CALIFORNIA STATEWIDE
UTILITY CODES AND STANDARDS PROGRAM

2016 Title 24 Codes & Standards Enhancement (CASE) Proposal

ASHRAE Electricity Savings – Fan Efficiency Grades

CEC Pre-rulemaking Workshop, June 12th, 2014

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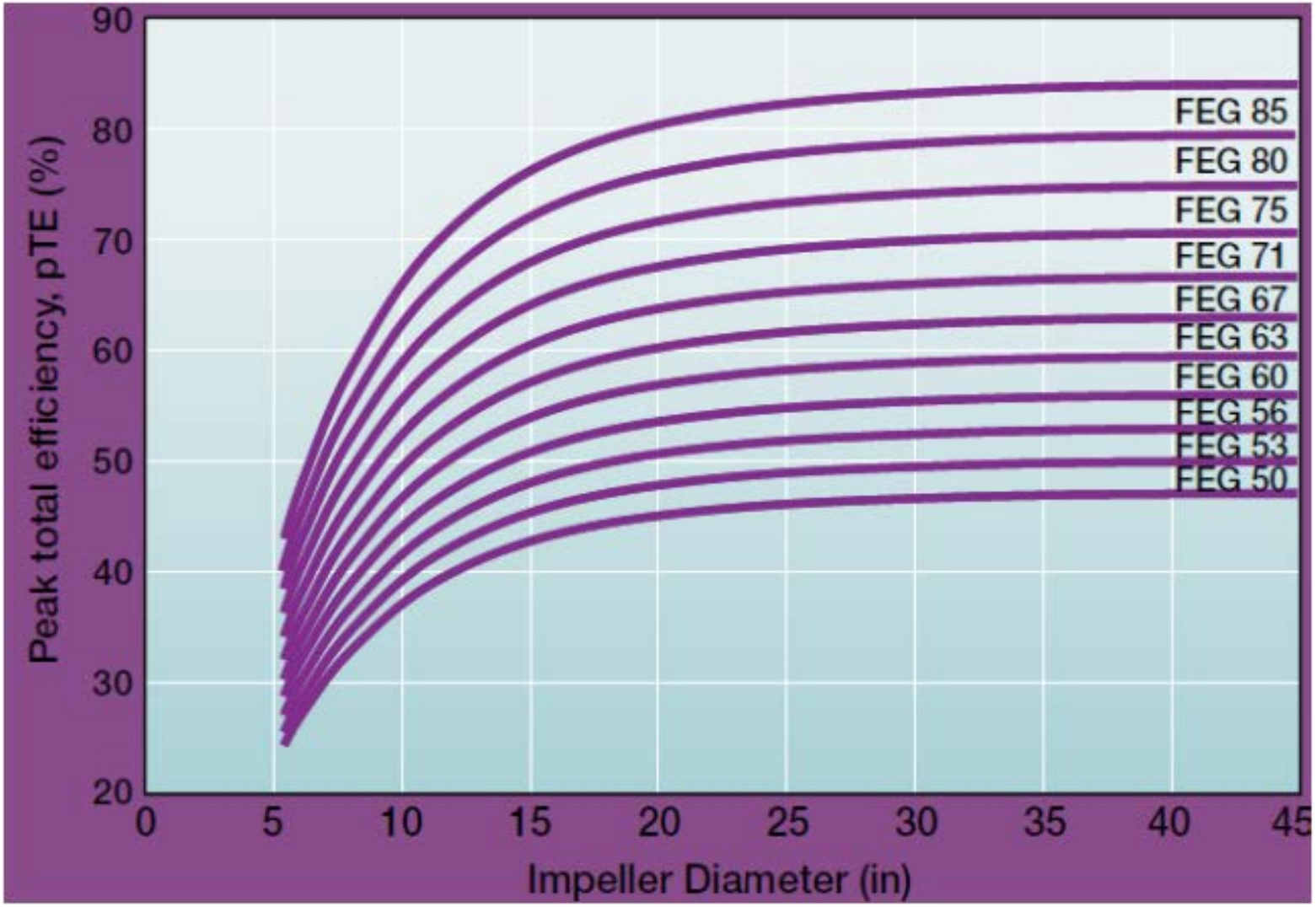
Pre-rulemaking Workshop: Agenda

- What is the FEG?
- Code Change Overview
- Proposed Code Change Language
- Summary of Current Code Requirements
- Typical Practices
- Methodology
- Initial Data and Findings
- The Future of FEG
- Possible Alternatives
- Stakeholder Meeting Feedback
- Specific Stakeholder Requests

What is the FEG?

- A Fan Efficiency Grade (FEG) is a numerical rating that classifies fans by their aerodynamic ability to convert mechanical shaft power to air power.
- A more efficient fan model will have a higher FEG rating. FEGs apply to the efficiency of the fan only and not to the motor and drives. (Not wire to air)
- The FEG Metric was created by the Air Movement and Control Association (AMCA) in conjunction with ASHRAE and is defined in AMCA 205-12.
- Has been very well vetted through the ASHRAE 90.1 TC5.1 Task Force

Fan Efficiency Grade Chart

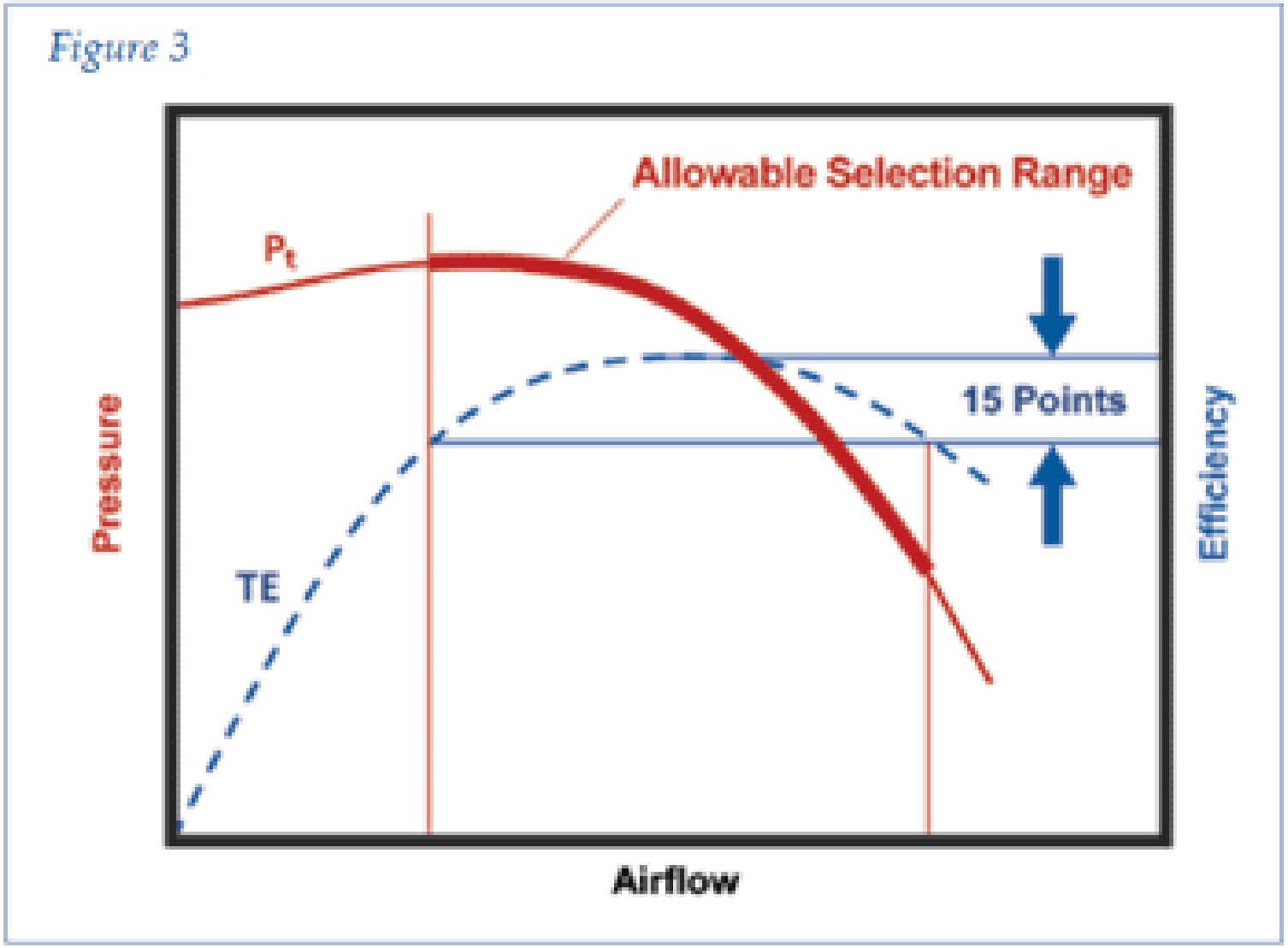


Proposed Code Change Overview

- The proposed measure will impact the fan selection process by setting a minimum Fan Efficiency Grade of 67.

- The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

Allowable Selection Range



Proposed Code Change Overview (Cont.)

- This applies to all fans except the following:
  - Single fans with a motor nameplate horsepower of 5 hp (4 kW) or less.
  - Multiple fans in series or parallel (e.g., fan arrays) that have a combined motor nameplate horsepower of 5 hp (4 kW) or less and are operated as the functional equivalent of a single fan.
  - Fans that are part of equipment listed under ASHRAE 90.1 2013 Section 6.4.1.1 “Minimum Equipment Efficiencies – Listed Equipment – Standard Rating and Operating Conditions.”

Proposed Code Change Overview (Cont.)

Exceptions Continued:

- Fans included in equipment bearing a third-party-certified seal for air or energy performance of the equipment package.
- Powered wall/roof ventilators (PRV)
- Fans outside the scope of AMCA 205
- Fans that are intended to only operate during emergency conditions

Proposed Code Change Language

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

(b) Definitions

Fan Efficiency Grade (FEG): The fan efficiency without consideration of drives, as defined in AMCA 205.

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

Power Consumption of Fan

5. Fans shall have a fan efficiency grade (FEG) of 67 or higher based on manufacturers' certified data, as defined by AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

   Exception 1 to 140.4(c)5: Single fans with a motor nameplate horse-power of 5 hp or less.

   Exception 2 to 140.4(c)5: Multiple fans in series or parallel (e.g., fan arrays) that have a combined motor nameplate horsepower of 5 hp or less and are operated as the functional equivalent of a single fan.

   Exception 3 to 140.4(c)5: Fans that are part of equipment listed under Section 6.4.1.1 of ASHRAE 90.1, 2013.

   Exception 4 to 140.4(c)5: Fans included in equipment bearing a third-party-certified seal for air or energy performance of the equipment package.

   Exception 5 to 140.4(c)5: Fans outside the scope of AMCA 205.

   Exception 6 to 140.4(c)5: Fans that are intended to only operate during emergency conditions.

Impacts

- Will regulate most large nonresidential buildings, with little impact.
- Anticipated to be a prescriptive measure.
- Will encourage fan manufacturers to improve the efficiency of their like products.
- Will encourage fan selection near peak efficiency.
- Creates an efficiency minimum that does not punish smaller fans for being inherently less efficient.
- The FEG curves have been established in such a way that fans of a given model that are geometrically similar will each have the same (or close to the same) grade.

Proposed Code Change History

- AMCA developed FEG Metric conjunction with ASHRAE TC5.1 Task Force
- FEG is defined in AMCA 205-12.
- ASHRAE 90.1 adopted FEG standard
- California would be adopting ASHRAE 90.1-2013 standard.

Current Code Requirements

- There are currently no existing requirements for individual fans in Title 24. Section 140.4 (c) has prescriptive power requirements for fan systems as a whole.

- ASHRAE 90.1-2013 includes same language that is proposed for Title 24

- The International Green Construction Code (IGCC) has already implemented a FEG minimum of 71, with a window of 10% efficiency from the peak.

Typical Practices

- The current practice for fan selection is based on fan static pressure rather than total pressure.

- This measure may for the most part already be a standard practice in the industry, as a FEG value of 67 is not a very high bar.
  - Energy savings may be minimal
  - The minimum can always be raised once the metric is established

Methodology for Savings Analysis

- Energy and Demand Impacts
  - Energy savings and demand impacts are expected to be negligible, as the proposed conditions for the FEG measure do not deviate from the conditions currently in place.
  - If the minimum FEG is ever increased, energy savings may be determined through the use of prototype buildings in EnergyPlus.

Methodology for Cost Analysis

- Our research suggests that there are no incremental costs associated with the proposed code change.
- No impact on maintenance costs.

Initial Data and Findings

- Current Assumptions
  - A large majority of the fans above 5 HP already meet the minimum FEG of 67.
  - Energy savings associated with this measure may be minimal in nature.
  - The minimum FEG requirement could be increased in the future

The Future of FEG

- There are multiple ways to make the FEG more strict in later years that are being considered
  - Raising the FEG minimum from 67 to 71 or higher.
  - Lowering the 15% efficiency window to 10%.
  - Changing the 5 HP exception to 1 HP
  - Creating different FEG requirements for different types of fans

FEG alternative: PBER

Performance Based Efficiency Requirements (PBER)

- Covers the entire fan market
- Based off of the air power equations
- Required efficiency is determined by the application, not the equipment
- Determined from CFM and pressure
- Starts with a base efficiency level that applies to all fans. This base is multiplied by a capacity and application factor.
- Endorsed by AMCA

PBER Equation

A. For fans *without* a discharge duct, the minimum static efficiency shall be:

$$\textbf{Minimum Static Efficiency} = 60\% \times \left[\frac{\text{CFM}}{(250 + \text{CFM})}\right] \times \left[\frac{\text{Ps}}{(0.25 + \text{Ps})}\right]$$

B. For fans *with* a discharge duct, the minimum total efficiency shall be:

$$\textbf{Minimum Total Efficiency} = 68\% \times \left[\frac{\text{CFM}}{(250 + \text{CFM})}\right] \times \left[\frac{\text{Pt}}{(0.25 + \text{Pt})}\right]$$

Feedback From IOU Stakeholder Meeting

- Stakeholder Meeting was held May 20th
  - FEGs have been determined for approximately 43% of the fans on the market.
  - No specific type of fan will be eliminated by the FEG or PBER, but some inefficient fans would not meet requirements.
  - FEG cost impact is minimal.
  - AMCA is reviewing PBER
  - PBER has not been vetted through ASHRAE
  - Notes and presentations from stakeholder meeting available at Title24Stakeholders.com.

Requests from Stakeholders

- We would greatly appreciate any information you are able to provide to assist our efforts

- If you would like to provide us with any additional feedback or information, send an email to Jbaffa@aswb-engineering.com

Questions?

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