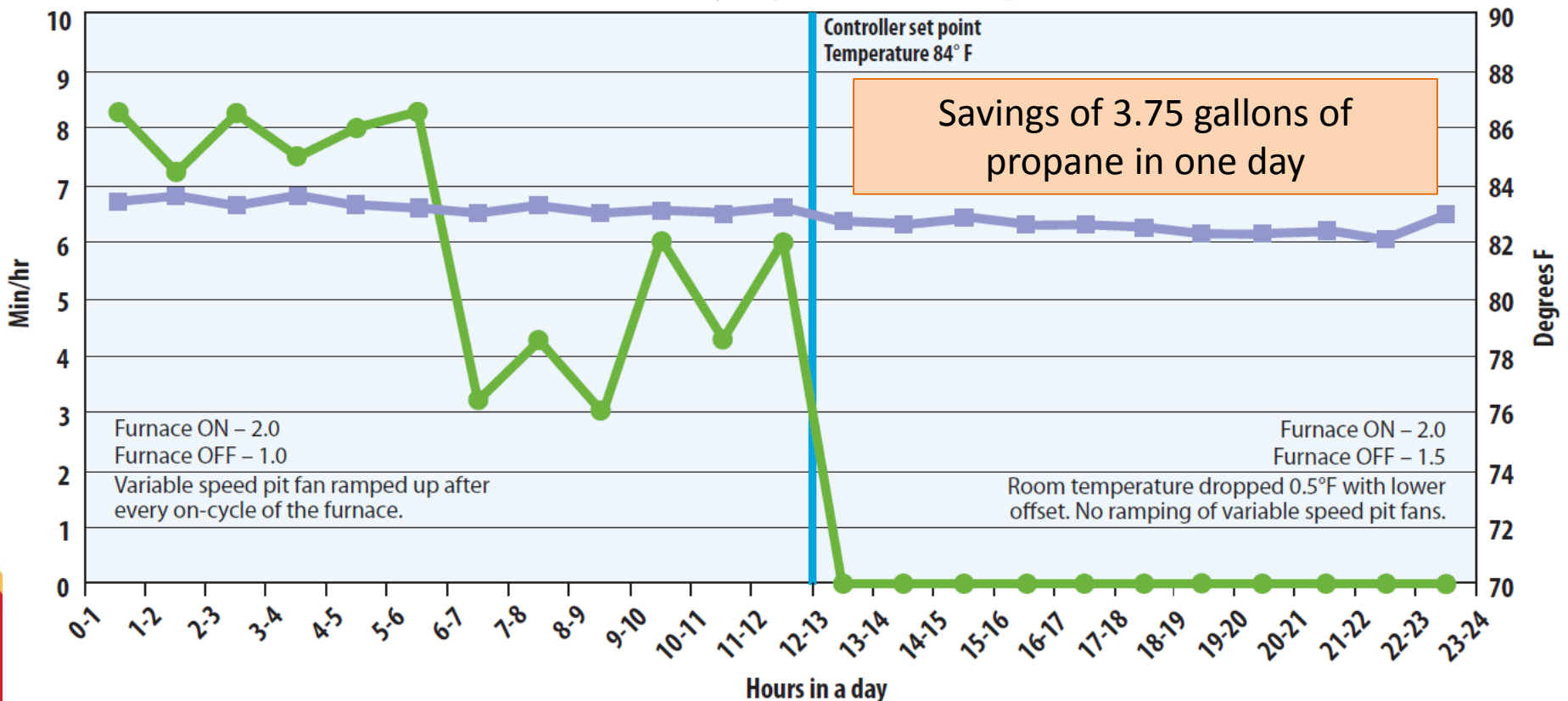
Case Study

Impact of furnace offset on furnace run time

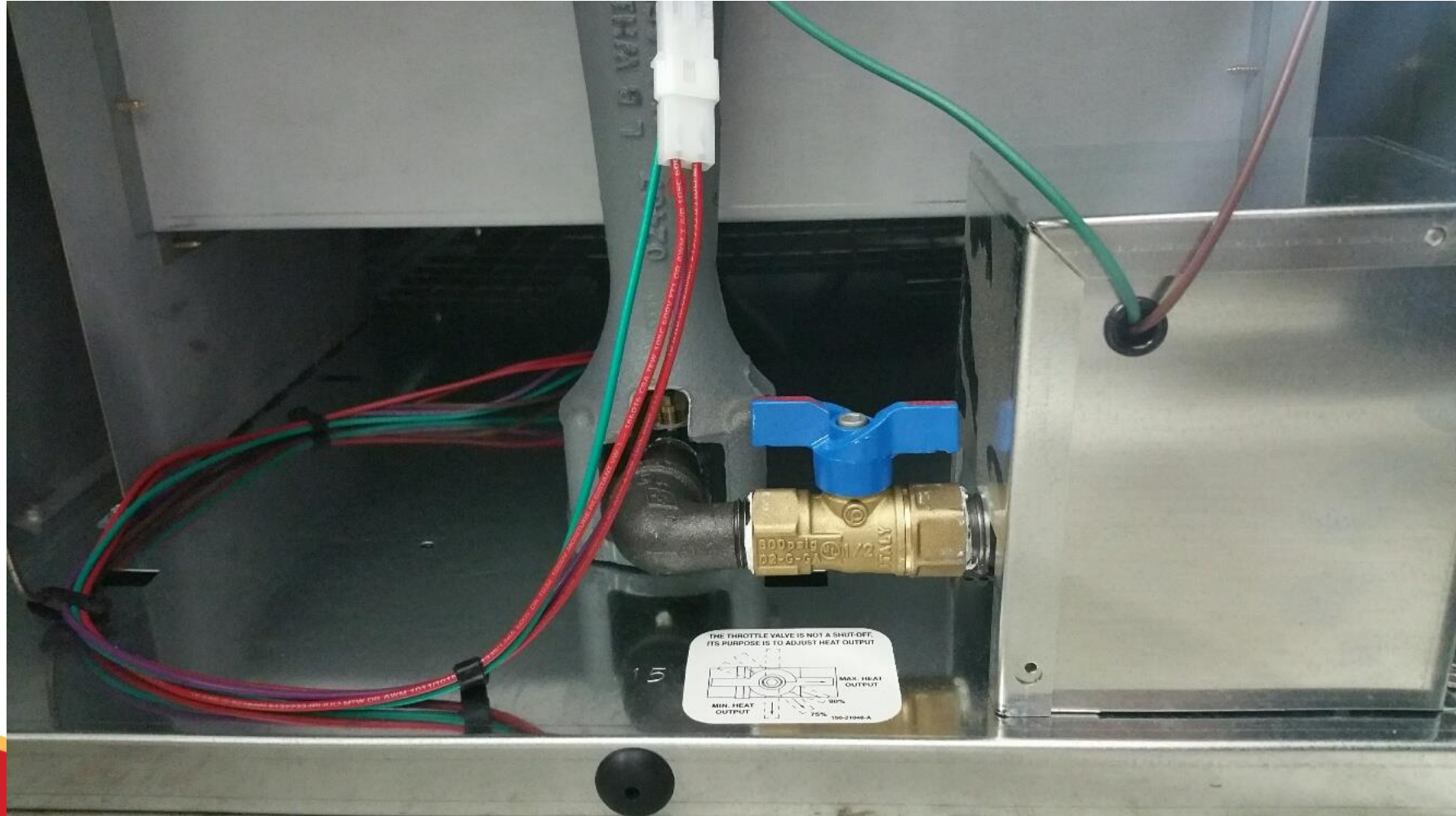
Offset changed at noon (blue vertical line)

Furnace run time Temperature

Outside conditions – steady temperature (34°F) with fog/drizzle



Heater Modulation

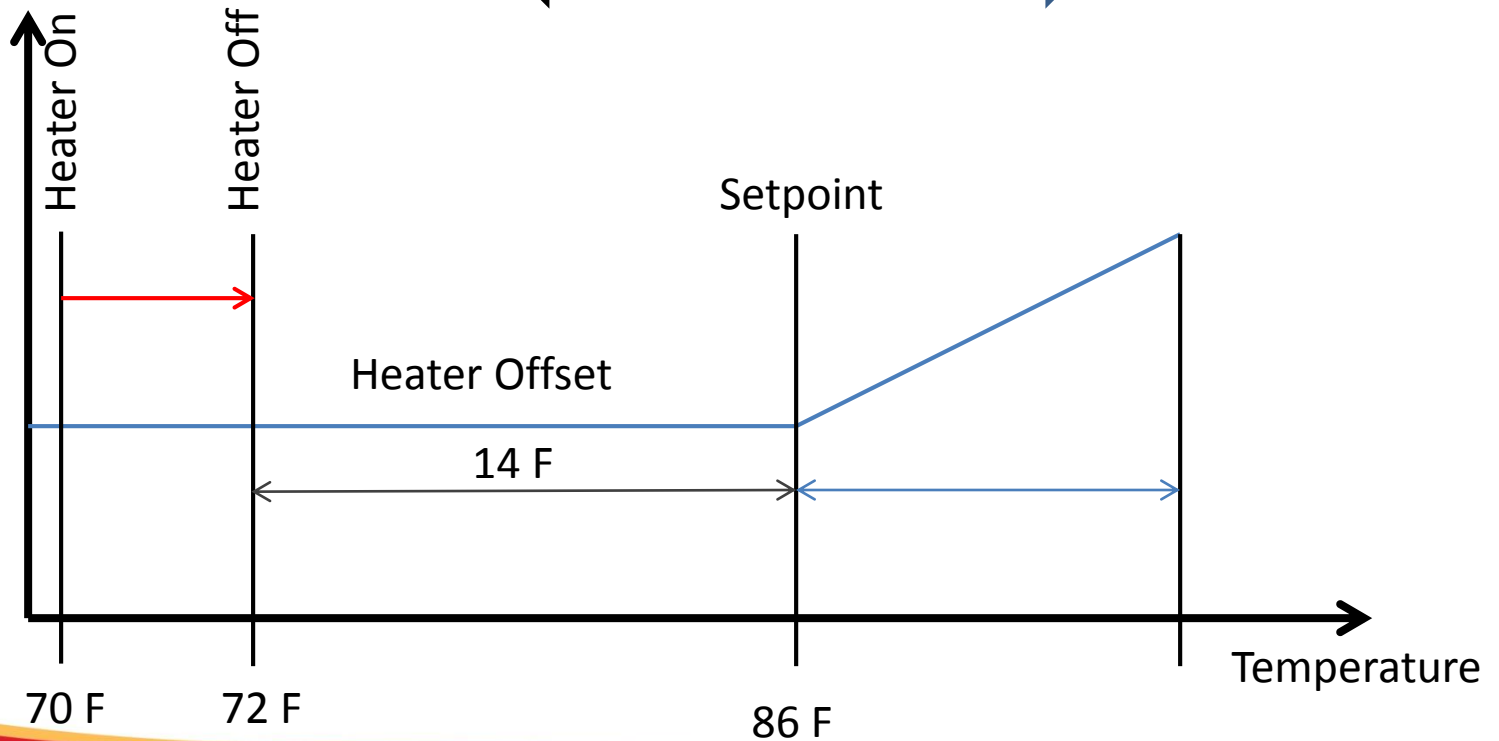
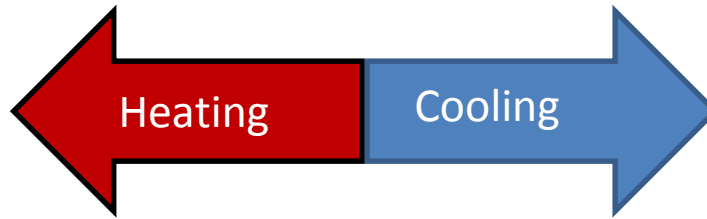


Guidelines

- Initially set offset to 1.5 to 2 F below the setpoint.
- Offset needs to be larger in rooms where the furnace is large for the room size.
- Use modulation valves to turn the heater down when the full capacity is not needed. More constant operation keeps a more steady environment.
- LISTEN!
 - ***If the furnace runs, and then the minimum ventilation fans begin to increase speed after it has shut off, the offset needs to be larger!***

Heater Control – Using Brooders

Setpoint is set to slightly above the brooder temperature



Brooder Usage

- Keep room setpoint near the brooder temperature (~85)
- Set the heater offset so that the room space heaters come on at a lower temperature (~70 F)
- Keeps from exhausting extra heat when you still need it.



Dirty Fans and Shutters

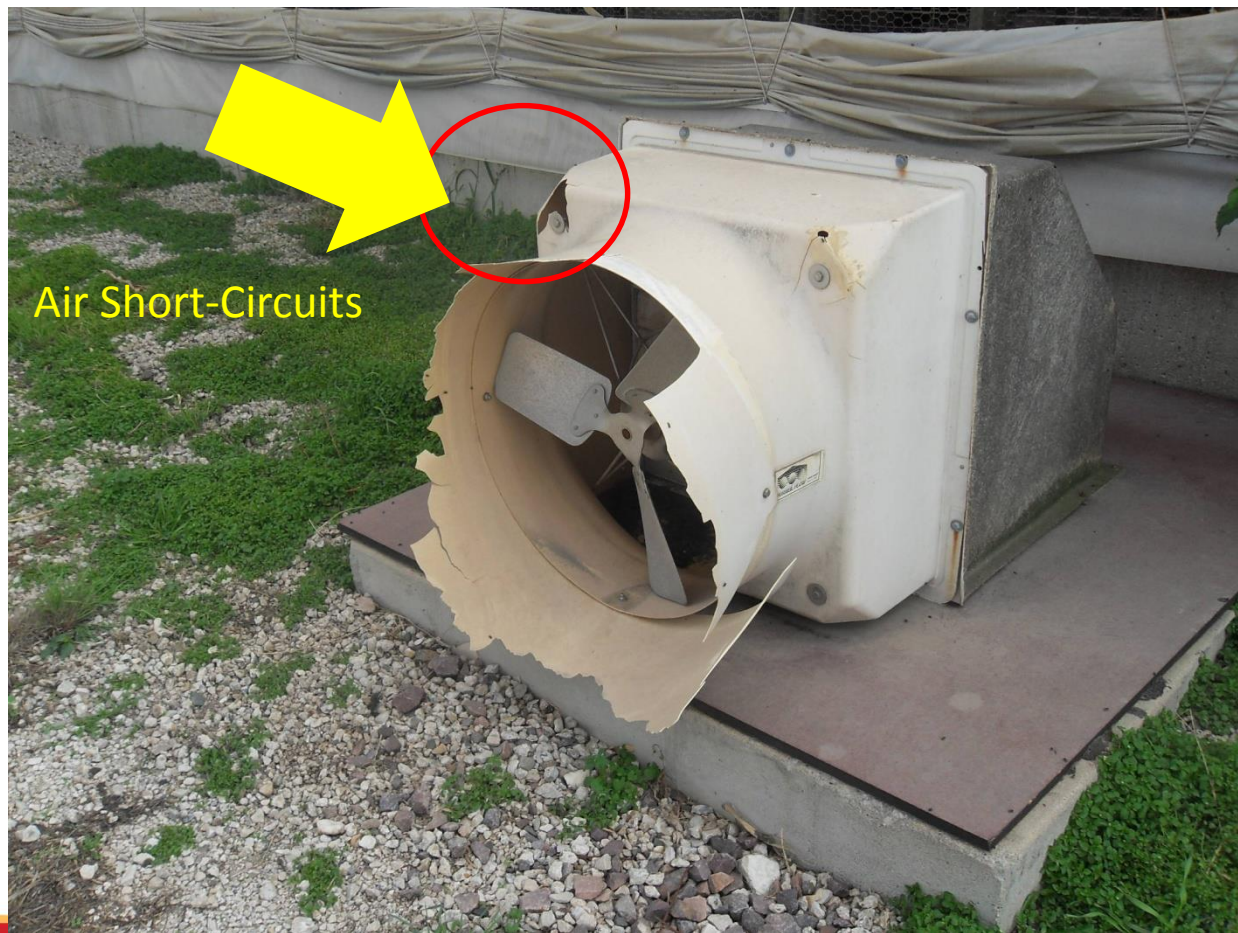
- 1/8 inch of dirt/dust can cause up to a 40% reduction in fan and shutter air flow.
 - Triggers next ventilation stage sooner costing more energy.



How Does this Impact Performance?

Air is lazy and follows the easiest path... therefore air comes from here instead of the room.

Result is poorer air quality and possibly sicker pigs.

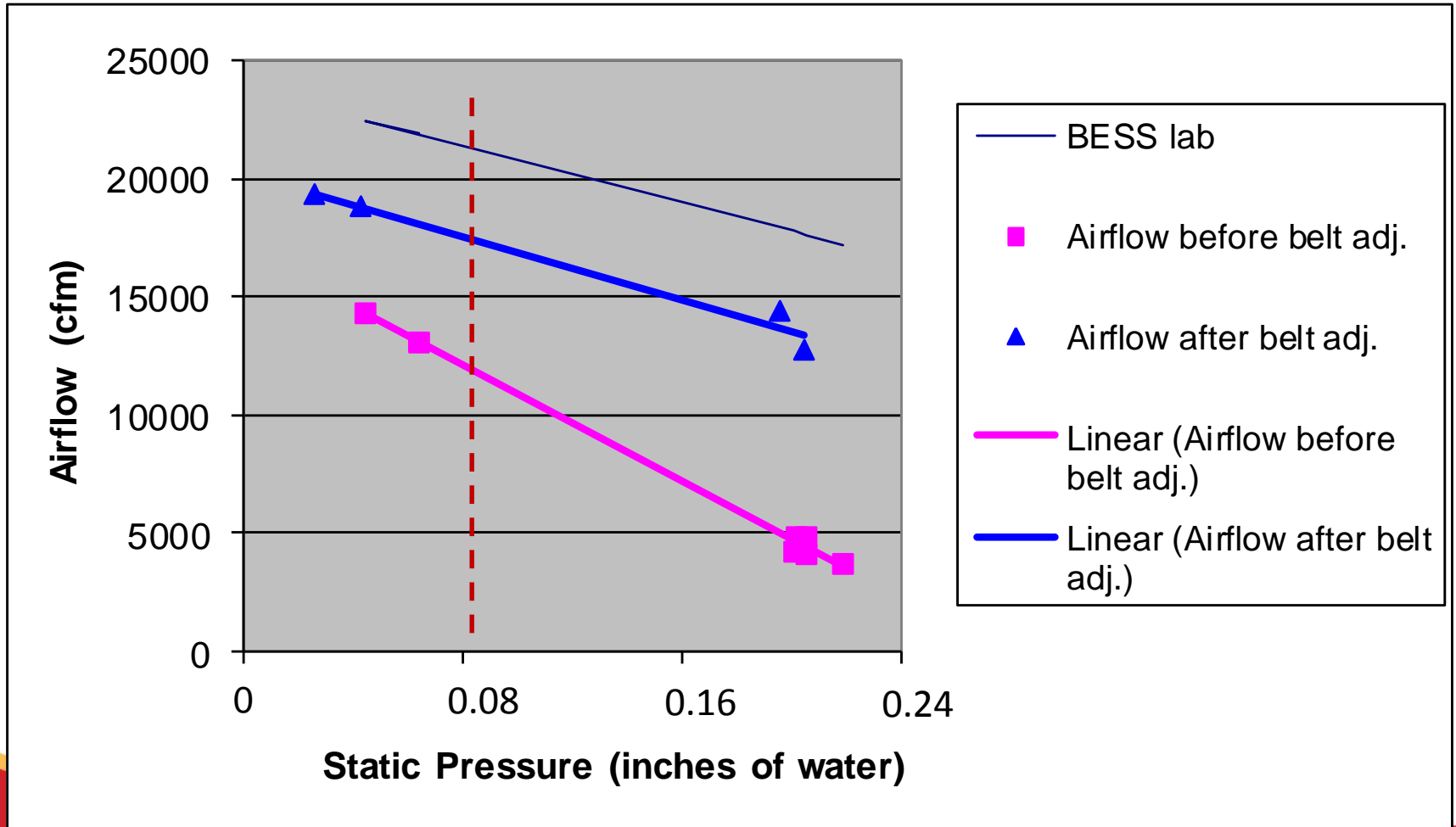




Loose fitting pit covers and fan shrouds allow short-circuiting and loss of ventilation

Effect of Drive Belt Tension

48-inch Fan



Sunken Belt 1/4" Due to Worn Pulley



Reduction in fan Speed

Preventing Belt and Pulley Wear

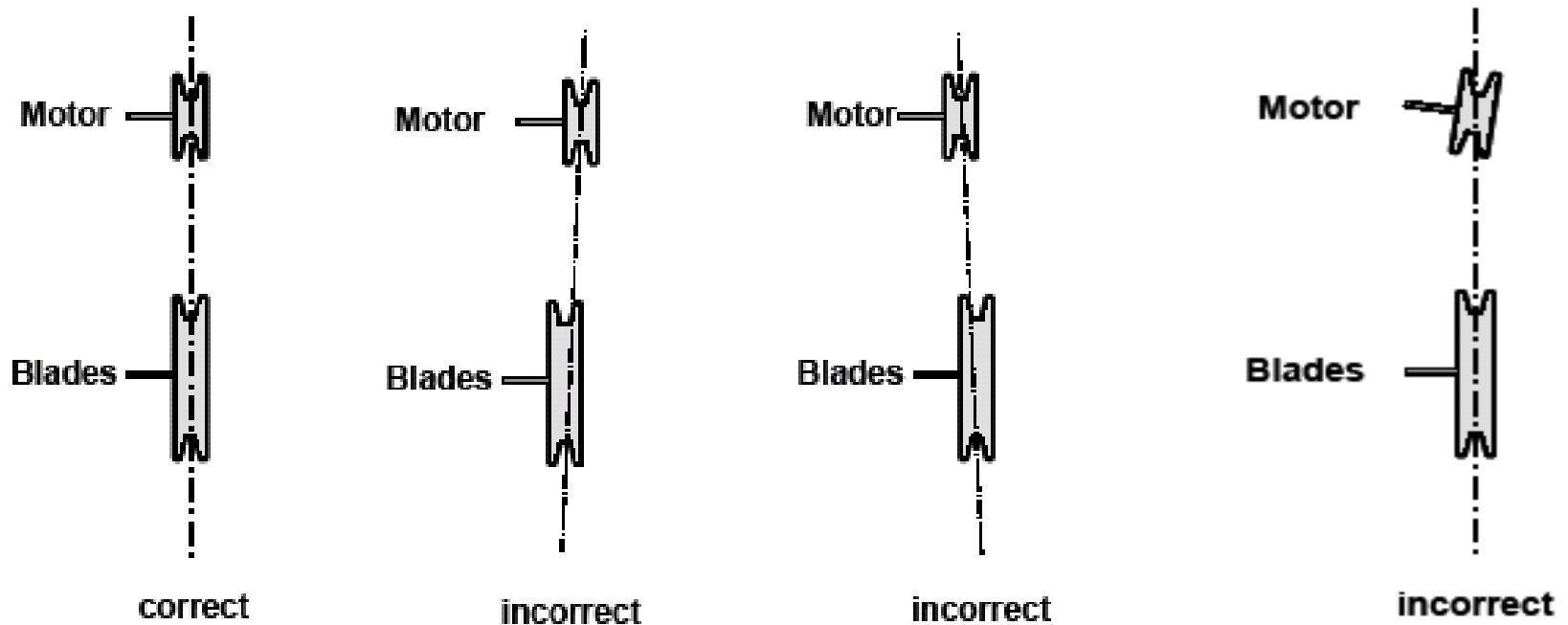


Figure 1. Fan pulley alignment.

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Check Electrical Systems



- At the fan and in the electrical panel.
- Connections tend to loosen over time with heating and cooling.

Poorly Maintained Fans:

- Reduce air quality in winter
- Cause higher stages to run earlier and use more electricity
- Cause curtains to drop when it is colder outside
- Reduce the ability to cool animals in summer

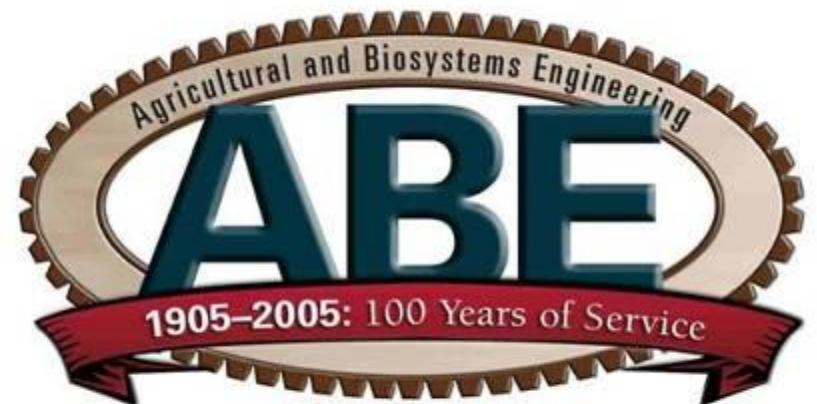
Summary

- Begin by tracking your energy usage
- Ventilation Management is critical to energy management
- Controller Settings are an important part of efficient operation.
 - No investment in many cases .. Only management

What questions do you have?



ISU Extension Farm Energy Initiative
Farmenergy.exnet.iastate.edu



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