

ARI 260 Standard: Sound Rating of Ducted Air Moving and Conditioning Equipment

Common Sources of Noise in Air Handling Equipment

ASHRAE Seminar 51

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29 January 2003

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Carrier

A United Technologies Company

Common Sources of Noise in Air Handling Equipment -- Overview

- What is Noise?
- Air Turbulence Noise from Fans
- Air Turbulence Noise from Obstructions in Air Stream
- Noise Characteristics of Fan Types
- Mechanical Noises
- Vibration Induced Noises
- Other Noise Sources

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What is Noise?

- **An Unwanted Sound**
- **Small Fluctuations in Air Pressure**
- **Air Molecules Oscillate About an Equilibrium Position**
- **Distinguishable by Human Ear**
- **Vary in Frequency and Amplitude**
- **Caused by Object in Air that Move or Vibrate**

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Air Turbulence Noise from Fan

- **Fan Noise Largest Contributor to Noise in Duct**
- **Broad Band**
- **Noise Increases With Fan Speed**
- **Different Fan Types Have Different Noise Signature**
 - Forward Curve
 - Backward Inclined
 - Air Foil
 - Vane Axial or Propeller Type
- **Fan Design and Construction Effects Noise**

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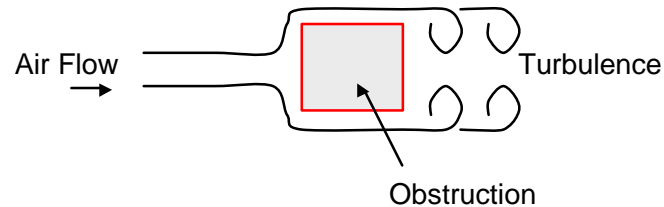
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Air Turbulence Noise from Obstructions in Air Stream

■ Fan Inlet Effects

- Obstructions in Airflow Cause Downstream Turbulence



- Turbulent Air at Inlet Side of Fan Blade Causes More Noise Than non Turbulent Air
- Inlet Obstruction Noise Increases the Closer Obstruction is to Fan Inlet
- Examples
 - IGV's
 - Bearing Mounting brackets
 - Bearings
 - Direct Drive Motor

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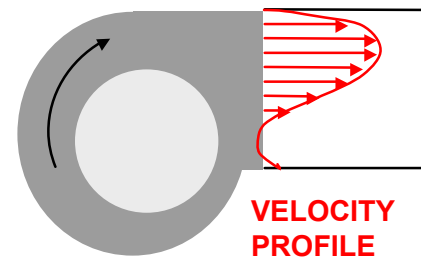
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Air Turbulence Noise from Obstructions in Air Stream

■ Fan Outlet Effects

- Turbulence Increases as Air Velocity Increases
- Objects in Blast Area Generate More Noise



- Outlet Obstruction Noise Increases the Closer Obstruction is to Fan Outlet
- Examples
 - Gas Heat Exchanger
 - Electric Heaters
 - Outlet dampers

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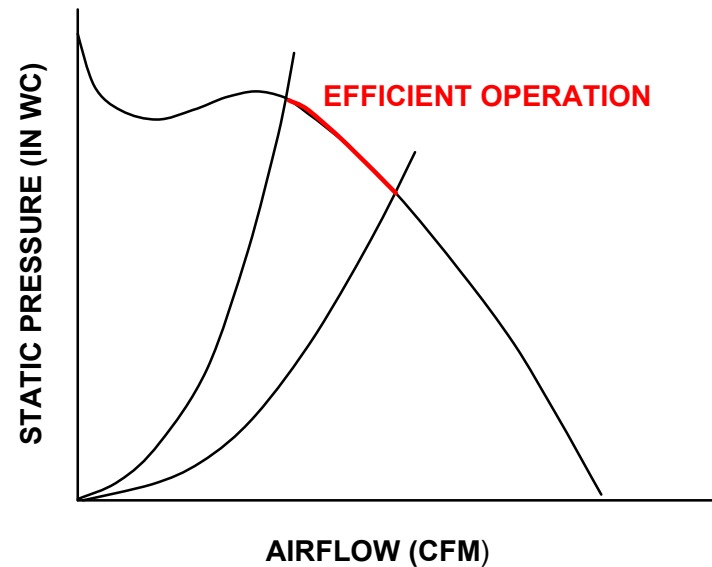
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Noise Characteristics of Fan Types

■ Forward Curve Centrifugal Fans

- Run Fan in Efficient Operation Area
- Forward Curve Fan Stalls when Operated to Left of Efficient Operation Area
- Stalled Fan Blade Causes More Turbulence and More Noise



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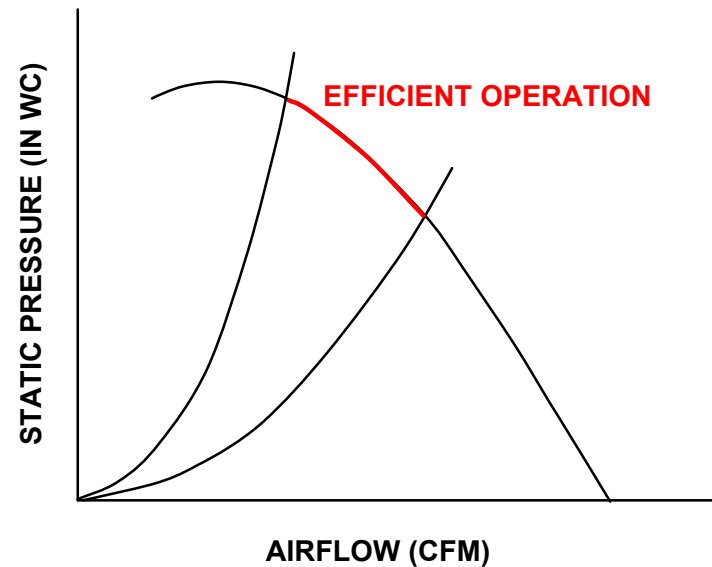


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Noise Characteristics of Fan Types

■ Air Foil or Backward Inclined Fans

- Run Fan in Efficient Operation Area
- AF or BI Fans Surge when Operated to Left of Efficient Operation Area
- Stalled Fan Blade Causes More Turbulence and More Noise



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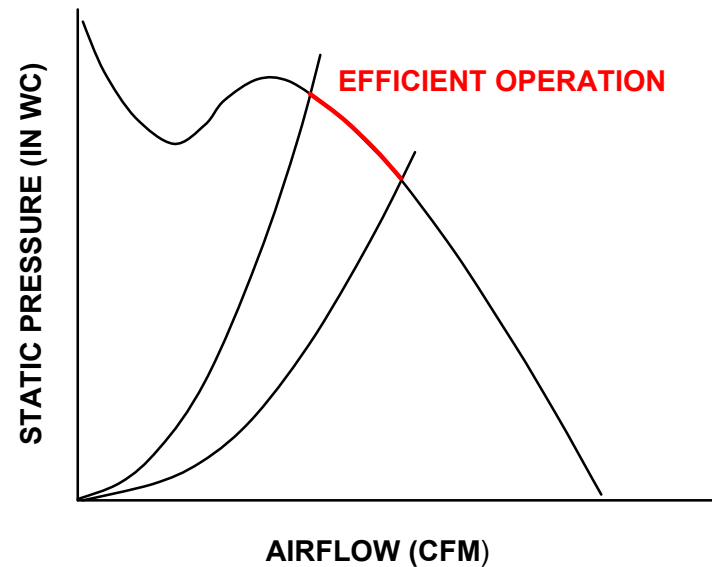
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Noise Characteristics of Fan Types

■ Vane Axial Fans

- Run Fan in Efficient Operation Area
- Forward Curve Fan Stalls when Operated to Left of Efficient Operation Area
- Stalled Fan Blade Causes More Turbulence and More Noise



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Mechanical Noises

■ Compressor

- Airborne Noise Bleeds into Conditioned Air Stream
- Vibration can Transfer Through Unit Structure to Conditioned Air Stream
- Compressors Noise Vary With Cooling Load
- ARI 260 - Run Compressors at Respective ARI Cooling Rating Point

■ Bearings

- Ball Bearing
- Sleeve Bearing
- Ball Bearings Noisier Than Sleeve Bearings - More Moving Parts

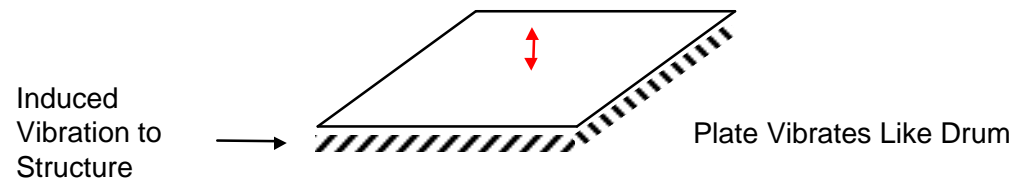
■ Drive mechanisms

- Belt drives
- Damper linkages



Vibration Induced Noises

- Plate Modes of Sheet Metal Panels



- Substructure Modes of Major Unit Components
- Motor Noise from Variable Frequency Drive
- Vibration Induced into Building Structure

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Other Noise Sources

- **Return Fans**
- **Power Exhaust Fans**
- **Combustion Noises from Gas or Oil fired Heat Section**
 - Steady State Burner Noise
 - Combustion Chamber Can Become Resonator
 - Tubular Heat Exchanger Can be Tuned to Combustion Noise
 - Light off Noise
- **Induced Draft Fan Noise**
- **Refrigerant Flow Noise**
 - Control Devices - Thermostatic Expansion Valves

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Conclusions

- **Turbulence Biggest Contributor to Ducted Noise**
- **Turbulence Noise Increases as Obstructions are Moved Closer to the Fan**
- **Operate Fans in Efficient Operation Range**
- **Noise From Other Sources Can Bleed into Condition Air Stream**
- **Vibration from Compressors and Fans Can Induce Noise into Unit Panels and Structures**

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References

- American Society of Heating, Refrigeration and Air-Conditioning Engineers Inc., *2001 ASHRAE Handbook—Fundamentals*, ASHRAE, 2001.
- Charles Ebbing and Warren Blazier, *Application of Manufactures' Sound Data*, American Society of Heating, Refrigeration and Air-Conditioning Engineers Inc., 1998.

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[Return to www.noisecontrol.com](http://www.noisecontrol.com)

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