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Twin City Fan presentation for CIFB workshop

Presentation for the workshop on Commercial and Industrial Fans and Blowers in regards to the proposed regulation staff report.

Additional submitted attachment is included below.

Air systems excellence since 1917

An AMCA Organizational Introduction

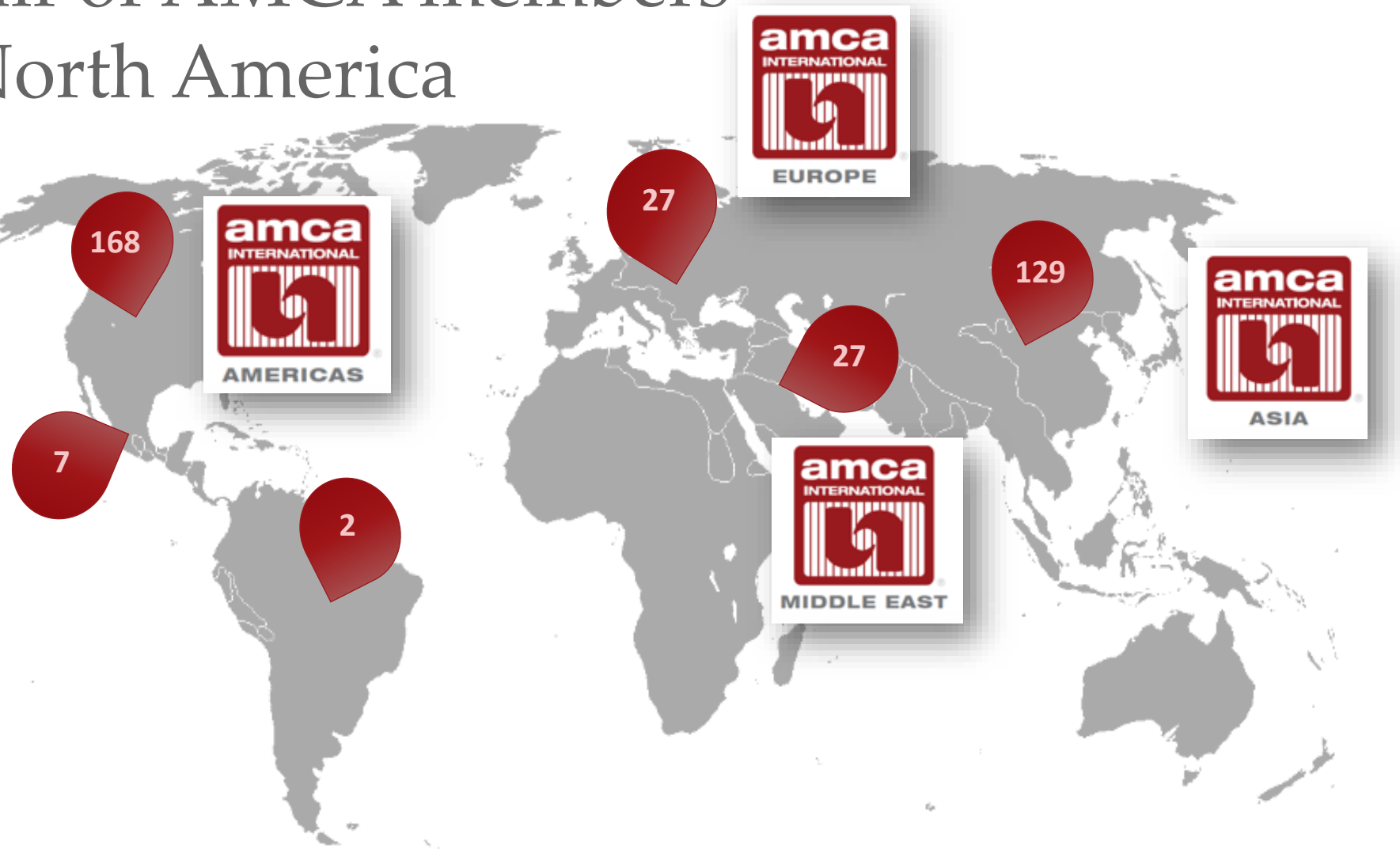
Trinity Persful
VP Marketing
Twin City Fan

AMCA International Board of Directors
Member, AMCA ASRAC Negotiating Team
Chair, AMCA Rebate Committee

About AMCA

- Not-for-profit **manufacturers association** first established in 1917 with seven fan companies in USA
- Mission: **Promote the health, growth and integrity of the air movement and control industry**
- More than 380 member companies worldwide

More than half of AMCA members are outside North America



AMCA Fan Industry Expertise

- 18 ANSI-accredited standards for product testing calculations for rating
- AMCA HQ Lab and four independent accreted labs
  - 50+ accredited member labs
- More than 4000 AMCA-certified products from
  - 150+ participating companies representing all AMCA regions
- Research and education worldwide on fans and fan systems

AMCA Fan Committees

- Fan Regulation Committee
  - Consensus positions and communications on U.S. fan efficiency regulations
- Fan Engineering Committee
  - Primary fan technical committee
- AMCA 210, 207, 208 Committees
  - ANSI-guided standard committees open to non-members
- Air Movement Code Action and Review Committee
  - Codes and standards related to fans except for energy efficiency
- Rebate Committee
  - Developing fan-efficiency incentive programs, including EMPLI motor-driven loads

Fan **Energy** Index (FEI)

- "Efficiency" (power) metric spurred by federal regulation
- Predecessor is Fan Efficiency Grade (FEG)
- FEG is a peak-total efficiency metric for bare-shaft fans
  - Not a wire-to-air metric
  - No motors or drives
- When U.S. DOE published the framework document in 2013, the Department communicated a preference for a wire-to-air metric
  - But also rejected Fan Motor Efficiency Grade (FMEG) used in Europe
- AMCA and AMCA members got to work developing a new metric

Fan Efficiency Varies with Size for a Duty Point

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

Fan Regulation Metric is Tricky

- The regulation should address electrical input power
- Consider fan static pressure for non-ducted fans
  - …which are exempt from ASHRAE 90.1 due to FEG problems
- Unlike energy codes, product regulations cannot 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

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

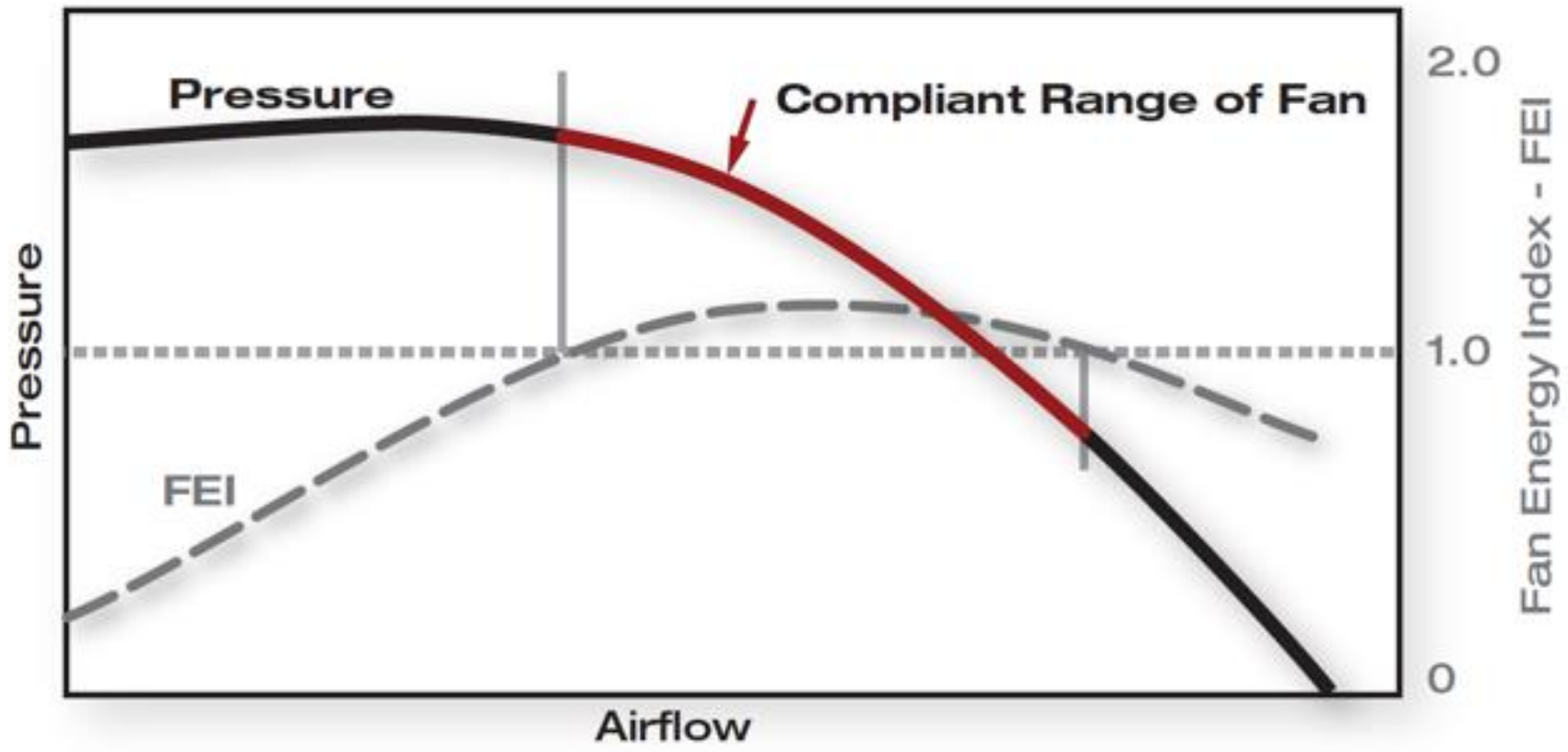
$$W_{i,ref} = H_{i,ref} + AMCA\ 203\ Belt\ Loss + IE3\ Motor\ loss$$

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

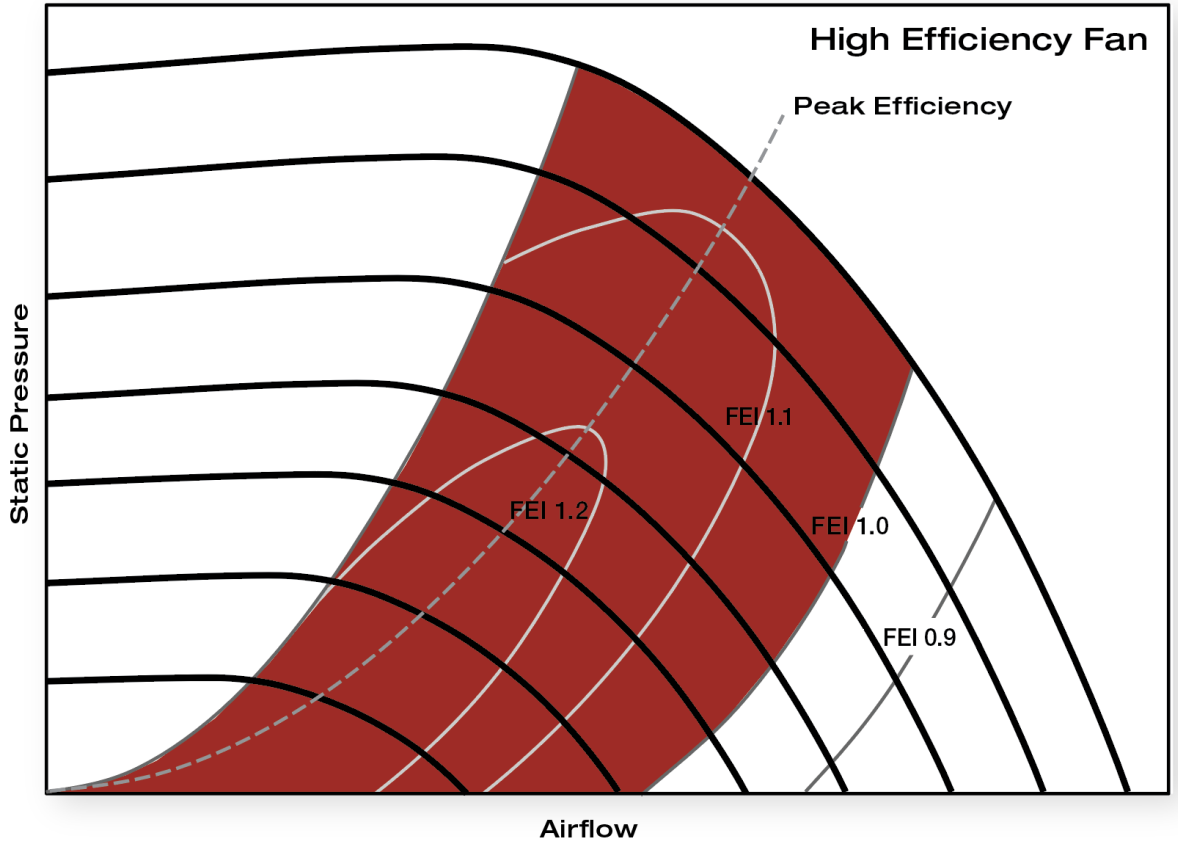
Comparing FEI against FEG

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

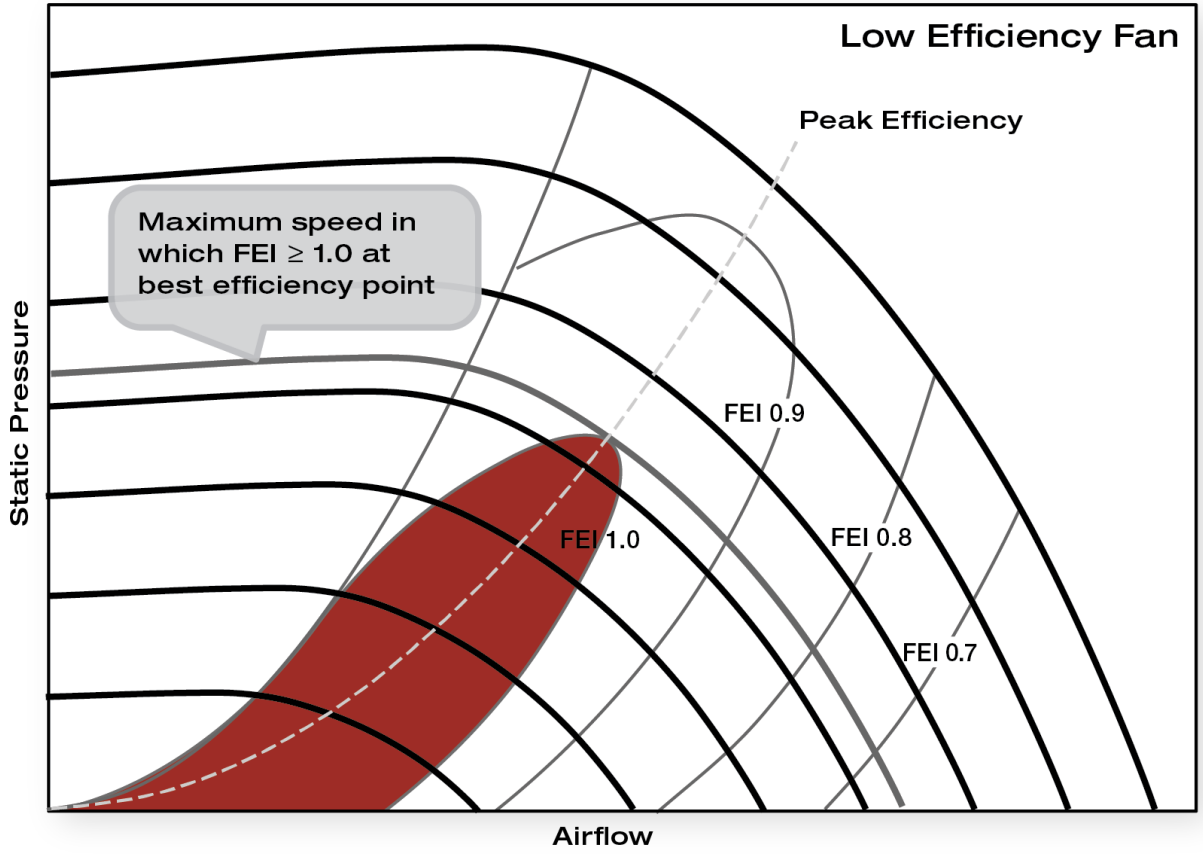
FEI Range for Constant Speed Fan



FEI Range for Centrifugal with Speed Control

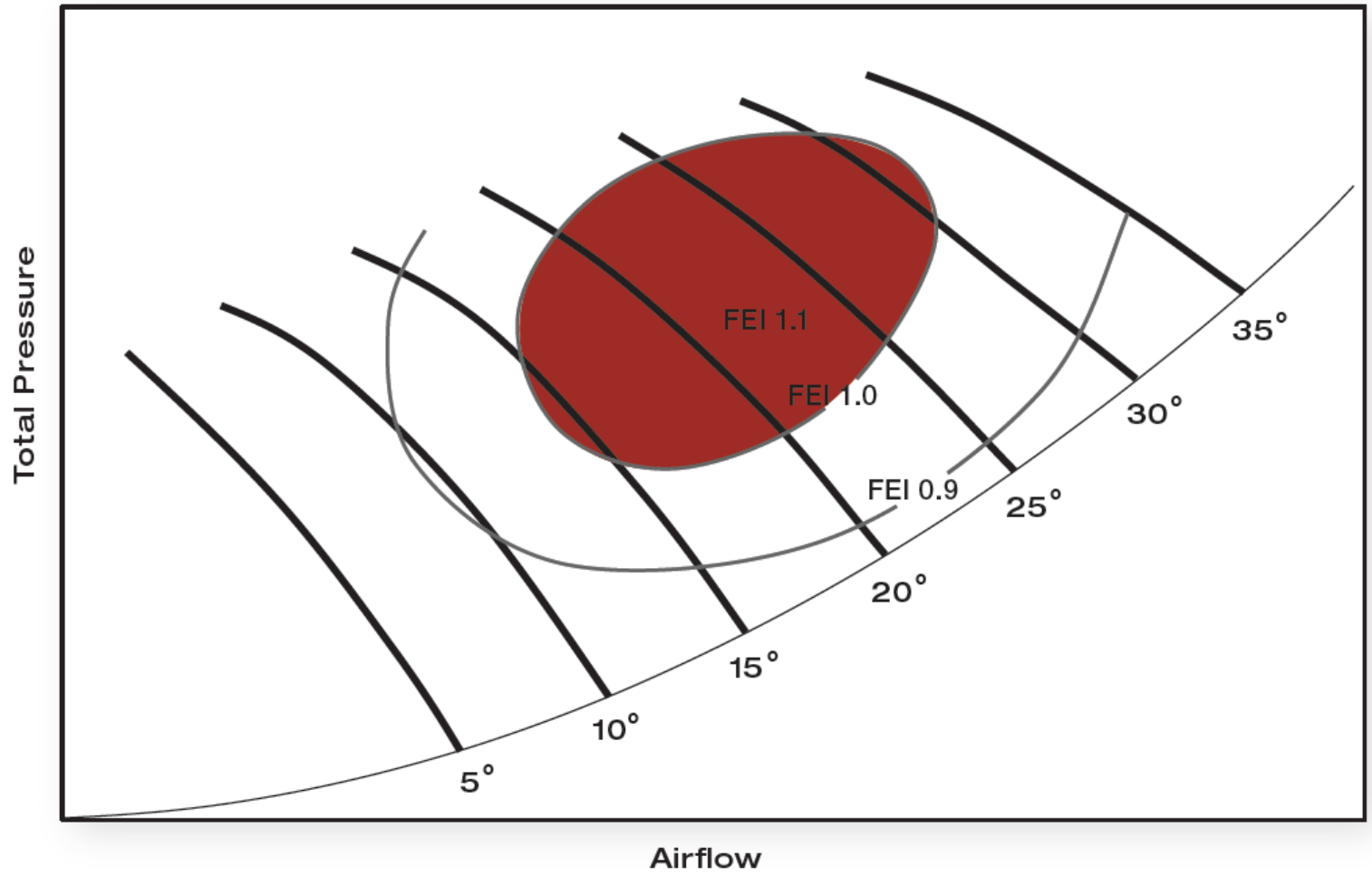


EFFICIENT FAN



INEFFICIENT FAN

FEI Range for Adjustable Pitch Axial



FEI is Quickly Becoming a Mainstream Metric

- AMCA Standard 208 defining FEI published in 2018
- AMCA 208 will be integrated into ISO Standard 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
- FEI metric of choice in ASRAC Term Sheet, published by DOE

FEI is Quickly Becoming a Mainstream Metric

- California Draft Staff Report based on FEI per Joint Recommendation
- ASHRAE 90.1 Addendum *ao* replacing FEG with FEI in public review until July 29, 2018
- Proposal to IECC will seek to replace FEG with FEI
- EnergyPlus will be updated in with FEI in September 2018 release
- DOE Fan System Assessment Tool (FSAT) for industrial fan efficiency programs being updated with FEI

Resources

- Peer-reviewed technical papers and PowerPoint presentations: http://www.amca.org/resources/knowledgebase.php
- AMCA Standard 208: www.amca.org/store
- Fan sizing/selection with FEI: https://tinyurl.com/y98cfb7l

Bonus Slides: FEI Equations