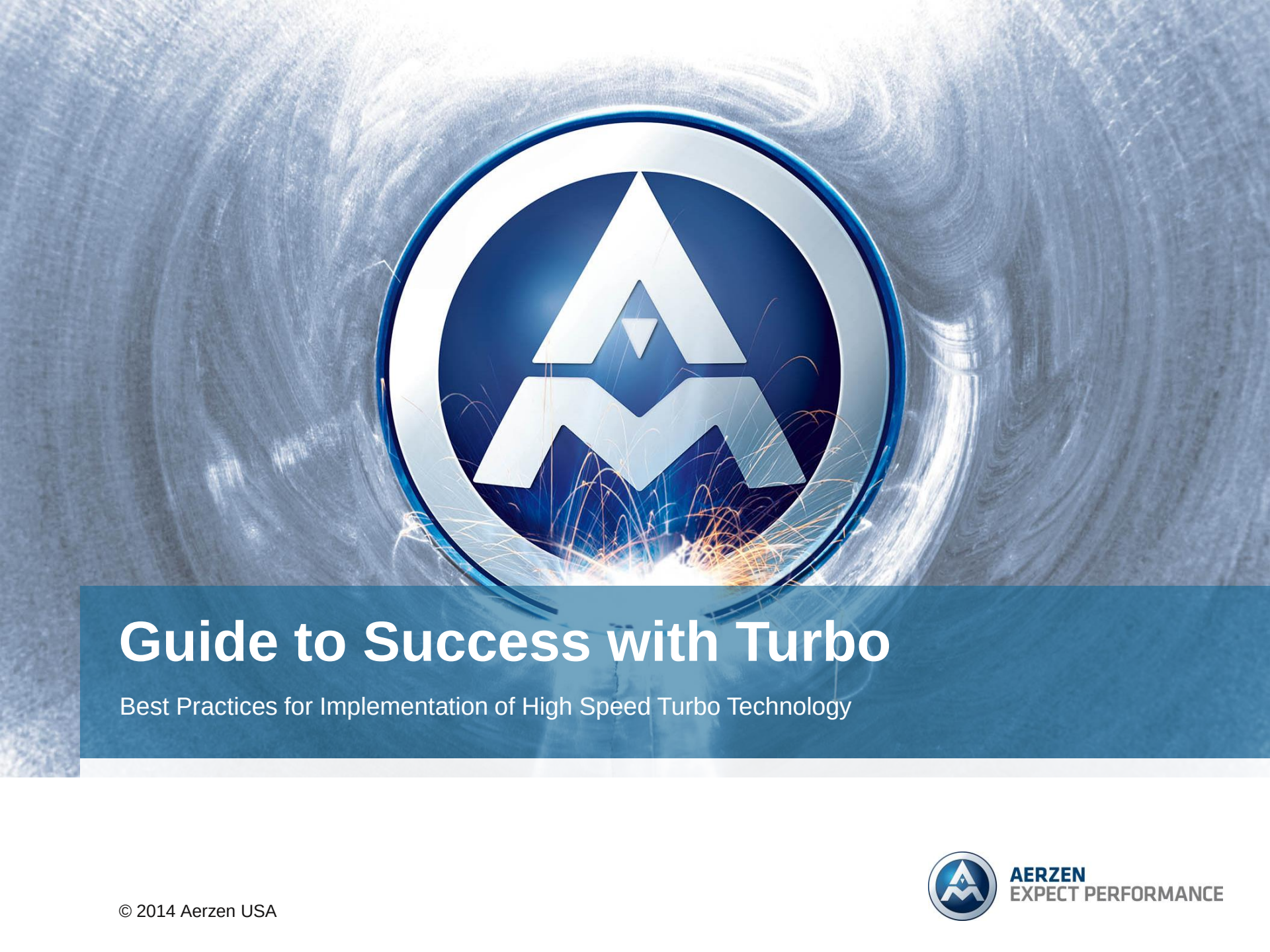

Guide to Success with Turbo

Best Practices for Implementation of High Speed Turbo Technology

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EXPECT PERFORMANCE

Aerzen Technologies

Intro to Aerzen – Wastewater Product Lines

Positive Displacement Blowers

Hybrid Blower/Compressor

Turbo Blowers

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EXPECT PERFORMANCE

Key information for Turbo Blowers

1. How do Turbos Operate?
2. What are some Advantages of Turbo Blowers?
3. What are their Limits?
4. What “Best Practices” Apply?
5. What Maintenance is Required?

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EXPECT PERFORMANCE

How do Turbo Blowers Operate?

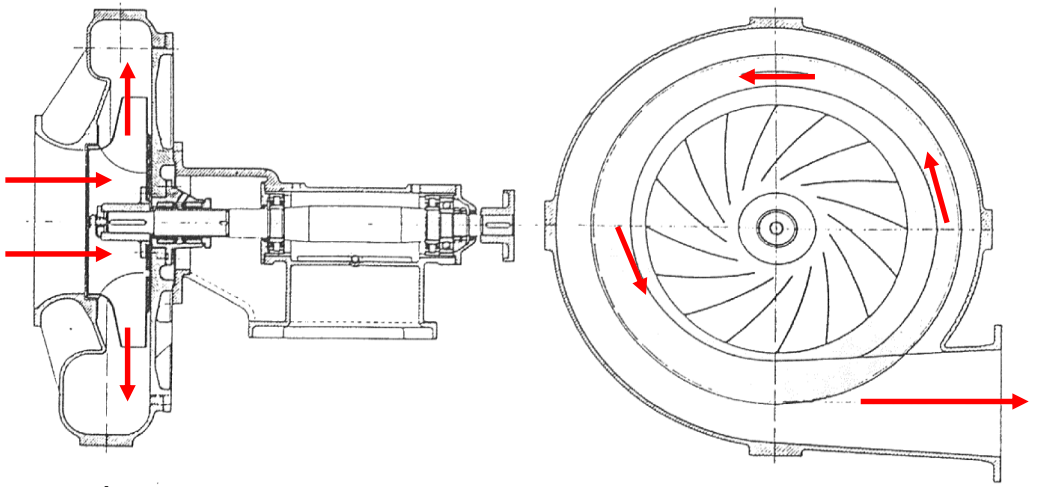
Dynamic Compression

Impeller creates velocity

Diffuser cone slows air stream

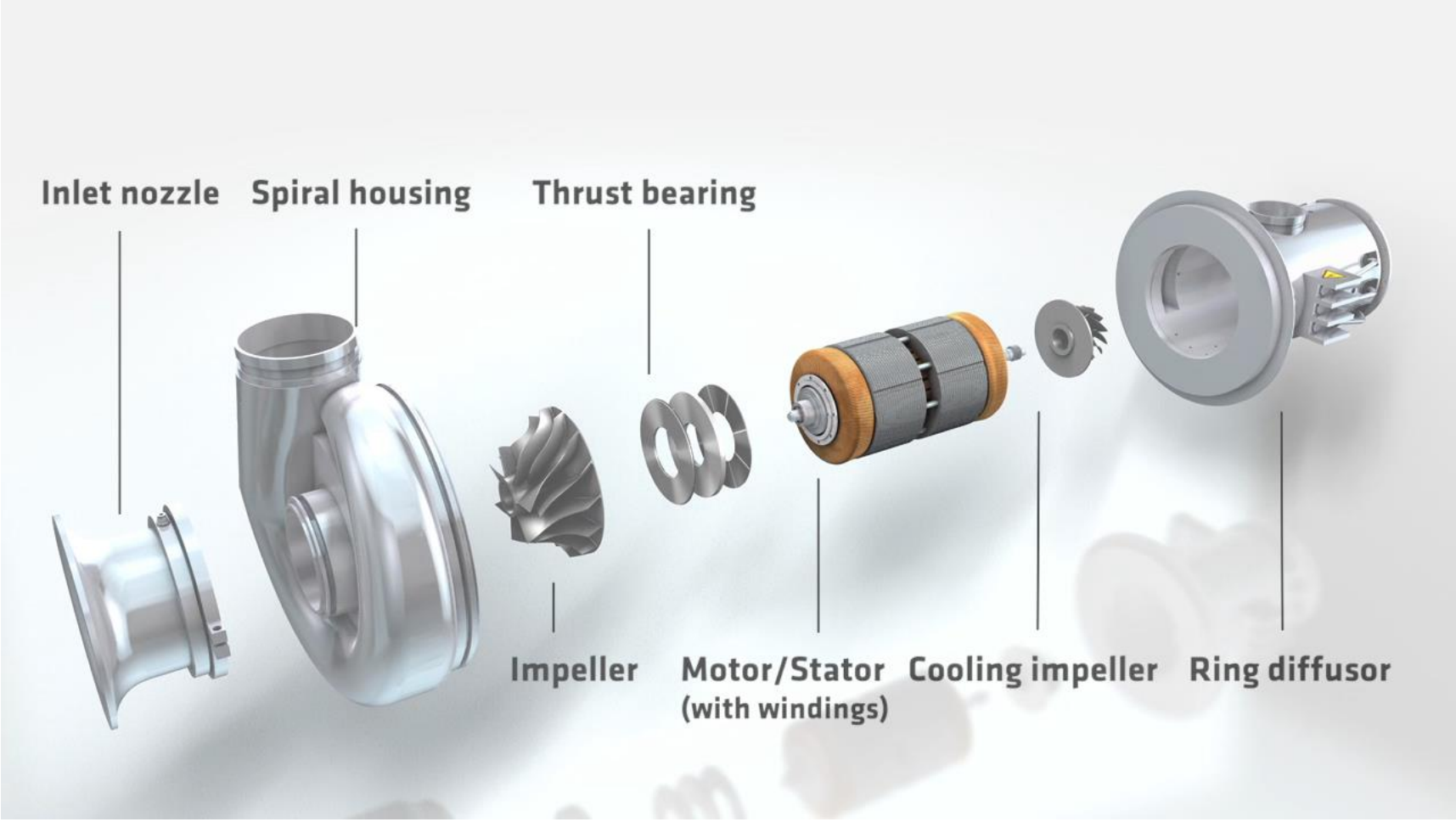
Kinetic energy ➪ Potential Energy

Velocity ➪ Pressure



How do Turbo Blowers Operate

Airfoil Bearings



Bearing Design

Airfoil Bearing Evolution

- **First Generation**
- **Multi-Leaf Design**
- **HSi Design**
  - Failed in Wastewater Service
  - Especially Vulnerable to Start/Stop Damage

HSi FAILURES TARNISHED THE REPUTATION OF AIRFOIL BEARINGS

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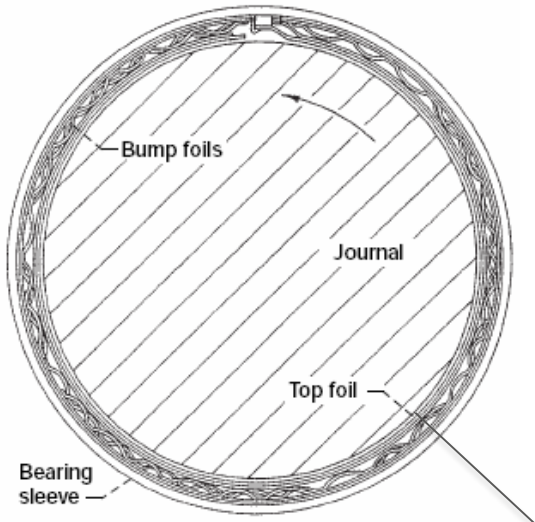
EXPECT PERFORMANCE

Bearing Design

Airfoil Bearing Evolution



- **Fourth Generation**
- **Multi-Pad Bump**
  - Radial and Axial Variations
  - Able to run at low RPM (Idle)
  - Smoother sequencing of multiple machines into system header.

Air Pressure in Gap Between Rotor and Top Foil: 300-600 PSIG

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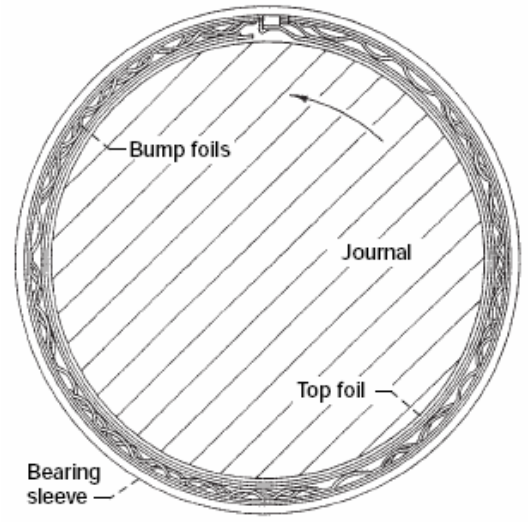
EXPECT PERFORMANCE

Bearing Design

Airfoil Bearing Evolution



- **Generation 4 Design**
  - Idling feature is unique
    - Low RPM
    - Low power (2% of Design)
    - Less wear on Capacitors (Discharging and Recharging)

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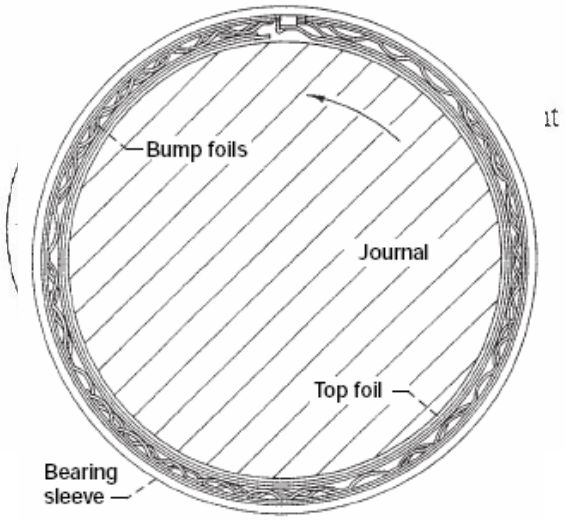
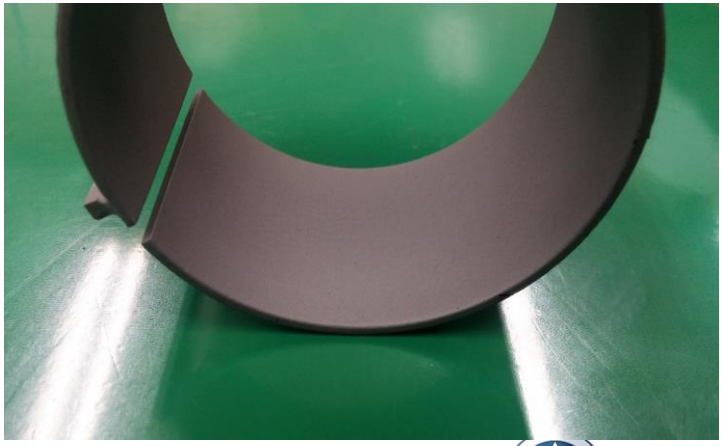
EXPECT PERFORMANCE

Bearing Design

Airfoil Bearing Evolution



- **Innovations**
  - Enhanced Coating resists Hard Stop damage (>850 times and counting)
  - Temperature rating 650°C (Increased from 250ºC)



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EXPECT PERFORMANCE

Turbo Package Overview

Axial compensator

Exhaust cooling air silencer

HMI

Cooling Turbo

VFD

Cone Diffuser

Blow Off Valve Silencer

Blow Off Valve (BOV)

Process Filter

Turbo Core

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EXPECT PERFORMANCE

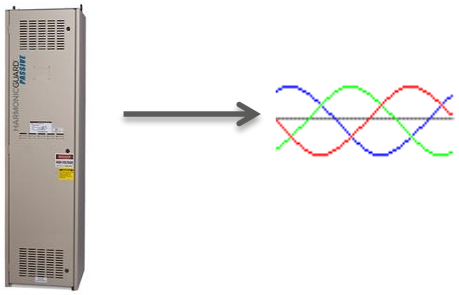
Specialized Inverter

Variable frequency drive specifically designed for turbo blowers

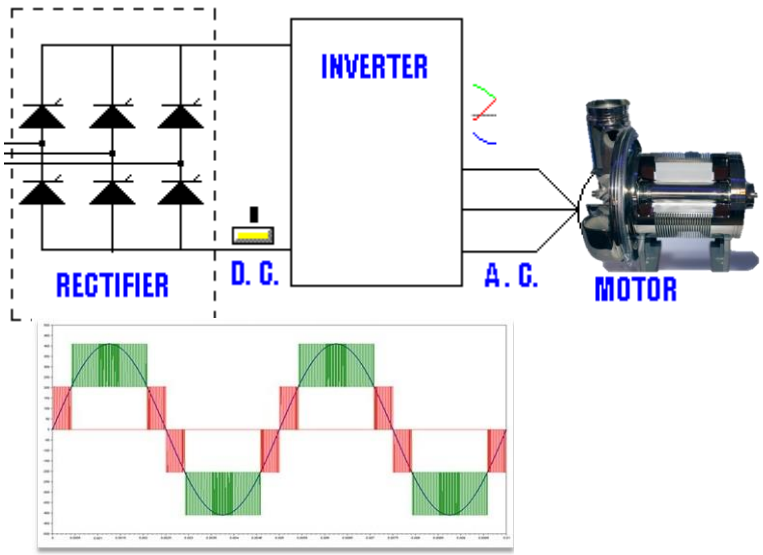
Multilayer Pulse Amplitude Modulation

High Switching Frequencies

Harmonic Filter



Frequency Converter



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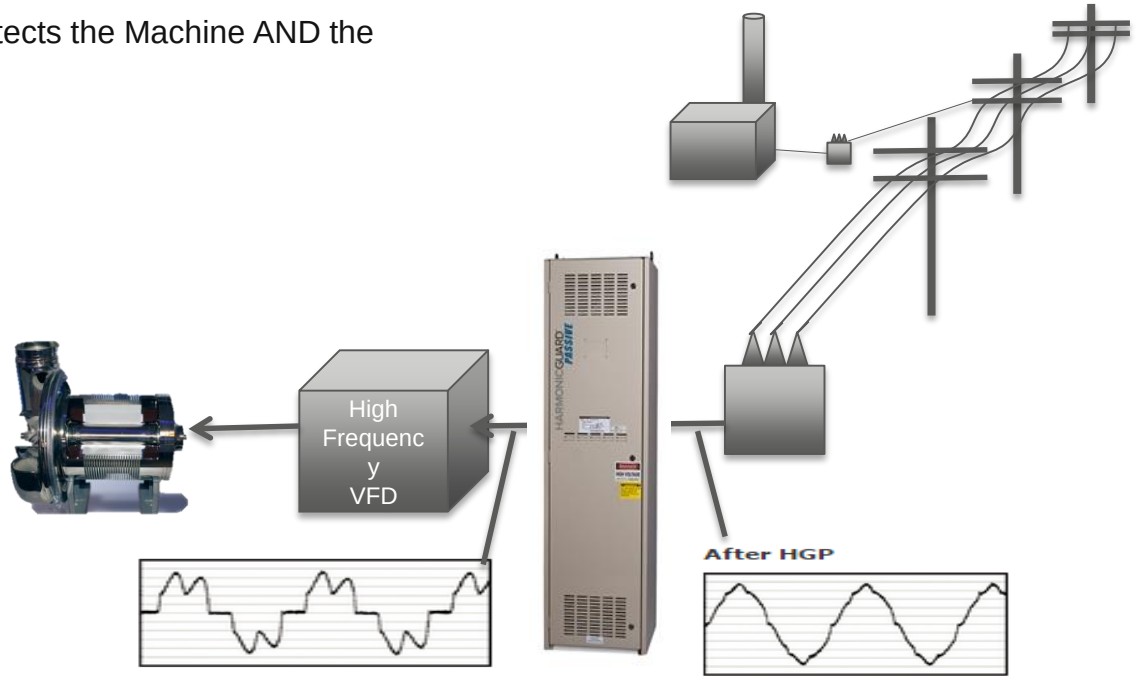
EXPECT PERFORMANCE

Electronic Harmonics

Minimizing Harmonic Distortion

- Harmonic Filter Protects the Machine AND the Utility System



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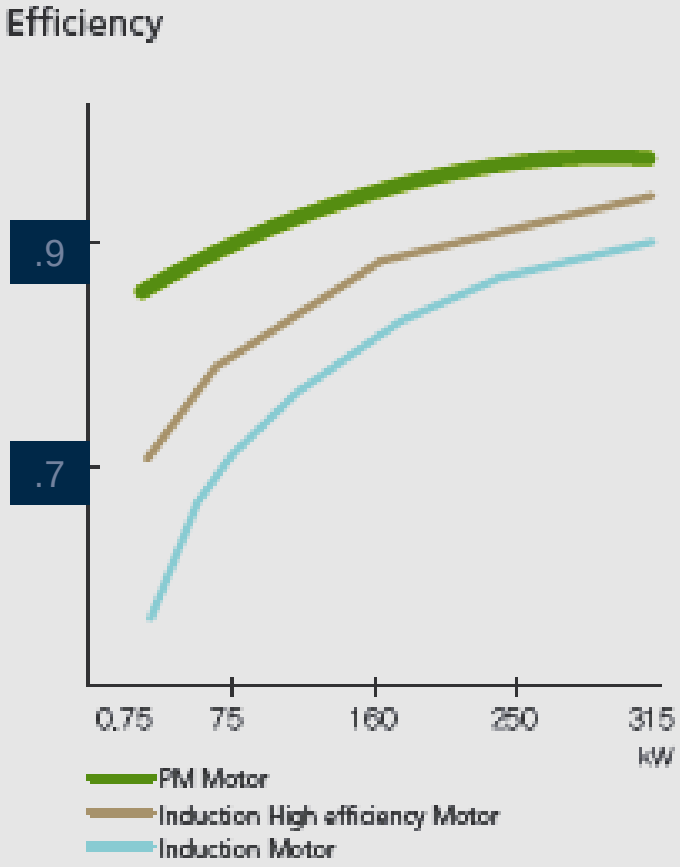
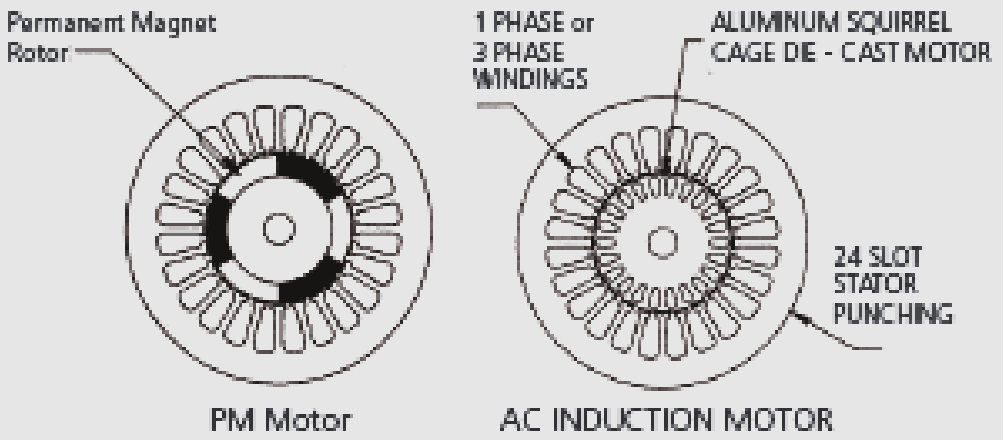
EXPECT PERFORMANCE

Permanent Magnet Motor





- No magnetizing power is necessary
- Lower heat generation means less cooling loss.
- Smaller rotor means less friction loss
- No slip means high efficiency even at part load condition.

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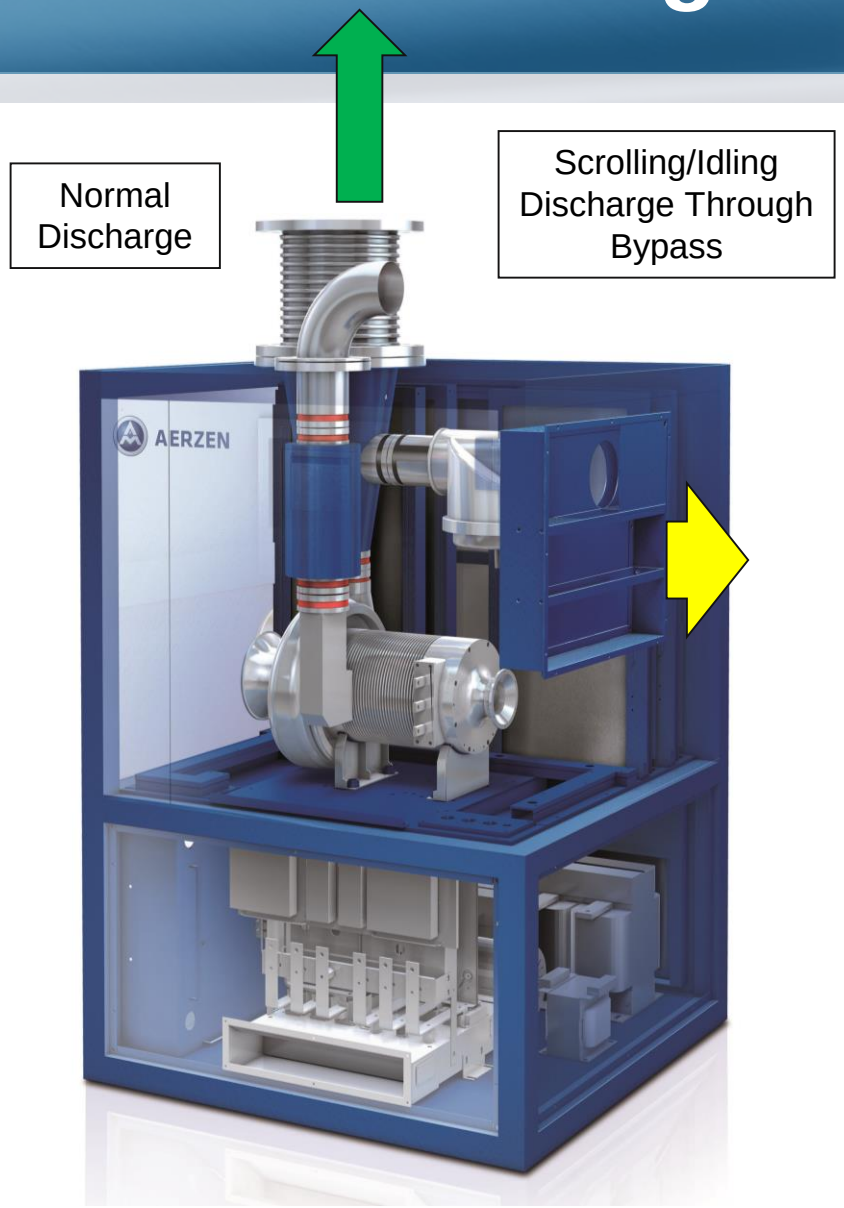
EXPECT PERFORMANCE

BOV and Idling



Essential to Starting/Stopping

And Idling

Bypass Valve Opens

Speed Drops to ~10,000

- Sufficient to maintain “loft” on Bearings
- Minimal Power Draw (Avg 2%: 2 – 5 kW)

Avoids Bearing Wear

Avoids Start/Stop Cycles that shorten capacitor life

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EXPECT PERFORMANCE

Controller

- **Real-time transparency:**

Integration of all Turbo blower parameters
Set permissible minimum and maximum values (surge limit, maximum RPM, overload, etc.):

- Filter pressure differential
- Differential pressure
- Volume flow
- Intake and discharge temperatures
- RPM
- Electric power
- Operating hours
- Error codes and error history
- Live visualization of Performance curve

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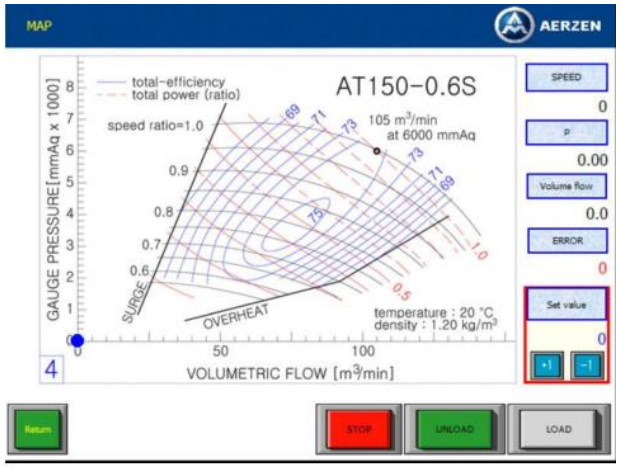
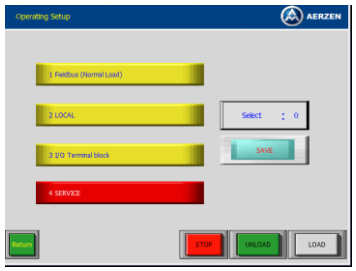
EXPECT PERFORMANCE

Local Control and HMI



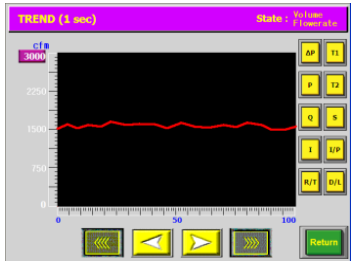
AND MORE..

LOCAL/REMOTE

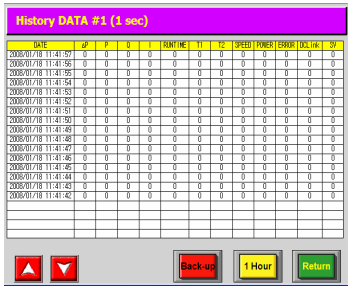


CONTROL TYPE

TRENDING



EVENTS



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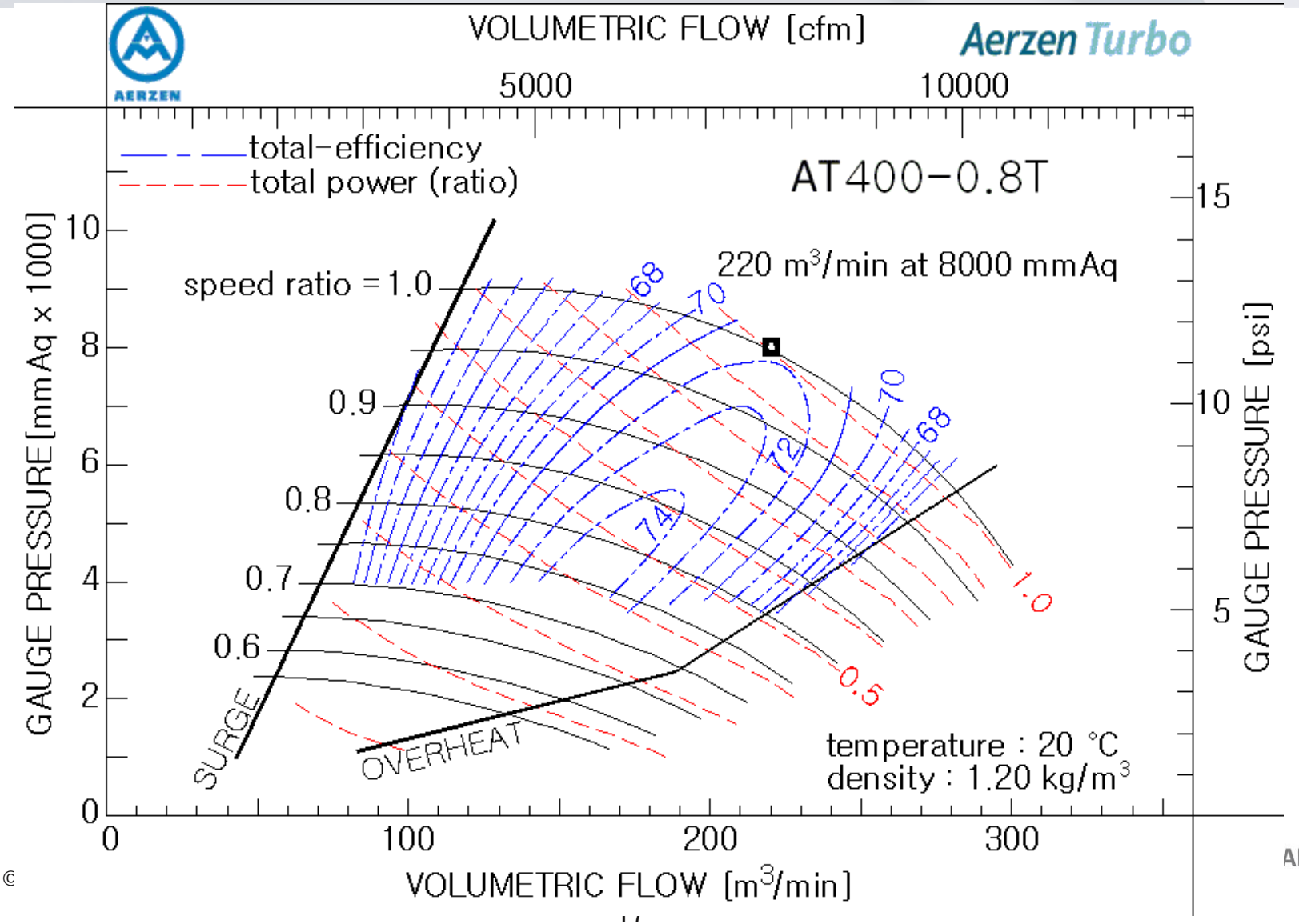
EXPECT PERFORMANCE

Turbo Performance Map



ANCE

Turbo Performance Map

Speed Control vs Current Control

Speed Control – Controlling blower output via Motor Speed

Current Control – Controlling blower output via Motor Current

Current Control results in better performance

Remember – Turbo blowers are ENERGY MACHINES

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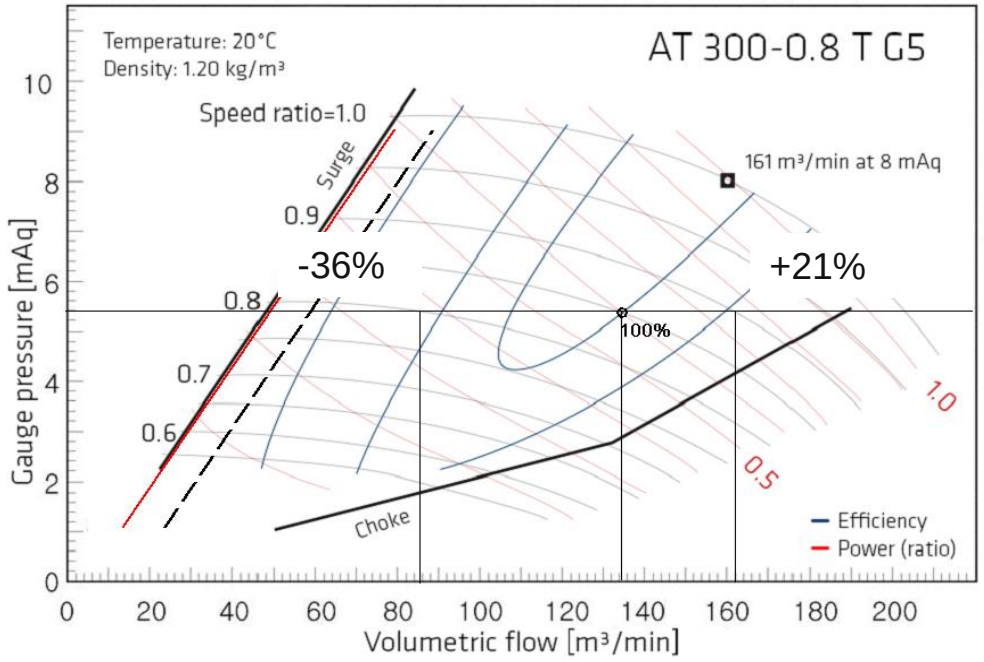
EXPECT PERFORMANCE

Turbo Performance Map

Speed Control



A variation of ± 5% in speed is equivalent to a variation of + 21% and -36% in flow

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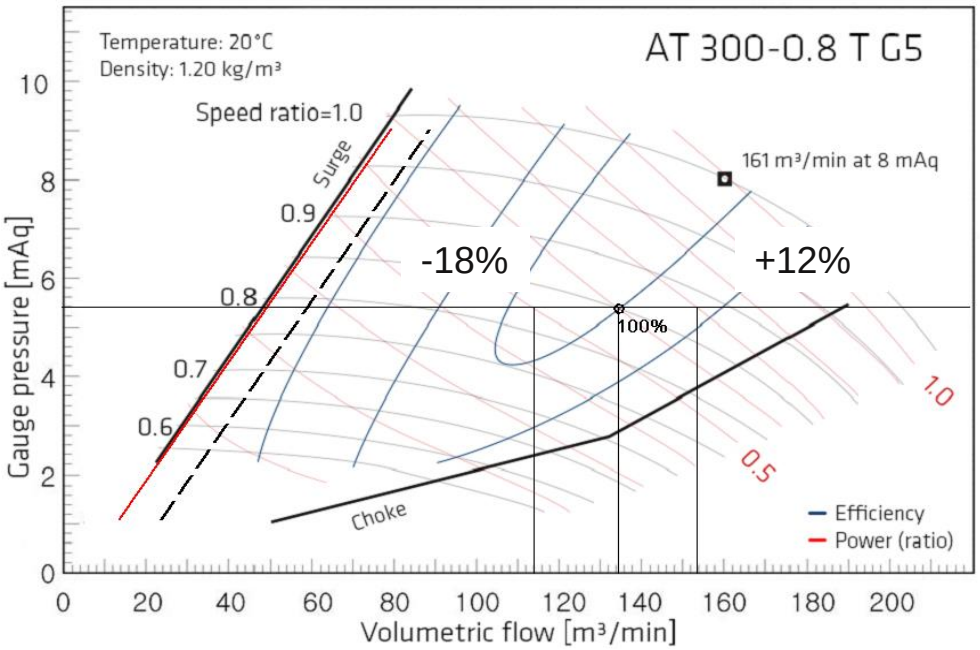
EXPECT PERFORMANCE

Turbo Performance Map

Current Control



Controlling the flow through current instead of speed achieves greater flow precision

A variation of ± 10% in current is equivalent to a variation of ± 15% in flow.

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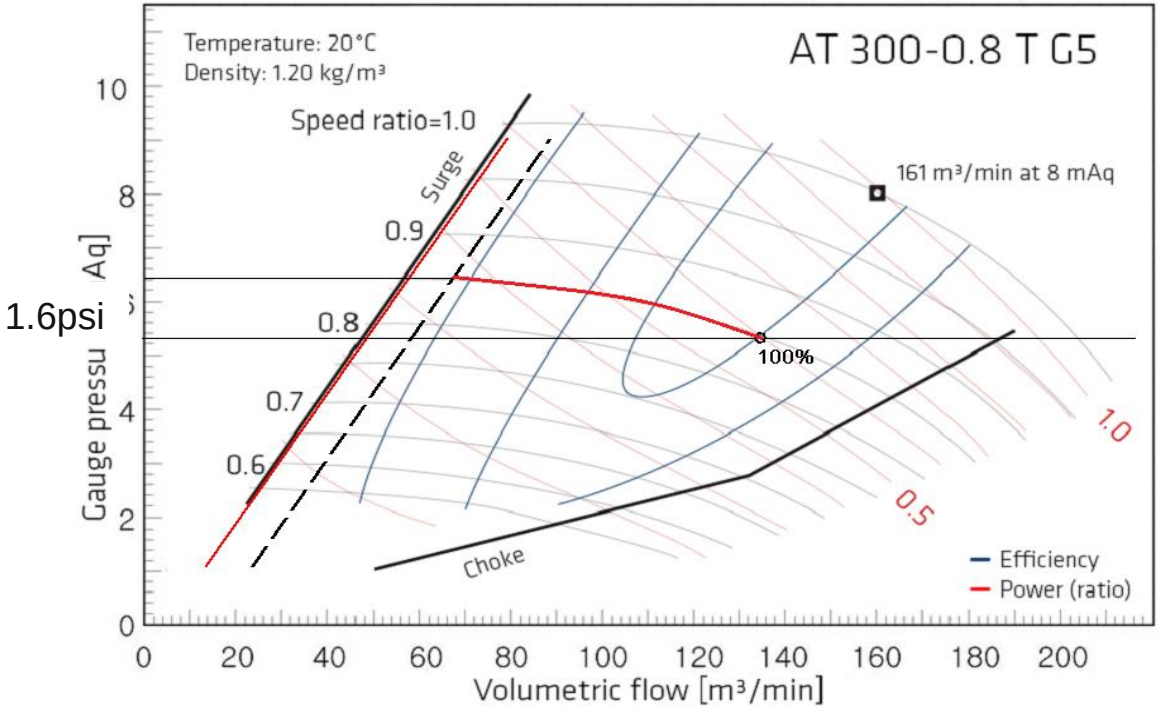
EXPECT PERFORMANCE

Turbo Performance Map

Speed Control – Rise To Surge



1.6psi Rise to Surge using Constant Speed

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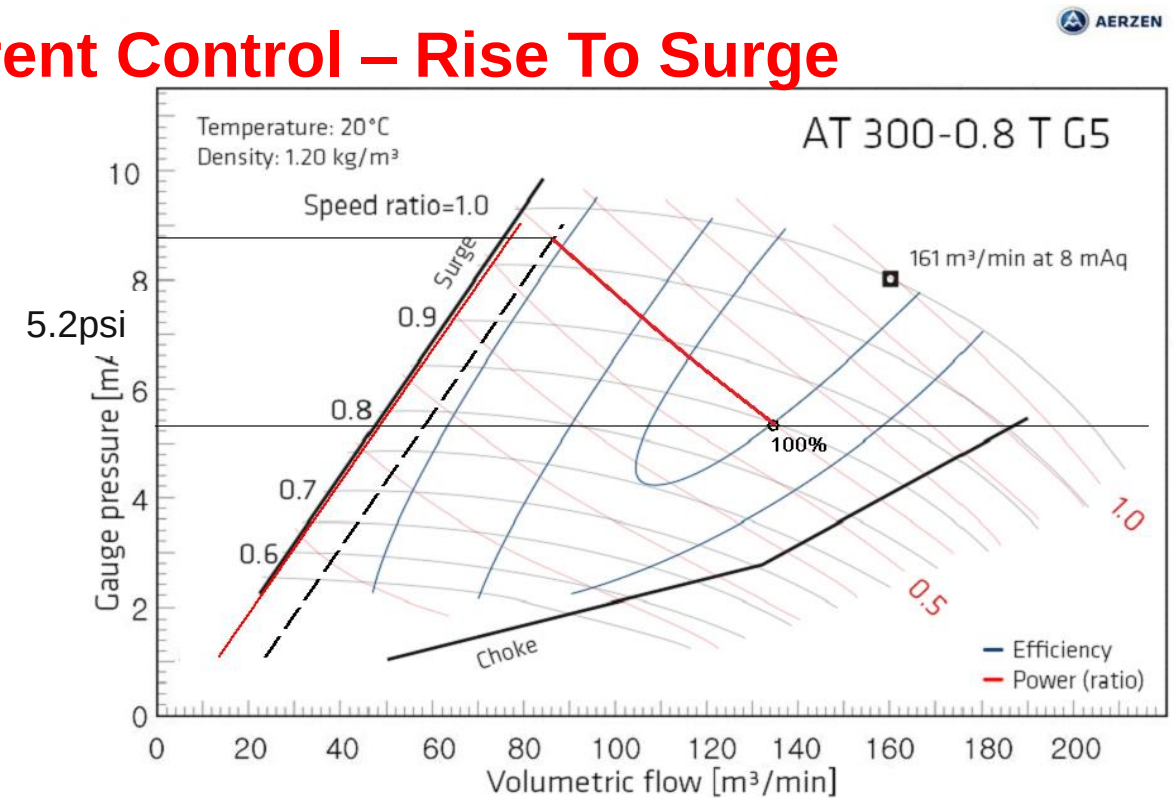
EXPECT PERFORMANCE

Turbo Performance Map

Current Control – Rise To Surge



5.2psi

Controlling the flow through current instead of speed achieves greater tolerance to pressure spikes

Here, 5.2psi rise to surge instead of 1.6psi

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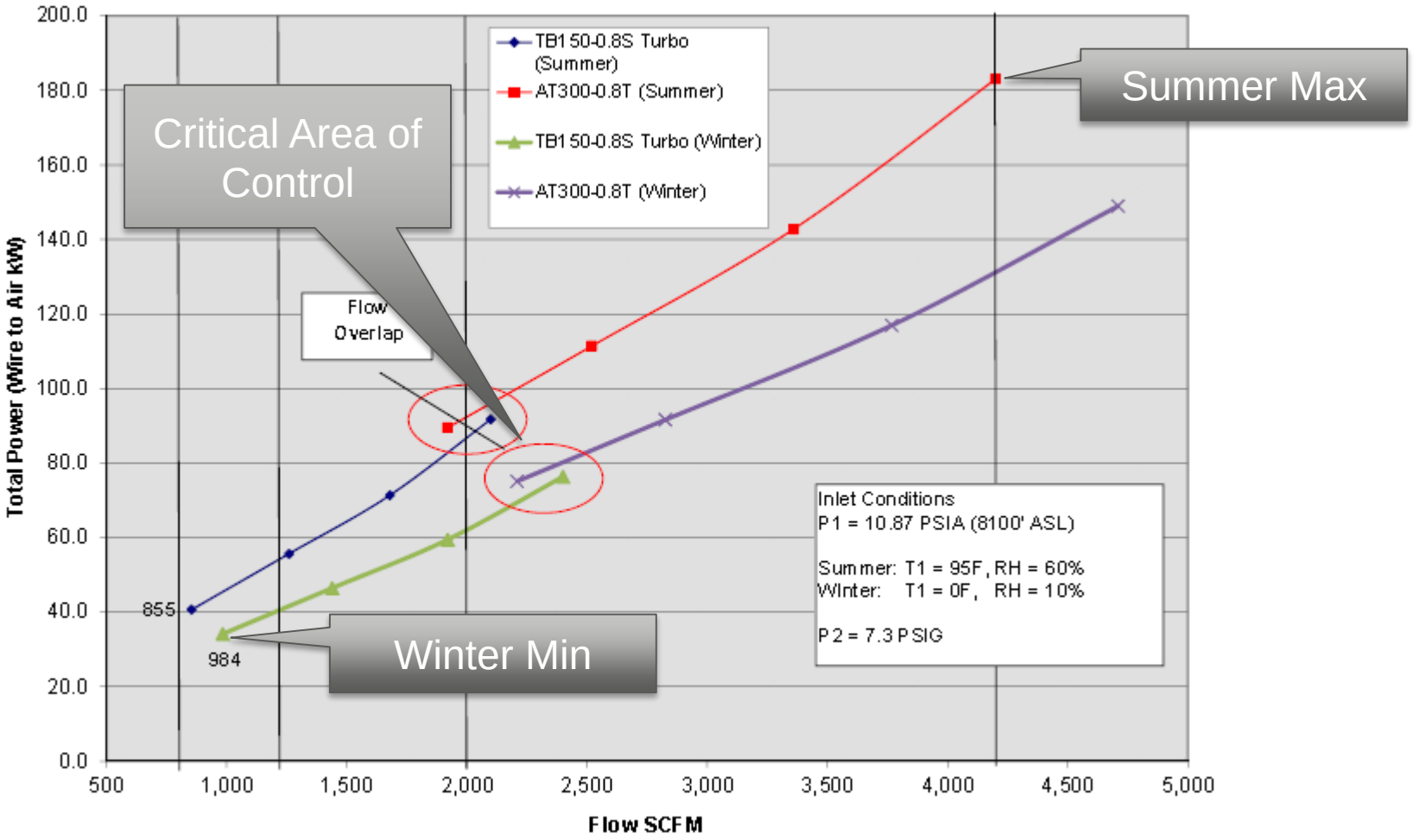
EXPECT PERFORMANCE

Managing Flow Variation



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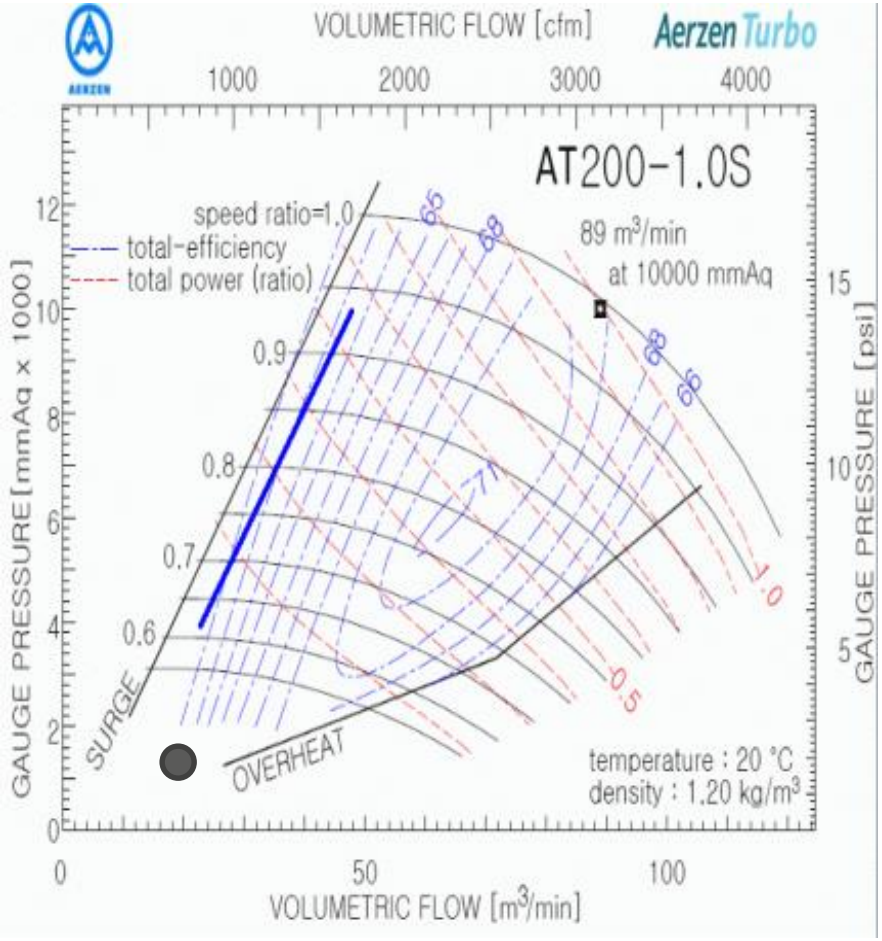
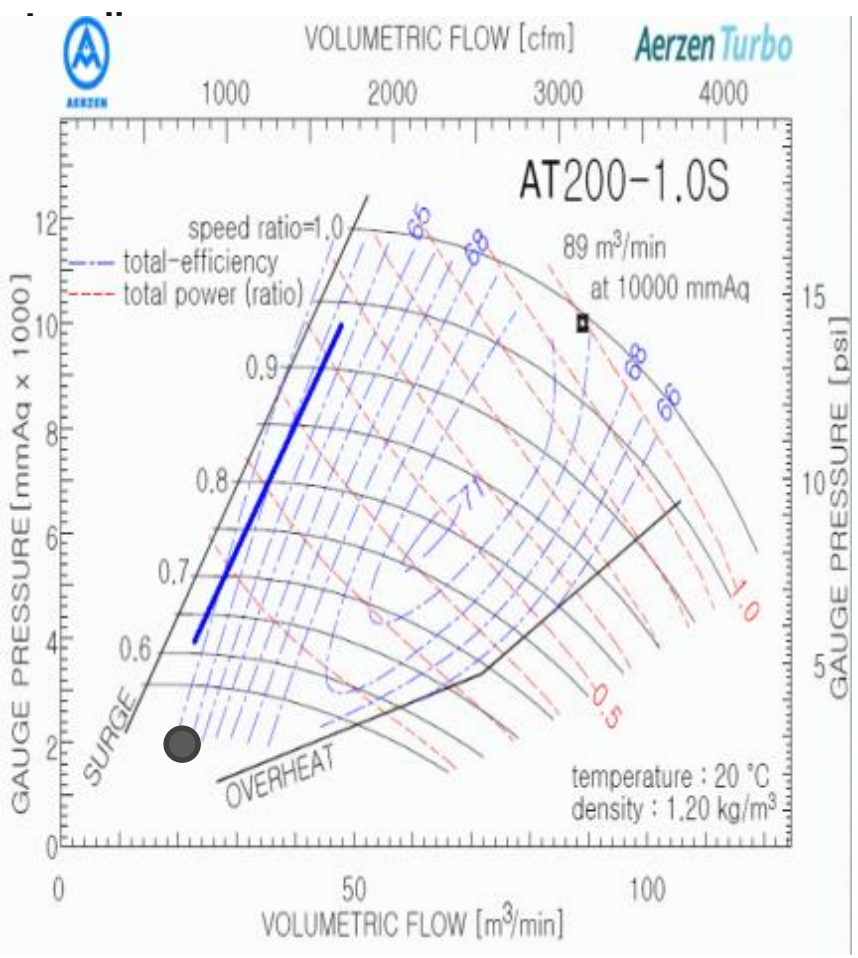
EXPECT PERFORMANCE

Multiple Aerzen Turbo Control Method





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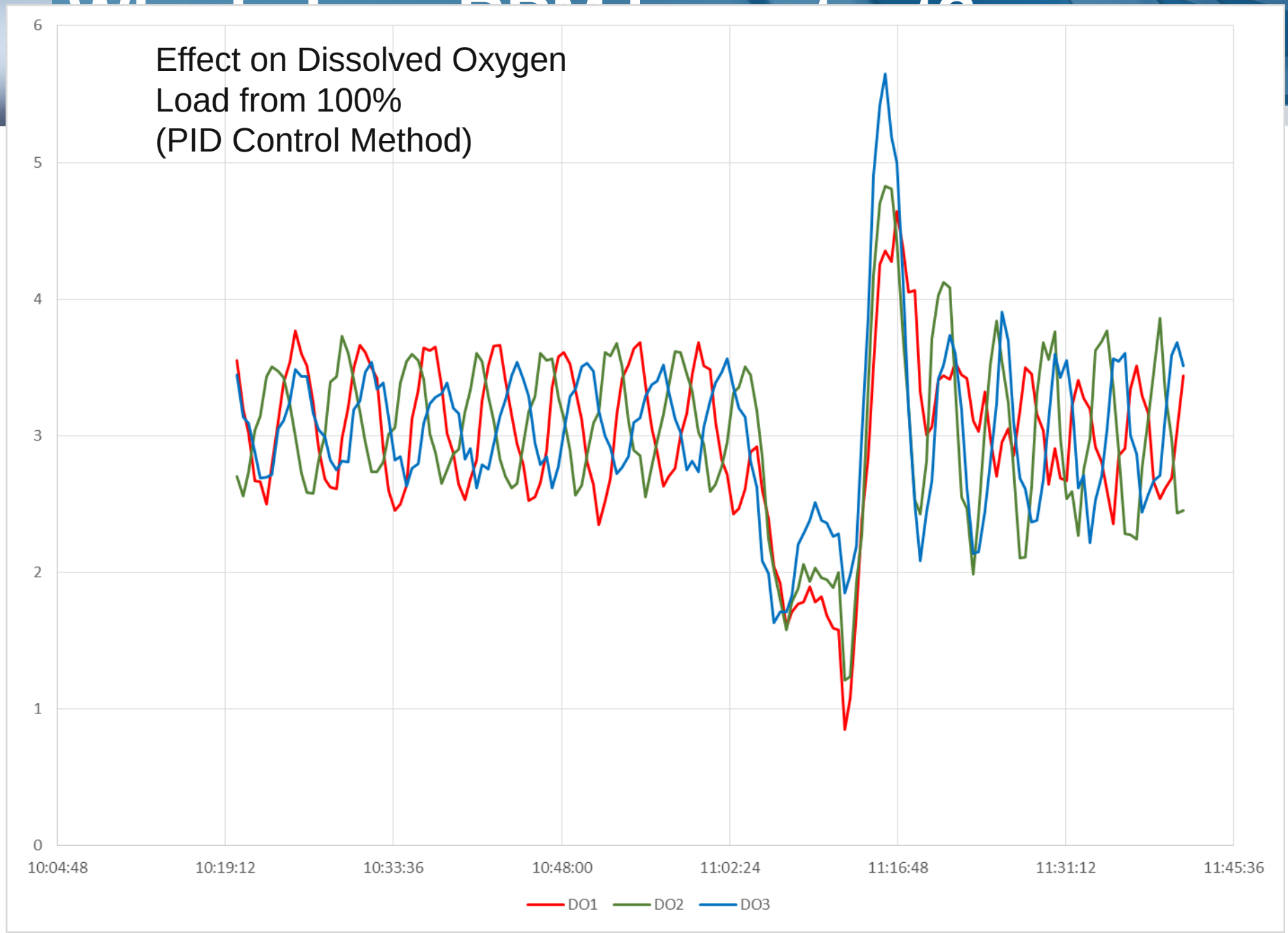
EXPECT PERFORMANCE


Effect on Dissolved Oxygen
Load from 100%
(PID Control Method)
6
5
4
3
2
1
0
10:04:48
10:19:12
10:33:36
10:48:00
11:02:24
11:16:48
11:31:12
11:45:36
DO1
DO2
DO3

Installation Location

Indoor Installation is Best Practice.

- Avoid Wind-Driven Rain, Blowing Snow

Ambient Temperature Range

- 32F - 113F

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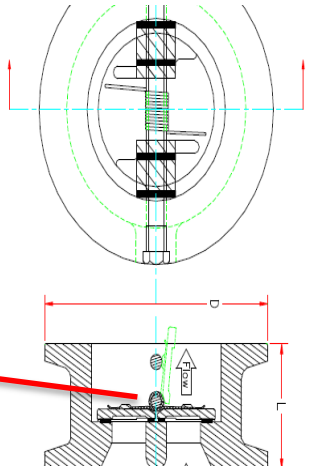
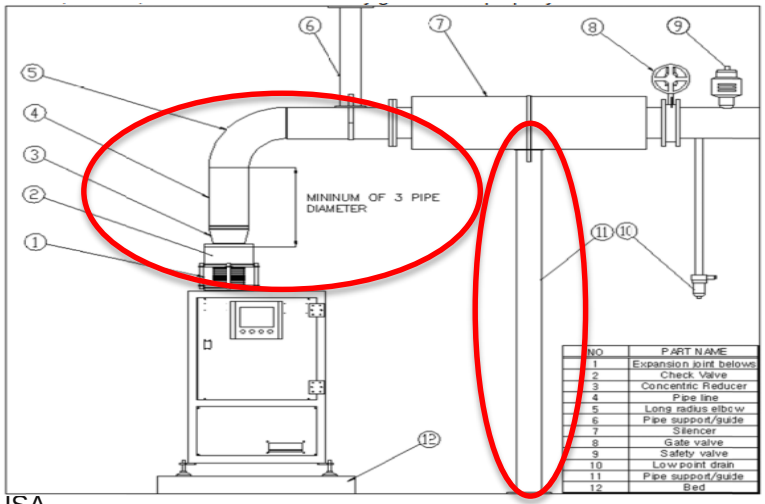
EXPECT PERFORMANCE

Piping

Discharge Piping:

1. Check Valve Positioning
    A. Reduce turbulence and backpressure
    B. Vertical or Horizontal
    C. Pin parallel with adjacent pipe bend
    D. Proper support





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EXPECT PERFORMANCE

Installation Recommendations

Discharge Pipe Insulation
Safety
Noise Attenuation

Motor Cooling Air Ducting
Heat Recycle Option (Cold Weather)
902btu/min per blower (200hp)

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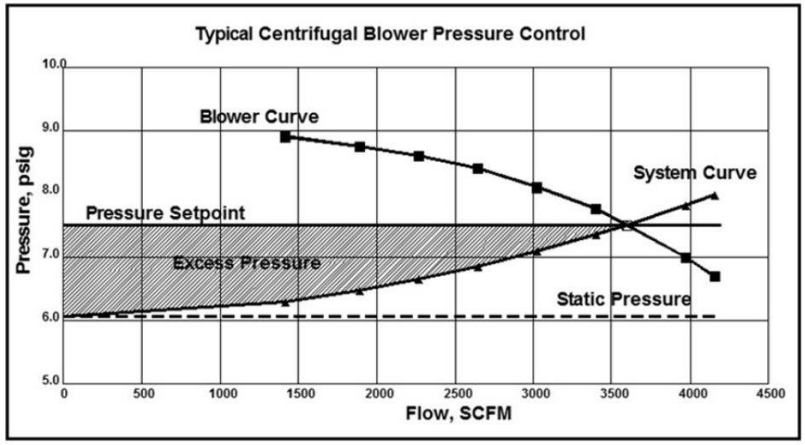
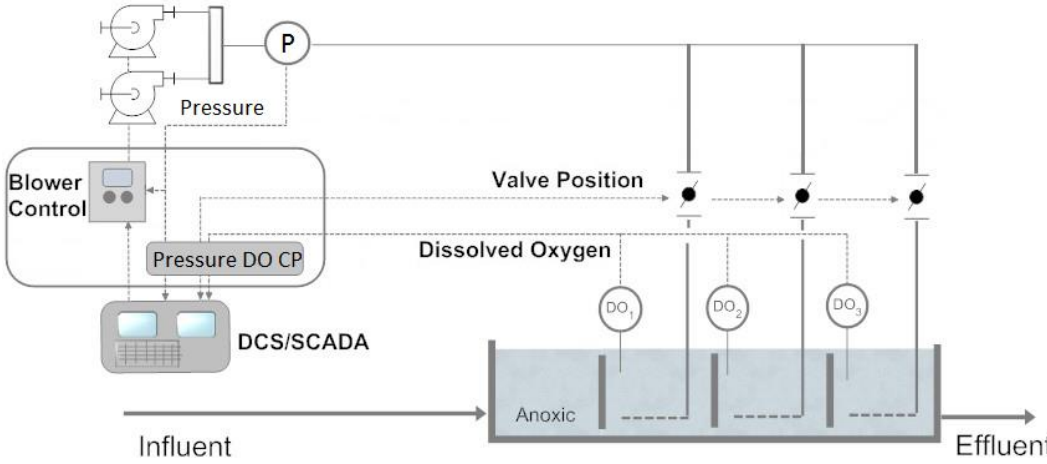
EXPECT PERFORMANCE

Aeration Control Methods

Traditional Pressure Control

- Increased Pressure less efficient
- Subject to surging turbo blowers





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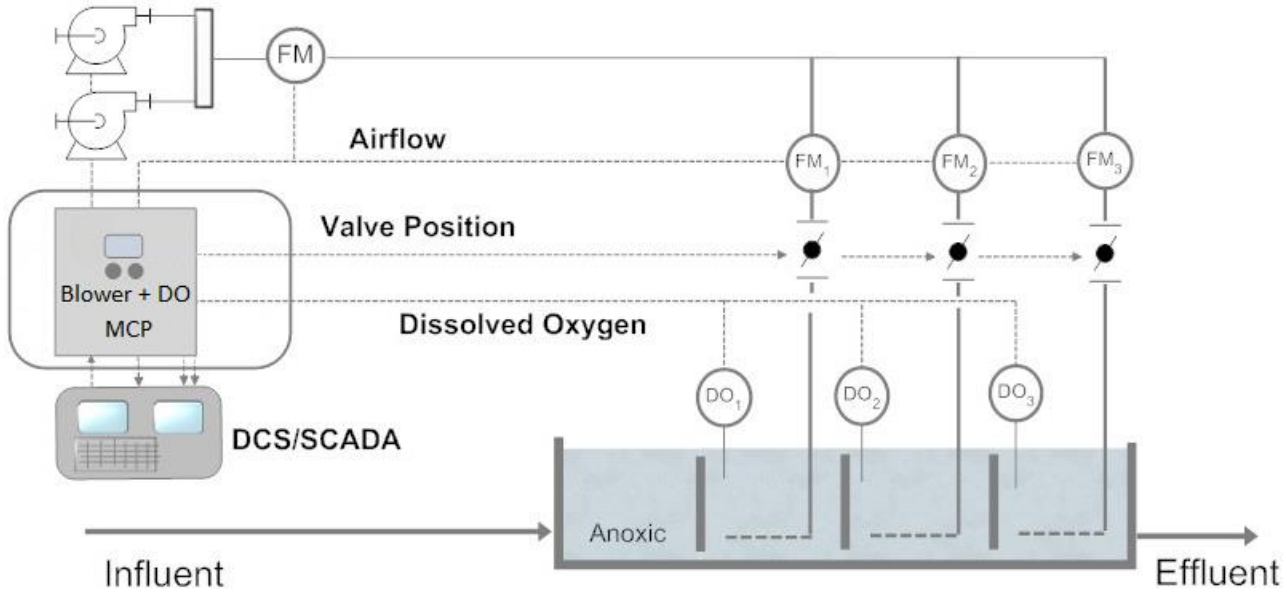
EXPECT PERFORMANCE

Aeration Control Methods

Most Open Valve Control

- Optimizes System Pressure
- Avoids Surge Conditions



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Turbo Blower Testing – PTC 13

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EXPECT PERFORMANCE

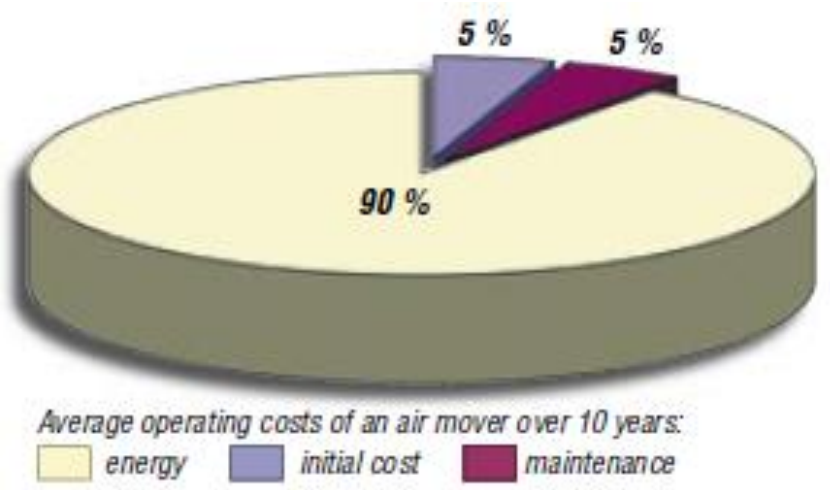
Aeration System Energy Consumption

Accounts for ~60% of WWTP Energy Consumption

And

~1% of all National Energy Use

Energy is the Largest Life Cycle Cost of the Blower



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EXPECT PERFORMANCE

Performance Verification

ASME PTC-13 – Released in 2020

Standard basis of comparison

True measure of Wire to Air Efficiency

Accounts for all package losses

Applicable to all blower technologies

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EXPECT PERFORMANCE

Maintenance Schedule

Easy to Maintain

Interval	Maintenance		Authority
Monthly	Check filters for contamination	- Pre-filter - Medium filter	User
Annual	Visual inspection	- Piping system for any leakage - Cleaning the intake and exhaust air covers	User
		- Cleaning of main inverter or fan inverter (optional)	Authorized personnel
	Cleaning intake and exhaust	- Exhaust air opening of blow off valve (BOV) - Cooling system's exhaust air outlet	User
	Checking emergency stop function		Authorized personnel

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Air Filter Change

Fig. 6-1 Position of medium filters

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THANK YOU

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