Fan Efficiency Metrics

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Presentation Outline

- Introduction to AMCA
- Why Obsolete the Current Metric (FEG)?
- Introduction of the Fan Energy Index
- Questions

Introduction to AMCA

- **Air Movement and Control Association Int.**
- Not-for-profit manufacturers association established in 1917
- More than 370 member companies worldwide
- Mission is to promote the health, growth and integrity of the air movement and control industry


amca INTERNATIONAL AMERICAS
amca INTERNATIONAL EUROPE
amca INTERNATIONAL ASIA
amca INTERNATIONAL MIDDLE EAST
170
7
3
28
27
142

Content Development

- Test Standards
  - ANSI Accredited
  - ISO Member
- Application Guides
- White Papers
- Videos
- Magazine
- Social Media

AMCA Educational Programs

- Meetings
- Conferences
- Engineering Seminars
- Workshops

Worldwide Network of Test Labs

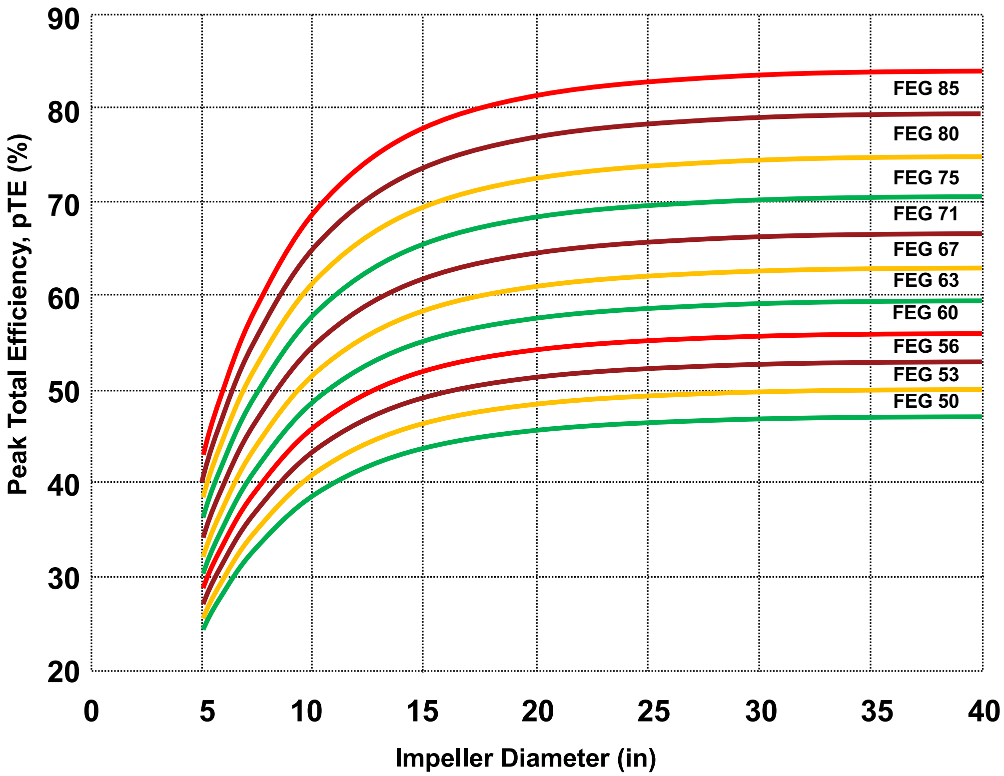
- Chicago headquarters
- Regional independent labs
  - Dubai
  - Malaysia
  - France
  - Korea
- Accredited manufacture’s labs
  - > 50 worldwide

The AMCA Certified Ratings Program

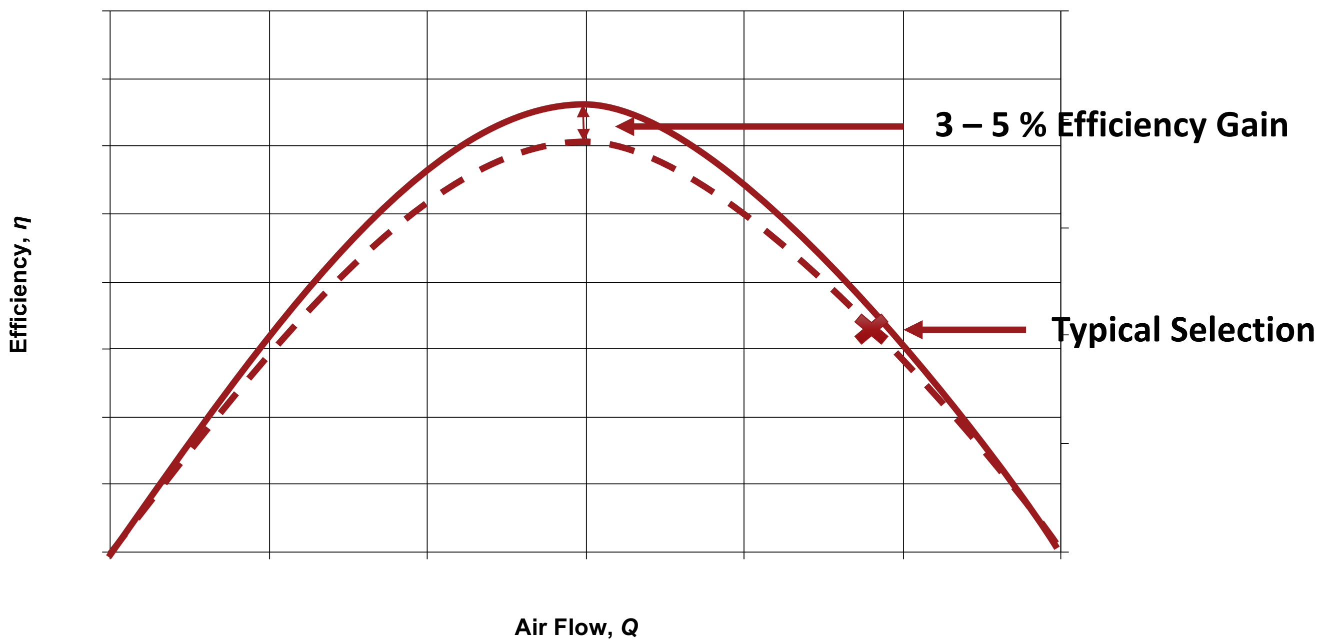
- Helps ensure honest and accuracy in product rating

Why Obsolete the Current Metric (FEG)?

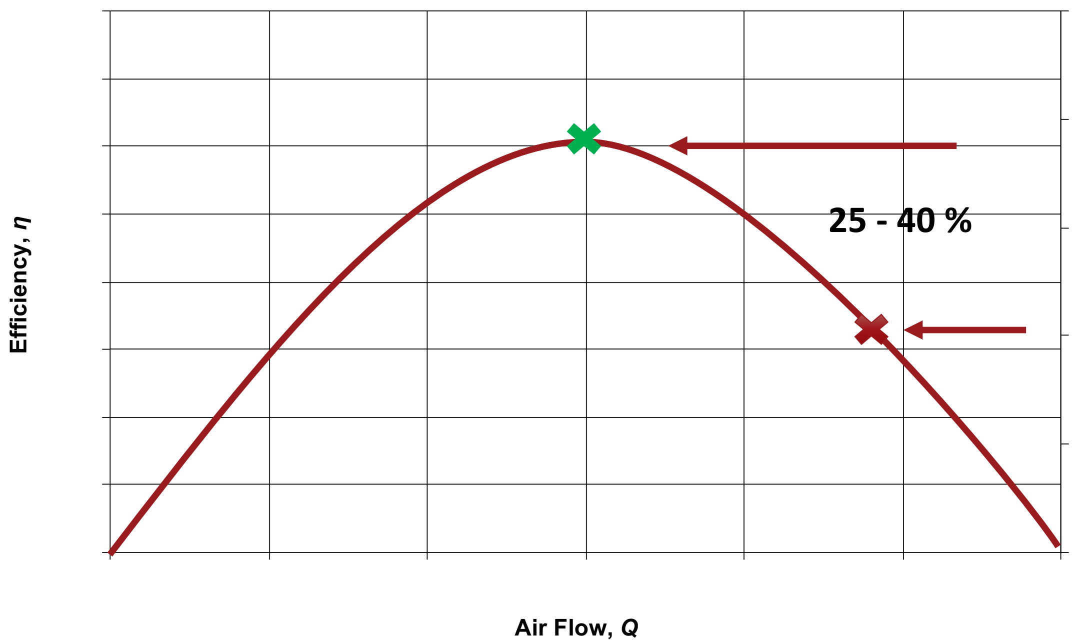
Fan Efficiency Grade



Single Point Metric



Leaves Efficiency Gains on the Table



Fan Efficiency Varies with Size for a Duty Point

Fan Size [in.] (mm)	Fan Speed (rpm)	Fan Power (bhp) [kW]	Actual Total Efficiency (%)	FEG
18 (460)	3,238	11.8 [8.8]	40.1	85
20 (510)	2,561	9.6 [7.2]	49.5	85
22 (560)	1,983	8.0 [6.0]	59.0	85
24 (610)	1,579	6.8 [5.0]	69.1	85
27 (685)	1,289	6.2 [4.6]	75.8	85
30 (770)	1,033	5.7 [4.3]	82.5	85
36 (920)	778	6.0 [4.5]	78.7	85

Finally, we also needed to address:

- The regulation of electrical input power
- The use of fan static pressure for non-ducted fans
- The elimination of categories to allow product substitution
- DOE could not regulate fan application, but they COULD regulate how fan data is presented to the public

Introduction of the Fan Energy Index

Fan Efficiency Index (FEI)

$$FEI = \frac{Selected\ Fan\ Efficiency}{Baseline\ Fan\ Efficiency}$$

$$FEI = \frac{Baseline\ Fan\ Electrical\ Input\ Power}{Selected\ Fan\ Electrical\ Input\ Power}$$

Baseline Fan Shaft Input Power

$$H_{i,ref} = \frac{(Q_i + Q_0)(P + P_0 \times \frac{\rho}{\rho_{std}})}{1000 \times \eta_o}$$

Q_i - selected fan airflow
P_i - selected fan total pressure (ducted), or tatic pressure (nonducted)
P - air density
ρ_{std} - standard air density
Q_0 - 0.118 m3/s (SI), or 250 cfm (IP)
P_0 - 100 Pa (SI), or 0.40 in.wg (IP)
η_0 - 66% for ducted applications and 60% for nonducted applications

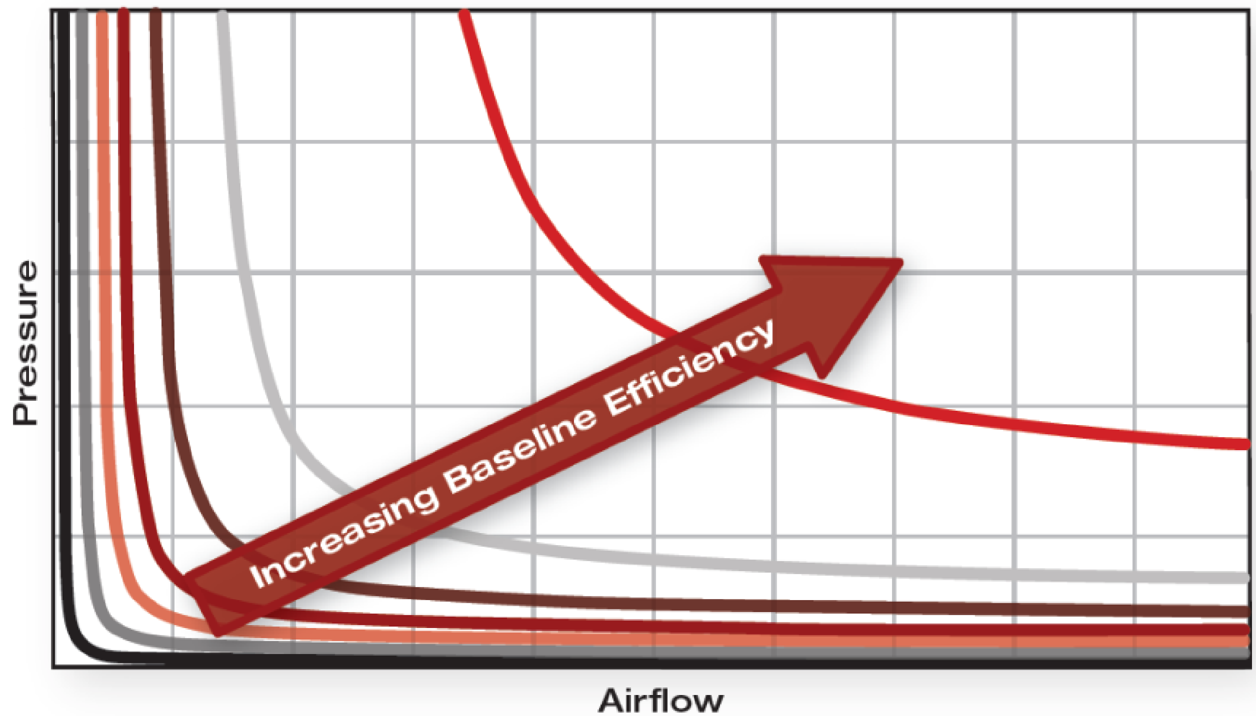
Baseline Electrical Input Power

$$H_{i,ref} = \frac{(Q_i + Q_0)(P + P_0 \times \frac{\rho}{\rho_{std}})}{1000 \times \eta_o}$$

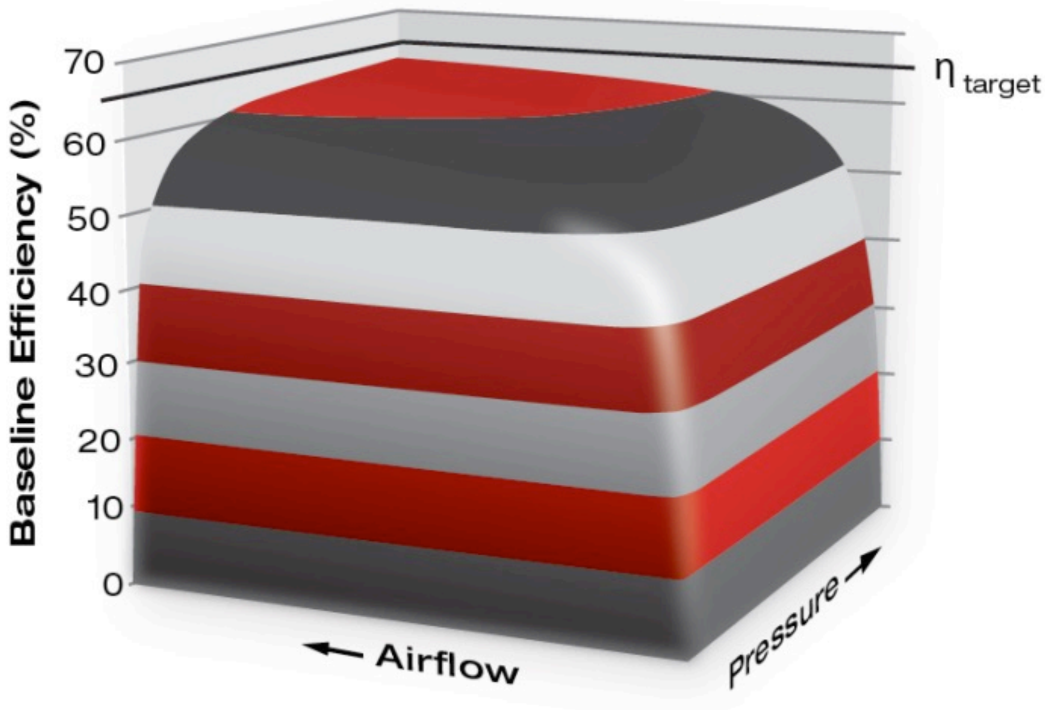
$W_{i,ref} = H_{i,ref}$ + *AMCA 203 Belt Loss + IE3 Motor loss*

$W_{i,ref}$ = *Baseline Electrical Input Power*

Baseline Efficiency with Constant η_o



Baseline Efficiency with Varying η_o



Comparing FEI against FEG

Fan Size [in.] (mm)	Fan Speed (rpm)	Fan Power (bhp) [kW]	Actual Total Efficiency (%)	Baseline Power	FEG	FEI
18 (460)	3,238	11.8 [8.8]	40.1	7.96	85	0.67
20 (510)	2,561	9.6 [7.2]	49.5	7.96	85	0.83
22 (560)	1,983	8.0 [6.0]	59.0	7.96	85	0.99
24 (610)	1,579	6.8 [5.0]	69.1	7.96	85	1.16
27 (685)	1,289	6.2 [4.6]	75.8	7.96	85	1.28
30 (770)	1,033	5.7 [4.3]	82.5	7.96	85	1.39
36 (920)	778	6.0 [4.5]	78.7	7.96	85	1.32

More Comparisons

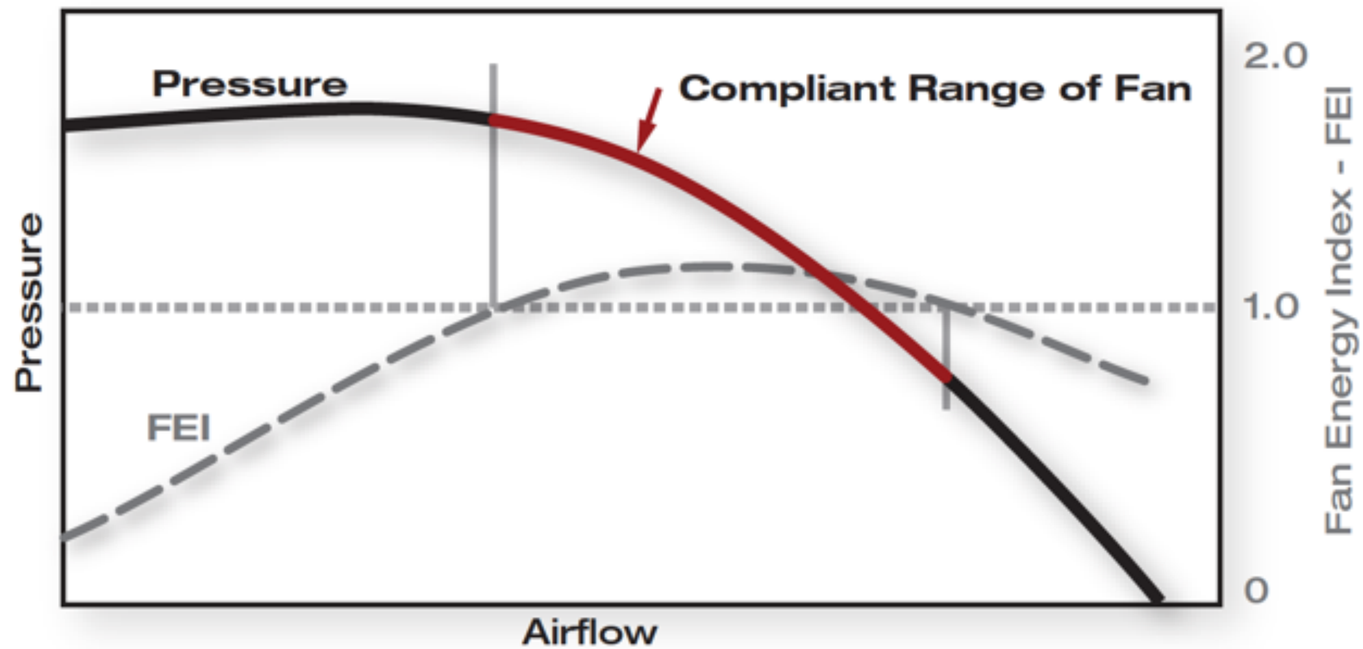
Fan Size (in.) [mm]	Fan Speed (rpm)	Speed Reduction from Smallest Diameter	Fan Power (bhp)	Power Reduction from Smallest Diameter	Actual Total Efficiency	Efficiency improvement Over Smallest Diameter	Baseline Power (bhp)	FEI	FEI Improvement over Smallest Diamter
18 [460]	3238		11.8		40.10%		7.96	0.67	
20 [510]	2561	79%	9.56	81%	49.50%	23%	7.96	0.83	24%
22 [560]	1983	61%	8.02	68%	59.00%	47%	7.96	0.99	48%
24 [610]	1579	49%	6.84	58%	69.10%	72%	7.96	1.16	73%
27 [685]	1289	40%	6.24	53%	75.80%	89%	7.96	1.28	91%
30 [770]	1033	32%	5.73	49%	82.50%	106%	7.96	1.39	107%
33 [840]	887	27%	5.67	48%	83.40%	108%	7.96	1.4	109%
36 [920]	778	24%	6.01	51%	78.70%	96%	7.96	1.32	97%

How Will FEI Be Used?

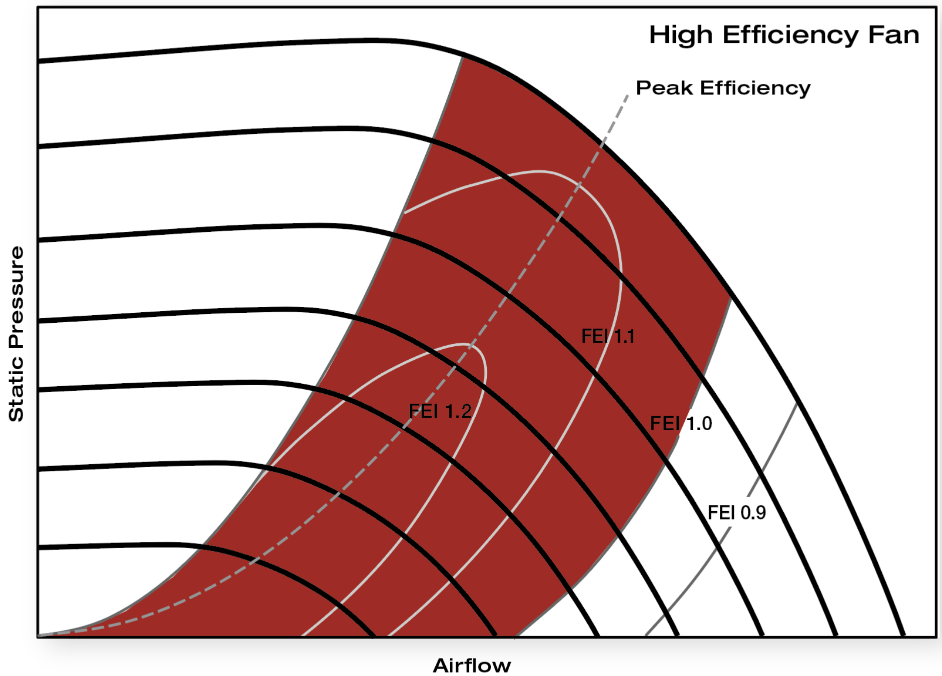
Body	FEI Requirement (forecast – not certain)
U.S. Federal or California Regulation	FEI ≥ 1.0 at Design Point
ASHRAE 90.1	FEI ≥ 1.0 at Design Point
ASHRAE 189.1	FEI ≥ **1.10** at Design Point
Rebates	FEI = Savings over Baseline

FEI = 1.10 means 10% energy savings over baseline

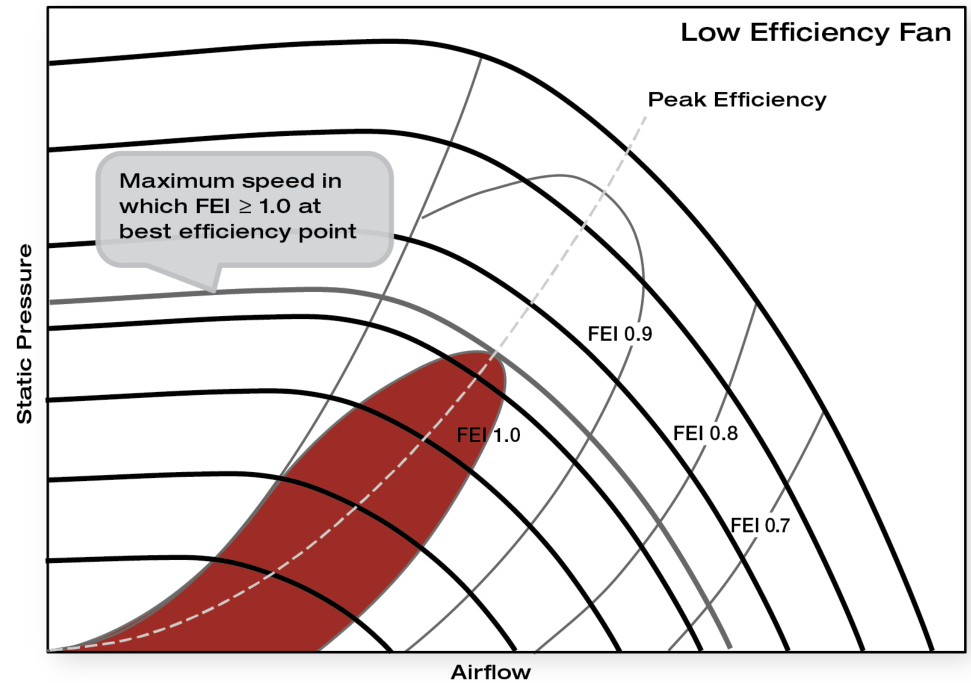
FEI Range for Constant Speed Fan



FEI Range for Centrifugal with Speed Control

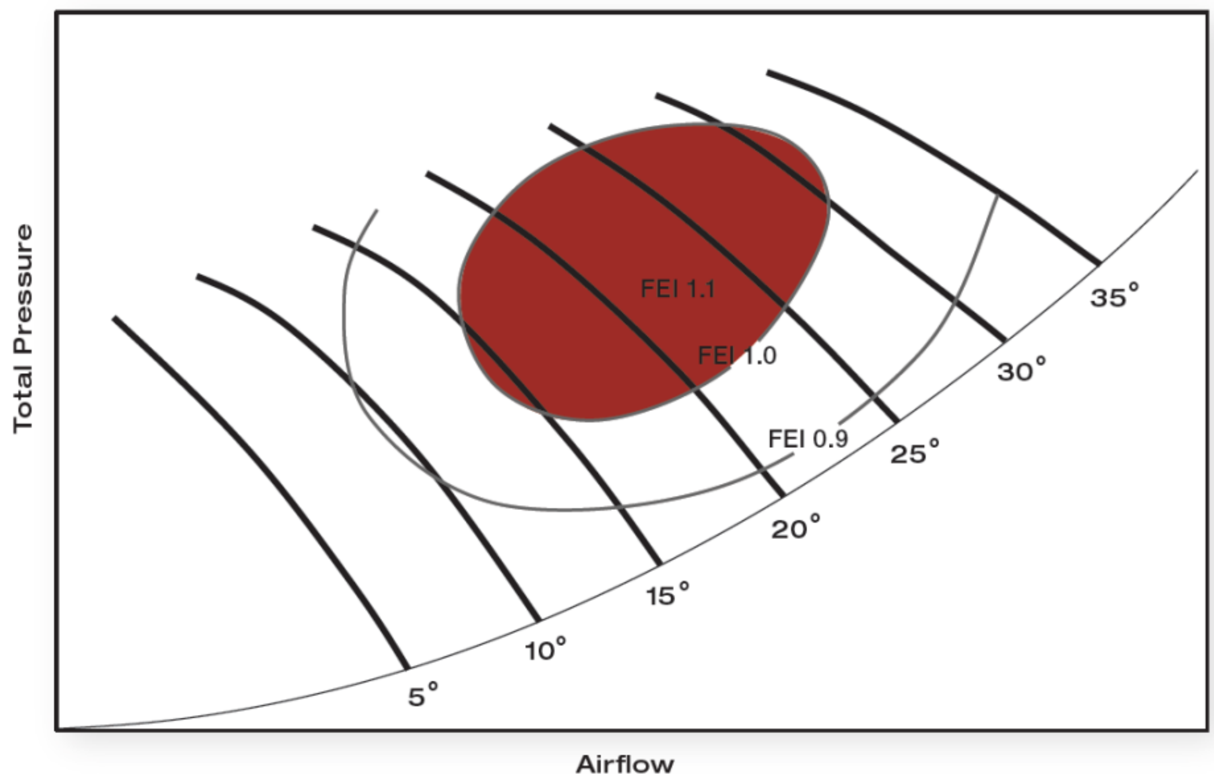


EFFICIENT FAN



INEFFICIENT FAN

FEI Range for Adjustable Pitch Axial



Status

- AMCA Standard 208 in ballot phase per ANSI process
- AMCA 208 will be integrated into ISO 12759
- Default losses for drive components based on AMCA 207 (draft ISO 12750)
- FEI would be calculated using rating data taken during AMCA 210 or ISO 5801 tests
- U.S. DOE regulation stalled, but would be based on FEI
- California stated regulation picking up where DOE left off
- ASHRAE 90.1 replacing FEG with FEI
- U.S. efficiency rebates will be based on FEI

Resources

- AMCA International: www.amca.org
- AMCA Standards Bookstore: www.amca.org/store

Thank You Very Much… and…Questions?