Fan Efficiency Codes & Standards
AND High Performance Air Systems

Presented by:
Wade Smith, Executive Director &
Michael Ivanovich,
Director of Strategic Energy Initiatives
About AMCA

• Fan efficiency codes & standards
  – Michael Ivanovich

• High Performance Air Systems
  – Wade Smith
About AMCA International

- Not-for-profit manufacturers association
- Mission: *To promote the health, growth, and integrity of the air movement and control industry*
- Active on national and international codes and standards bodies (ISO, ASHRAE, ICC, HVI, etc.)
- 306 member companies worldwide
About AMCA International

- Certified Ratings Program
  - Products
    - Fans
    - Dampers
    - Louvers
    - Air Curtains
Fan Efficiency Codes & Standards

- AMCA Standard 205
- ASHRAE 90.1-2013
- Intl. Green Construction Code (IgCC-2012)
- Future: ASHRAE 189.1
- Long-term: U.S. Dept. of Energy
ANSI/AMCA 205

- Published 2010; Revised 2012
- Defines Fan Efficiency Grade (FEG)
  - Imparts product efficiency requirement
- Prescribes fans selection + 15 percentage points of fan total energy
  - Imparts practice efficiency requirement
AMCA 205

Graph showing the relationship between fan peak total efficiency (%) and fan size (impeller diameter) (in.). The graph includes lines for different impeller types: Air foil, Backward curve, Backward incline, Forward curve, and Mixed impeller.
AMCA 205

![Diagram of fan performance characteristics showing Fan Total Efficiency ($\eta_t$) vs. Flow (cfm) and Fan Total Pressure ($P_t$) vs. Flow (cfm). The diagram highlights points $Q_{\text{min}}$, $Q_{\text{peak}}$, and $Q_{\text{max}}$ and includes a note indicating a max 15 percentage points change in efficiency.]
ASHRAE 90.1-2013

- FEG 67 for most types of fans > 5 HP
- Peak total efficiency 15 percentage point sizing/selection window
- Exclusions include powered roof and wall ventilators
- Refer to April 2013 ASHRAE Journal
IgCC-2012

- FEG 71 for standalone supply, return, and exhaust fans > 1 HP
- Peak total or static efficiency 10 percentage point sizing/selection window
- Buildings under 25,000 sq ft
- Limited market impact due to lack of adoption
IECC-2015

- ASHRAE 90.1-2013 basis
- Plus certification of FEG ratings
- Plus labeling
- Initial IECC hearings April 26-30
- Final IECC hearings Oct. 2-6
DOE Regulation

- Proposed scope is broad and deep
  - 125-W to 500-kW
  - Clean air, dusty air, material handling, etc.
- Metrics, test standard, and efficiency levels are not drafted yet.
- Will higher fan efficiency save energy?
- Impact on energy & building codes/standards?
DOE Rulemaking Schedule

• Development and review
  – 2013-2015

• Final Rule
  – 2016
  – Effective 2019

• AMCA working collaboratively with DOE, industry groups, and NGOs
Resources

  – Follow codes, standards, regulatory developments

  – Free technical articles on FEG etc.

• [www.amca.org/crp](http://www.amca.org/crp)
  – Find fans AMCA-certified for FEG
To duct, or not

• Today, “Ducted Systems” are used in the vast majority of comfort cooling applications in North America.

• Yet in Europe and Asia, ductless systems dominate the HAC market.

• Why this difference?
To duct or not?

• Walls and ceilings in North America are hollow – in Asia and Europe they are not.
• North American buildings provide space for ducts – Asia and Europe do not.
• Use of pipes to deliver heating and cooling is required in Asia and Europe.
• But piped systems cost more, so they are less popular in North America.
To duct or not?

So, in North America we have a choice. Most systems use air as the energy transport fluid because ducted systems deliver:

– Lower Installed Cost
– Better Efficiency (free OA cooling)
– Better Health (code compliant ventilation)
Can Ductless be better?

• In some cases, yes.
  – Sometimes, ducts don’t fit
  – Easy to add on for spot cooling
  – Individual zones can either heat or cool independently – no reheat
  – There are circumstances where ductless systems make sense
Can Ductless be better?

• But there are issues
  – Ratings – when manufacturers certify their ratings, cataloged performance drops by more than 20%. Buyer beware.
  – No ventilation – cannot meet code alone
  – Refrigerant obsolescence. There is no acceptable replacement for VRF systems.
Air systems have issues too

- Ducts leak
- Air transport energy is higher than water or refrigerant
- System effects that compromise fan performance are hard to avoid, predict
- Simultaneous heating and cooling usually involves some reheat
Air systems save energy when:

- Spiral ducts are used (leakage < 3%)
- Airside economizers fit loads (they do with new tight envelopes)
- Air transport energy is speed controlled, drops with cube of load reduction.
- Heat recovery is employed to avoid reheat.
- Ventilation demand is sensed and outside air is controlled – by zone.
If .... Air systems are done right

• They cost 20% less
• They consume 20% less energy
• They meet ventilation codes
• They carry no refrigerant risk
• Performance is certified by AMCA, AHRI
Vision 20/20 – by 2020

AMCA objective – make all air systems …
• Cost 20% less
• Consume 20% less energy
• Meet ventilation codes
• Eliminate refrigerant risk
• Performance certified by AMCA, AHRI
Vision 20/20 – by 2020

What are the attributes of a high performance air system needed to meet this objective?
Vision 20/20 Hi Perf. Air System

1. “Free Cooling” via airside economizers using AMCA certified class 1 low leak dampers.

2. Heat recovery to minimize heating and/or reheat energy use.

3. Speed controls that reduce fan part load energy
Vision 20/20 Hi Perf. Air System

4. Static regain duct designs that:
   - Cost $100 to $400 less per ton
   - Meet SMACNA class “A” leakage levels
   - Minimize duct system effect losses

5. Lower supply air design temperatures (below 50 degrees)
   - Costs $200 to $400 less per ton
   - Reduces overall system energy use
6. Efficient fan selections and application conditions
   - Minimum 70% efficient supply fan at the design point
   - Selection based on total pressure, to exploit static regain duct design
   - Proper inlet and outlet conditions to minimize system effects at the fans
7. Advanced control technologies, including:

- Ventilation optimization based on measured fresh air demand by zone.
- Duct pressure set-point reset controlling fan speed, tied to system demand
- Supply air temperature reset, tied to measured system demand
- Optimum start/stop and
- Thermal energy storage in building structure (pre-cooling with economizer) to reduce peak demand, shift cooling load to times of cooler outside air
8. No greater than xx lbs of refrigerant per ton of capacity to help reduce refrigerant emissions, and protect against regulatory obsolescence.

9. Monitoring, trending and automated reporting of diagnostics based on continuous measurement of airflow and sub-metering of fan, refrigeration and heat utility use.
Let’s Compare High Performance Air Systems

– Installed Cost
– Efficiency
– Indoor Air Quality
Vision 20/20 Installed Cost?

- Variable Refig. Flo → $20 to $26/sq. ft.
- Chilled beam → $30 to $45/sq. ft.
- Rooftop – VAV → $15 to $20/sq. ft.
- Hi Perf. Air → $17 to $24/sq. ft.
How 20% lower Installed Cost?

• High velocity, static regain, spiral ductwork saves $100 to $400/ton at equal or lower external total pressures

• Lower temperature air systems that save energy while lowering installed cost $200 to $400/ton.
How 20% lower Installed Cost?

- This savings in duct installed cost pays for other system enhancements
  - More efficient fans
  - Heat recovery (eliminates reheat)
  - Aerodynamic duct design – fewer system effects
  - Sophisticated controls to lower part load energy
  - Performance monitoring to identify future issues
Low Temp, Round Duct Means…

Lower weight: 25+%

Shorter installation hours: 30+%

Lower air leakage: 2–10+%

Lower fan energy use: 6-30+%

Source: SPIDA
How 20% lower Energy Cost?

– Free Cooling with outside air economizers.

• “Thermos bottle” building envelopes do not need heating down to ambient temperature of less than 20F so “free” outside air economizer cooling is especially valuable.

• Thermal storage strategies that shift loads off peak by pre-cooling the building mass – often done with “free” cool night air.
How 20% lower Energy Cost?

- Lower Fan Energy
  - More efficient fan selection and application
  - Lower design supply temp = less air moved
  - Aerodynamic duct designs that minimize losses
  - Variable speed fans with static pressure re-set at part load
How 20% lower Energy Cost?

- Demand based ventilation controls
- Heat recovery to eliminate most reheat
- Diagnostic monitoring to avoid degradation over time
How 20% lower Energy Cost?

Annual Building Energy Use, kBtu/yr
Meet Vent Codes (Better Health)

- Ventilation optimization
  - using CO2 measurement for highly variable occupancy areas
  - deliver the right outside air to the right place at the right time
  - incorporate the ability to use “Twice Around Ventilation”.

- Better air filtration options, like
  - MERV-13 (or higher) filters or
  - photo-catalytic air cleaning systems
Documented Sustainability

- No refrigerant issues

- Continuous remote monitoring of performance – system output, and energy input measured, monitored and diagnosed
Certified Performance Ratings

- AMCA certified air performance
  - Fan efficiency grades,
  - Ducted air system leakage
  - Sound levels

- AHRI certified thermal performance
  - Refrigeration system efficiency
Vision 20/20 Air systems done right

- They cost 20% less
- They consume 20% less energy
- They meet ventilation codes
- They carry no refrigerant risk
- Performance is certified by AMCA, AHRI
Vision 20/20 Air systems done right

• When you look at High Performance Air Systems with 20/20 vision,

• It’s easy to see why they will remain North America’s number one choice for comfort cooling.
Questions and Discussion

• Thank you for participating in AMCA’s seminar session.

Wade Smith
wsmith@amca.org
Ph: 847-704-6300

Michael Ivanovich
mivanovich@amca.org
Ph: 847-704-6340