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Guidelines for Selection of Energy Efficient Ventilation Fans

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Fans use 40% to 60% of the electricity in most mechanically ventilated swine, poultry, and dairy facilities.

- Fans account for only 13% of the electrical use for swine nursery buildings.
- The efficiency of the fans used can have a major impact on the energy needed to produce milk, meat, and eggs.

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What do we look for in an energy efficient fan?

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It is best to choose fans that...

- Are designed for use in harsh agricultural conditions.
- Provide the needed ***airflow rate*** (cubic feet per minute = **cfm**) at a ***pressure drop of 0.10 in of water (ΔP)***.
- Have a ***high ventilation efficiency ratio*** (**VER = cfm/W**)
- That are designed to ***maintain sufficient airflow at higher ΔPs*** (**Airflow ratio = AFR**)

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Sources

- ASABE Engineering Practice: Guidelines for Selection of Energy Efficient Agricultural Ventilation Fans (ASAE EP566.2)
- Bioenvironmental and Structural Systems Laboratory at the University of Illinois

http://www.bess.uiuc.edu/

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What is the most common characteristic of an energy efficient fan?

- It will have a **discharge cone**.
- **Cones can improve efficiency by 15%.**
- Not all fans with cones meet the minimum criteria. **Need data.**

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Reliable, independent fan test data for a particular fan can be obtained from…

Bioenvironmental and Structural Systems Laboratory (BESS Lab)
http://www.bess.uiuc.edu/

And

BESS Lab data published by many ag fan manufactures.

Recommendation: If you cannot get the data then don't buy the fan.

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Comparison of Fan Data for Two 48-inch Fans

One fan does not meet the ASABE Standard cfm/W recommendation, and the other has a VER that exceeds the Standard.

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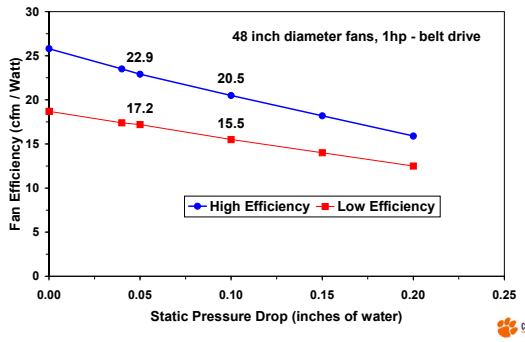
ASABE Recommendation = 17.6 cfm/W



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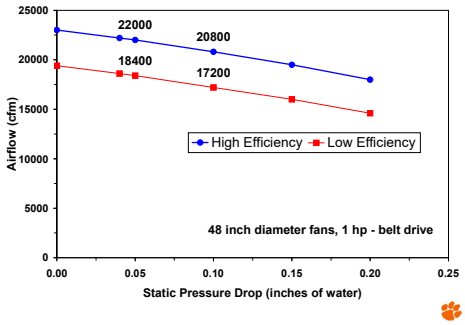
In this case, the high efficiency fan provided 21% more cfm at ΔP = 0.10 in of water.



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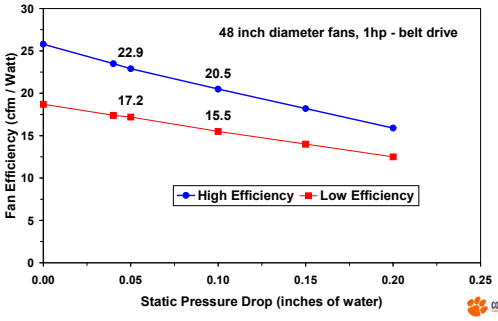
The greater cfm/W (VER) of the high efficiency fan indicates that less electricity is used per cfm provided.



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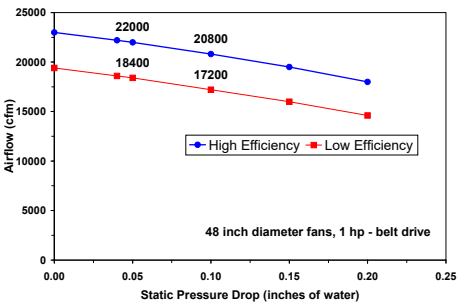
Airflow rate for any fan decreases as static pressure drop increases.



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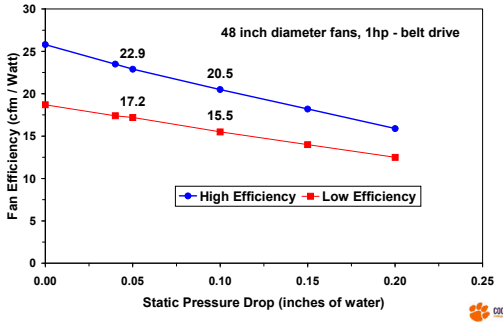
The cfm/W (VER) for both fans decreased as the fans worked harder.



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VER-0.10 Recommendations (cfm/W) from Chastain et al. (2017)

D (in)	Mean VER-0.10	Target VER-0.10
8 to 10	5.0	**5.7**
12 & 14	8.5	**9.2**
16 to 20	11.1	**11.5**
24 & 25	13.5	**14.3**
36	15.4	**17.0**
48	18.9	**19.3**
50 to 52	19.2	**20.2**
53 to 61	19.9	**21.1**

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Airflow Ratio - AFR

- **AFR is a critical fan selection parameter.**
- Airflow ratio is a measure of the steepness of the fan curve.
- Or to put it another was, ***the higher the AFR the stronger the fan.***
- AFR = Q at 0.20" / Q at 0.05".
- **The closer AFR is to 1.0 the better.**

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Minimum AFR Recommendations Chastain et al. (2017)

Diameter Range	Grand Mean AFR	Recommended Minimum AFR
8" to 16"	0.81	0.80
18" to 36"	0.79	0.75
48" to 55"	0.74	0.70
57" to 61"	0.64	0.70

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Application – Upgrade of Tunnel Ventilation Fans for an Old Broiler Barn

- House dimensions: 40 ft wide by 500 ft long.
- Existing Tunnel Fans, 10, 48-inch fans without cones.
- System ΔP = 0.10 inches of water (no tunnel doors)
- I selected the highest VER-0.10 fan possible.

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Upgrading the tunnel fans using the best fans possible provided an energy savings of 29.5%

	Q (cfm)	VER cfm/W	Use kWh	Cost	Savings (%)
OLD	185,000	**16.3**	28374	$3547	NA
NEW	186,000	**23.2**	20043	$2505	**29.5%**

Assumptions:
1. Operating time = 2500 hours
2. Electric Price = $0.125 / kWh

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Simple Pay Back

- LOW Efficiency – **Replace with the same fans** (16.3 cfm/W)
- Fans + Install = $6750/house
- Energy Cost = $3547

- HIGH Efficiency – **Replace with High-E fans** (23.2 cfm/W)
- Fans + Install = $9000/house
- Energy Cost = $2505

Difference in Price = $2250/house
Energy Savings = $1042/house/year
Simple Pay Back = ΔPrice / Savings/year = 2.2 years

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The fans that **just meet ASABE Standards** provide more airflow than needed and **will increase energy use.**

	Q-0.10 (cfm)	VER-0.10 cfm/W	Use kWh	Elec. Cost	Savings (%)
Existing	185,000	16.3	28374	$3547	NA
Rec.	**186,000**	**23.2**	**20043**	**$2505**	**29.5**
Sub 1	**226,000**	**17.6**	**32,102**	**$4013**	**- 13.1**
Sub 2	**229,000**	**18.0**	**31,806**	**$3976**	**- 12.1**

ASABE Standard recommends a minimum VER-0.10 of 17.6 cfm/W.

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Energy Efficient Fan Selection Guidelines

- The fan must be rated to provide the needed airflow at 0.10 inches of water.
- The fan must have a minimum airflow ratio of 0.70 to 0.80 depending on diameter.
- Best to select a fan with **the highest cfm/W possible.**

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Questions?

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