“Comparing Blower Technologies on a Wire to Air Basis”

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• Blowers are by far the largest energy consumer in a typical wastewater treatment plant using aeration.

• Energy usage is dependent on the process used.

• Currently there is no international published test codes to accurately compare blowers or blower technologies on an equal basis.

• Misinformation about efficiency is prevalent.
Four Common Blower Technologies in WWTP

- Gearless Turbo
  “High Speed”

- Geared Turbo
  “Single Stage”

- Multistage Turbo
  “Multistage”

- Positive Displacement
  “Lobe or Screw”
At a given flow and pressure there are many choices.

Which technology is the most efficient?

Answer is.....

IT DEPENDS!
Which Technology is the Best?

• How do you **Compare** efficiencies between competing blowers or blower technologies?

• How do you **Verify** what vendors claim?

• How do you **Guaranty** results you can see in the field?

We need to compare apples with apples:

![Apple and Orange](image)
• Isentropic? Polytropic? Adiabatic? Blower Efficiency? What are you describing?
• Is discharge temperature a valued state of energy?
• Efficiency should drive losses: Motor, VFD, Gears, Cooling System and any auxiliary power needs?
• Don’t be fooled by efficiency numbers, look at the actual power requirements in $\text{kw}$ used of the total system as compared to the flow and pressure you require for your process.

Your ONE Solution for Blower Systems

Efficiency Does Not Matter!

Which one Uses Less Power? 70% or a 80% Efficient Blower?
Blower Package is defined as the complete system consist of blower(compressor), motor, starter or inverter, harmonic filter, sine wave filter, gears, belts, blow-off valve, controller, inlet filter and cooling system as assembled as a system as it would be installed and operational.
Wire to Air

**[ Non Package Blower ]**

- Inverter
- Motor
- Panel Filter
- Suction Filter

Power input:
- **Ta** = Ambient Temp.
- **Ts** = Compressor Suction Temp.
- **Td** = Discharge Temp.
- **Ps** = Compressor Suction Pressure
- **Pd** = Discharge Pressure

Equations:
- **Ta** = **Ts**
- **Ps** = **Pa**

**[ Package Blower ]**

- Inverter
- Motor
- Panel Filter
- Suction Filter

Power input:
- **Ta** = Ambient Temp.
- **Ts** = Compressor Suction Temp.
- **Tm** = Motor Cooling Temp.
- **Ti** = Inverter Cooling Temp.
- **Td** = Discharge Temp.
- **Ps** = Compressor Suction Pressure
- **Pd** = Discharge Pressure

Equations:
- **Ta** = **Ts**
- **Ps** = **Pa**

- **Ps** = **Pa** - **ΔP** by **Pp**, **Pf**
- **Pp** = Passage Pressure Drop
- **Pf** = Suction Filter Pressure Drop
- **ΔP** = Suction Pressure Drop
The performance testing of Blower System
Input KW and LBS of Air on the discharge
Power consumption of the Blower System must be expressed Wire to Air Power Consumption Only.
Existing Codes are Not Adequate

ASME PTC 10 & ISO 5389  Industry standard for centrifugal compressors
  Shaft power only via a torque meter
  Not clear translation from test conditions to site conditions
  Can measure inlet or discharge flow
  No Packaged Power

ASME PTC 9 & ISO 1217  Positive Displacement Only
  Basic wire to air test standard
  Only at test conditions
New test code covering ALL blower technologies – Expected Release 2017!

**Wire to Air Format**

**Founding Committee Members**
- Hiran de Mel – CH2M
- Julie Gass – Black and Veatch
- Lloyd Slezak – Brown and Caldwell
- Tom Jenkins – JenTech
- Ralf Weiser – Aerzen
- Jacque Shultz – Siemens
- Andrew Balberg – Lone Star Blower
ASME PTC-13 “Wire to Air”

Covers ALL Blower Technologies

Accurate prediction for on-site kw usage

Specific Test to Site Calculations

Easily Verified and Simple

Will change people’s perception on which technology is more efficient

Your ONE Solution for Blower Systems
Which Technology is Most Efficient?

- Chart shows that a given diameter of impeller or lobe the specific speed that will allow the maximum aerodynamic efficiency possible.

- Centrifugal (CF) “Turbo” type can generally achieve higher efficiency than Positive Displacement (PD) type due to no speed limitation and no gas recirculation.

One Technology is Not Always More Efficient than Another!

PD Type Speed Limitation

CF Type Has No Speed Limitation
A blower is not equally efficient through the entire range of operation.

For most processes we should consider kw usage through a range of flow and pressure conditions rather than one point.

Some technologies have wider flow ranges than others and are more efficient in a larger range of operation.

### Which Technology is Most Efficient?

<table>
<thead>
<tr>
<th>Flow Capacity</th>
<th>100%</th>
<th>80%</th>
<th>60%</th>
<th>40%</th>
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</thead>
<tbody>
<tr>
<td>Weighted Time</td>
<td>20%</td>
<td>30%</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>Wire to Air Power</td>
<td>kw</td>
<td>kw</td>
<td>kw</td>
<td>kw</td>
</tr>
<tr>
<td>Weighted Power</td>
<td>kw * 20%</td>
<td>kw * 30%</td>
<td>kw * 30%</td>
<td>kw * 20%</td>
</tr>
</tbody>
</table>

**Total Evaluated Power in kw**

![Efficiency in Operational Range](chart.png)
Technology to Match the Process

Pressure – Vacuum – Air - Gas
Static Pressure or Variable Pressure
Constant Flow or Variable Flow
Flow or Pressure Range
Frequency of Start and Stops
Each process must be considered before picking a blower technology
Technology to Match the Environment

Blower Environment can Dictate Technology

- High or Low Ambient Temperature
- Air Quality – Clean or Dirty Environment
- Installation – Outside or Inside
- Sound Requirements
- Space Considerations
- Maintenance Intervals or Cost