Selecting the Right Blower Technology

OTCO Class III & IV Workshop

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Available Blower Technology

- **Positive Displacement**
  - Two lobe or Three lobe
  - Rotary Lobe Compressor

Rotary Lobe Compressor

Rotary Lobe Blower

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Available Blower Technology

- **Centrifugal**
  - Multi-stage
  - Single stage with gear
  - Single stage high speed turbo
    - Magnetic Bearing
    - Air Foil Bearing

Multi-stage

High Speed Turbo

Integral gear
single stage

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Positive Displacement – Three Lobe PD

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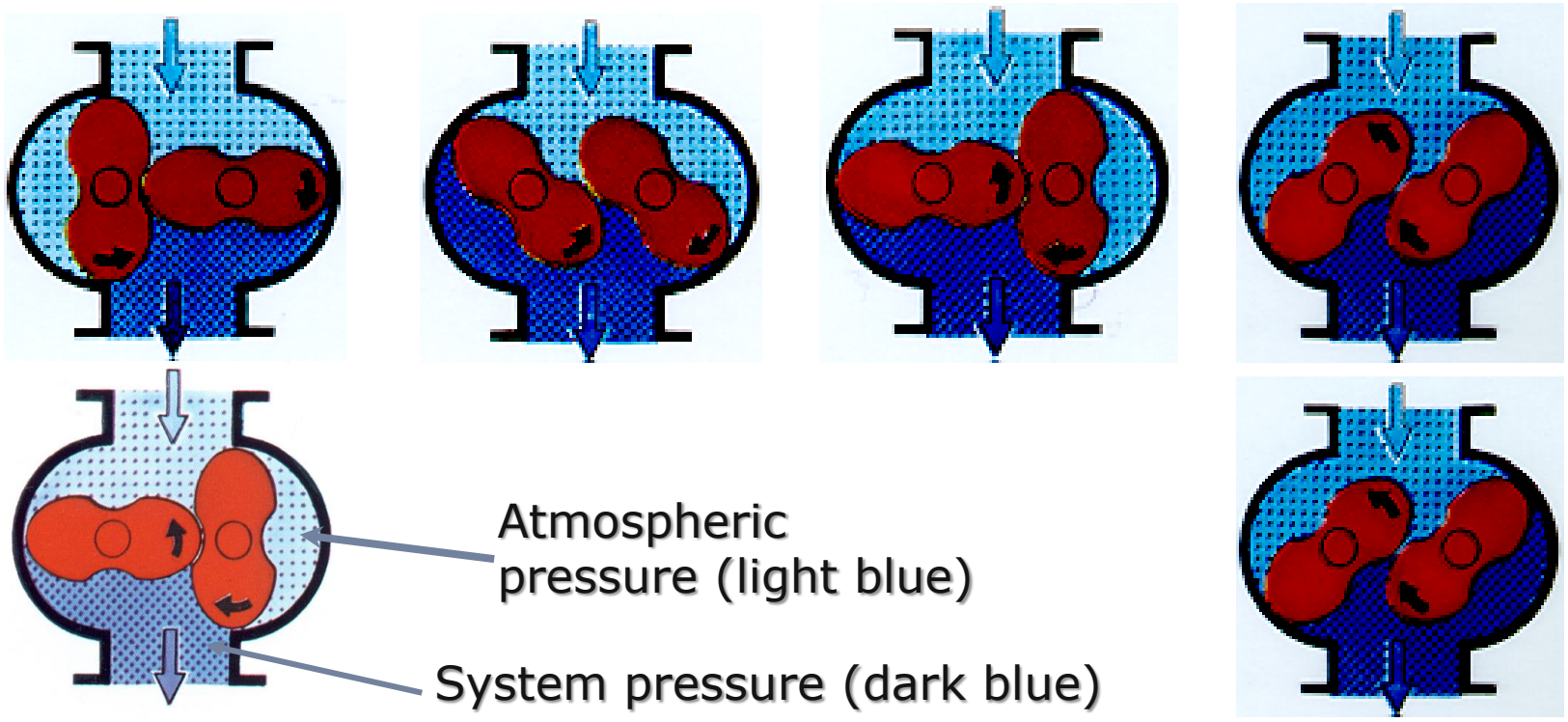
Pulsations and piping noise

Conventional blowers generate piping noise & destructive pulsations



Pressurized air in discharge is about to return into blower housing → Abrupt pressure equilization causes sound wave and shock

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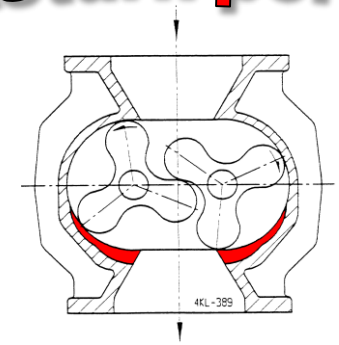
Three – Lobe Blower




Return ports



Returning air pressurizes this chamber

Wave created by squeezed volume meets discharge wave at 180°


the wave of reduced amplitude is then DEPHASED by the incoming 'squeeze' pulsation. The result is 95% - 97% pulsation cancellation!

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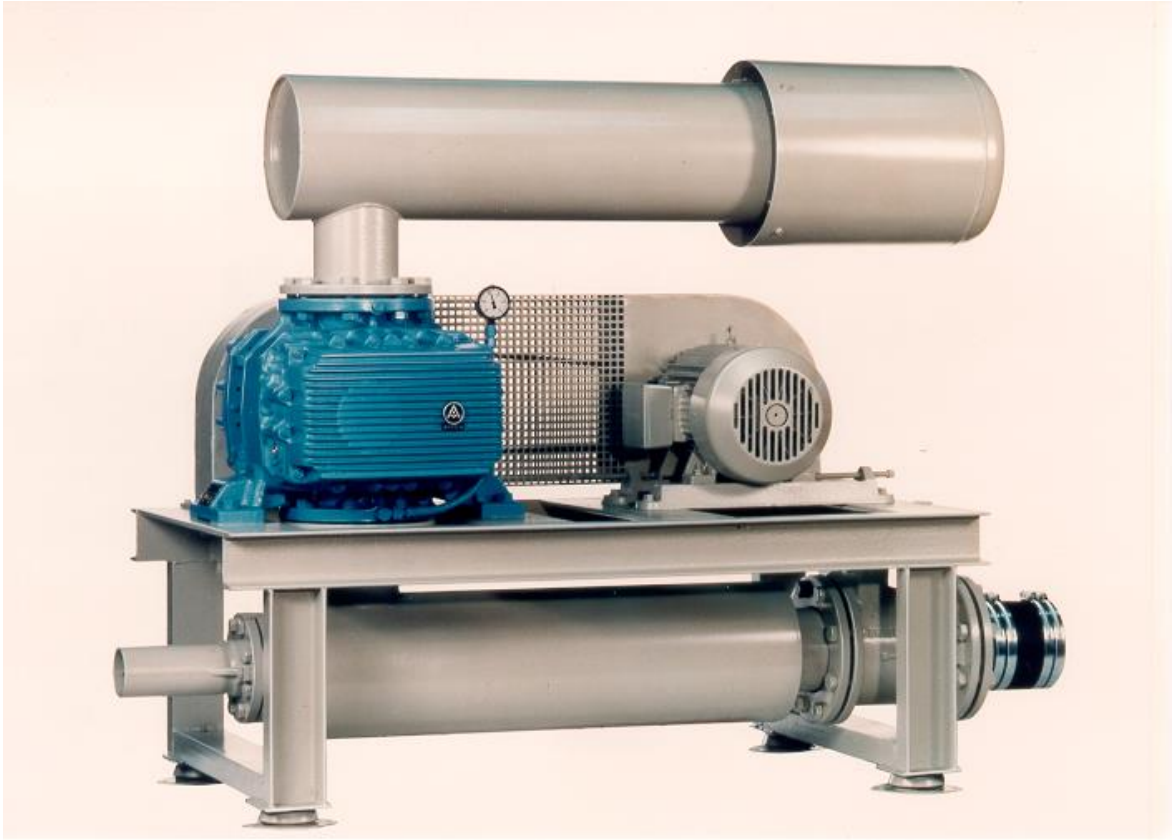
Packaging Innovation



Compact I from 1960's

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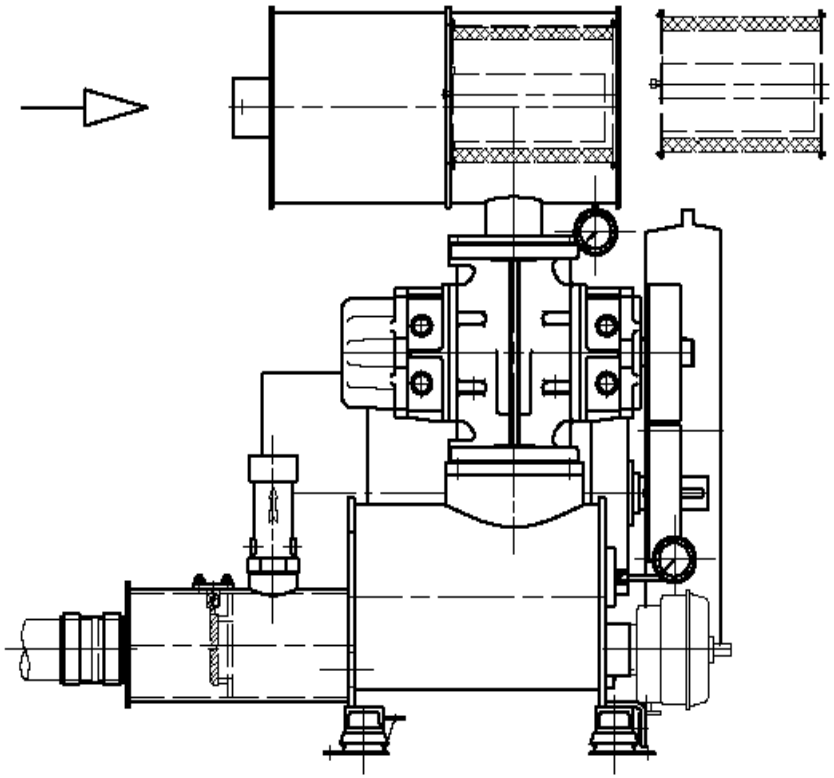
Packaging Innovation



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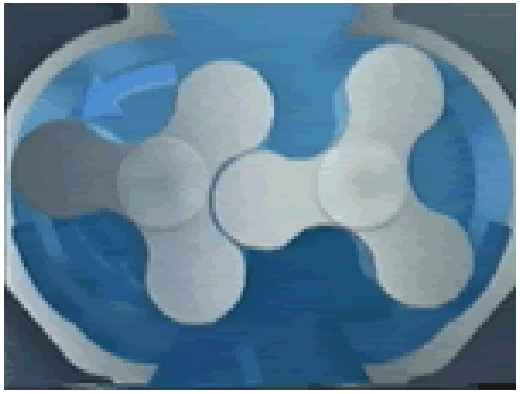
Blower Design Principles

- **Positive Displacement Blower**
  - Constant volume against varying pressure
  - Flow changes by varying speed with VFD
  - High Turndown (Typically 4:1)
  - Easily adapts to changes in pressure & temperature
  - Lowest initial cost



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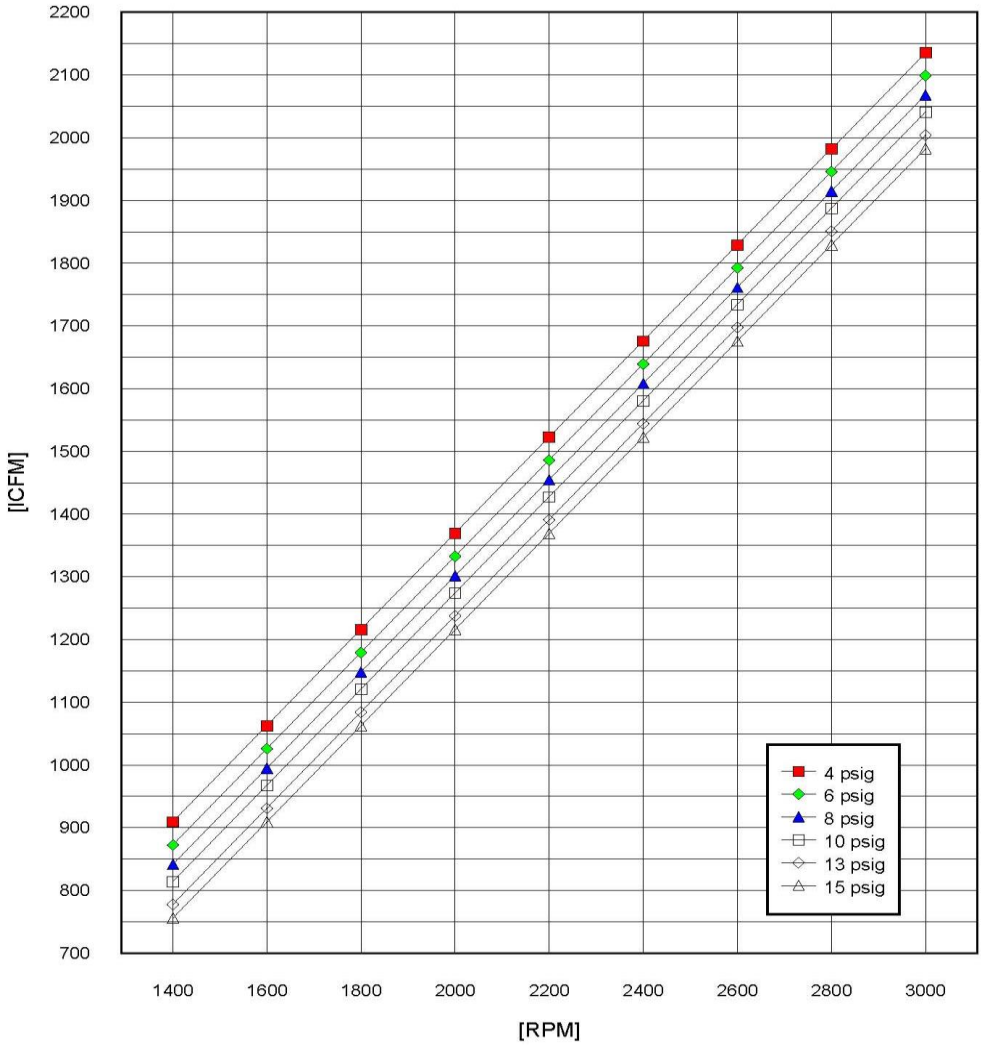
AERZEN GM 60S DELTA PACKAGE, PRESSURE
INLET FLOW



Performance data based on air @ 68 deg.F/ 14.7 psia inlet.

See temperature chart on second sheet for allowable operating range.

Positive Displacement – Rotary Compressor (Hybrid)

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Delta Hybrid Concept

- **High Efficiency of a Compressor**
  - Comparable Efficiency to Turbo
- **Packaging Principles and Economy of Aerzen Generation 5 Blower Package**
- **High Turndown (4:1)**
- **Proportional Control (Standard VFD)**
- **Capital Cost:**
  - 15% > PD
  - 20-40% < Turbo

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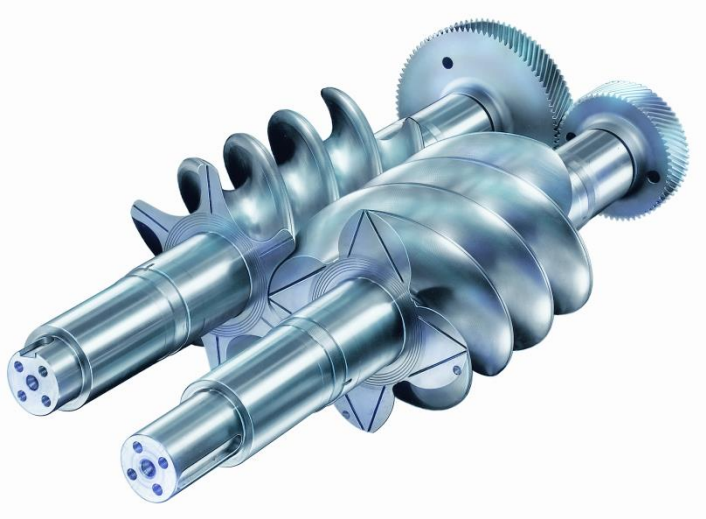
Compressor Design Principles

- **Positive Displacement Compressor (VML)**
  - Used since the 1940's (Deep Cell Aeration)
  - Rotors mesh, compressing air inside housing
  - Flow changes by varying speed (VFD)
  - Design for up to 50 psig
  - Higher capital cost (2.5X PD blower)



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Delta Hybrid Advantages

- **More Efficient than Aerzen 3 Lobe Blowers**
  - 5% - 25% Energy Reduction

- **Two rotor profiles:**
  - L: Isochoric compression (supercharger)
  - S: Screw compressor profile (3+4)
  - Why: Proper Profile Required for Optimal Performance

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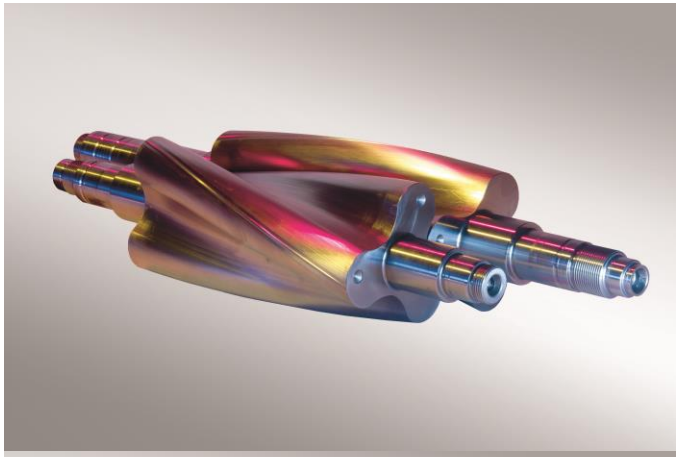
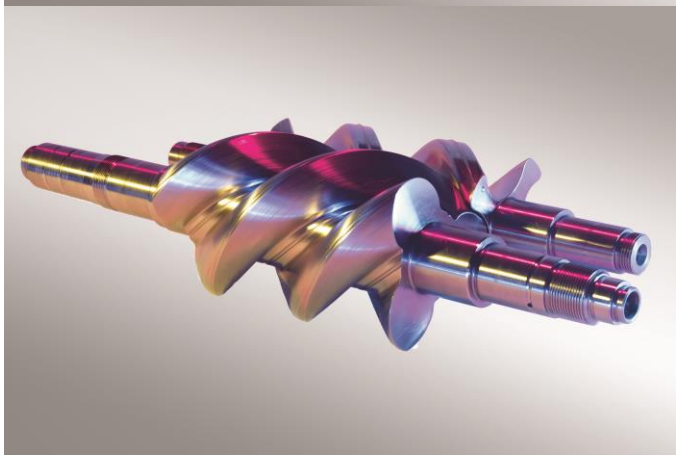
Hybrid Rotor Profiles



- L Series (Patented)
- 3 + 3 Twisted Rotors
- Range: 3-8 PSIG



- S and H Series
- 3 + 4 Screw Rotor
- Pressure Range:
  - S: 7-15 PSIG
  - H: 16-22 PSIG

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Hybrid Machine Ranges

250 to 5,000 CFM

25 to 400 HP

Aerzen Hybrid Model	Differential Pressure (max mbar)	(max psi)	Volume Flow (max m^3/h)	(max cfm)	Motor Power (max kW)	(max HP)
D 12 H	1500	22	670	390	37	50
D 12 S	1000	15	690	410	30	40
D 17 L	800	12	810	480	30	40
D 24 H	1500	22	1370	810	75	100
D 24 S	1000	15	1390	820	55	75
D 28 L	800	12	1340	790	45	60
D 36 H	1500	22	2100	1240	110	150
D 36 S	1000	15	2150	1270	75	100
D 46 L	800	12	2350	1380	75	100
D 62 H	1500	22	3400	2000	160	200
D 62 S	1000	15	3500	2060	110	150
D 75 L	800	12	3870	2280	132	175
D 98 H	1500	22	5600	3280	250	350
D 98 S	1000	15	5800	3390	200	200
D 152 S	1000	15	8900	5240	315	420

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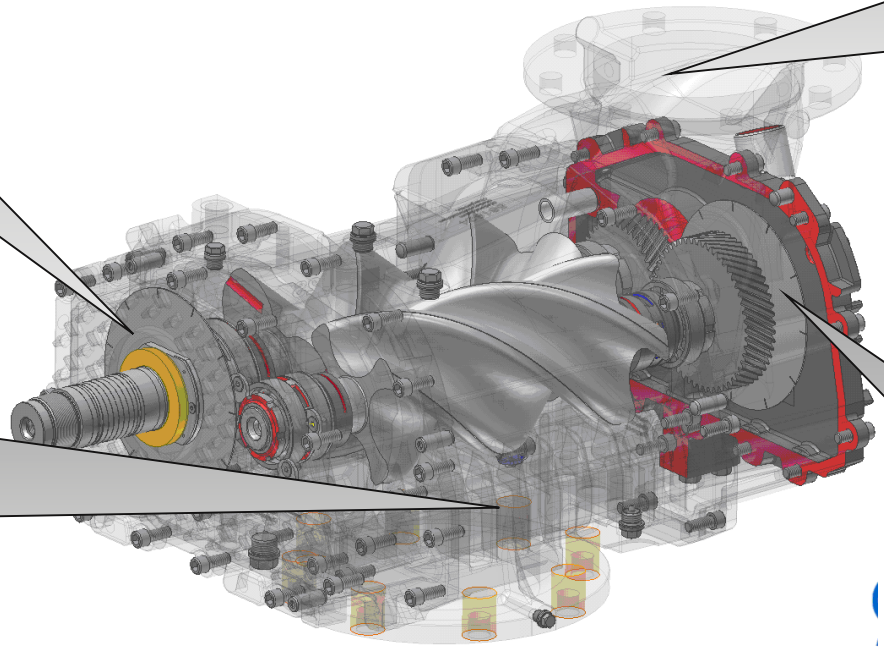
Delta Hybrid Innovations



Non-Wearing Shaft Seals

Fluidic Inlet Port

Large Oil Cooling Surfaces (Patent)

Timing Gears on Cool Side

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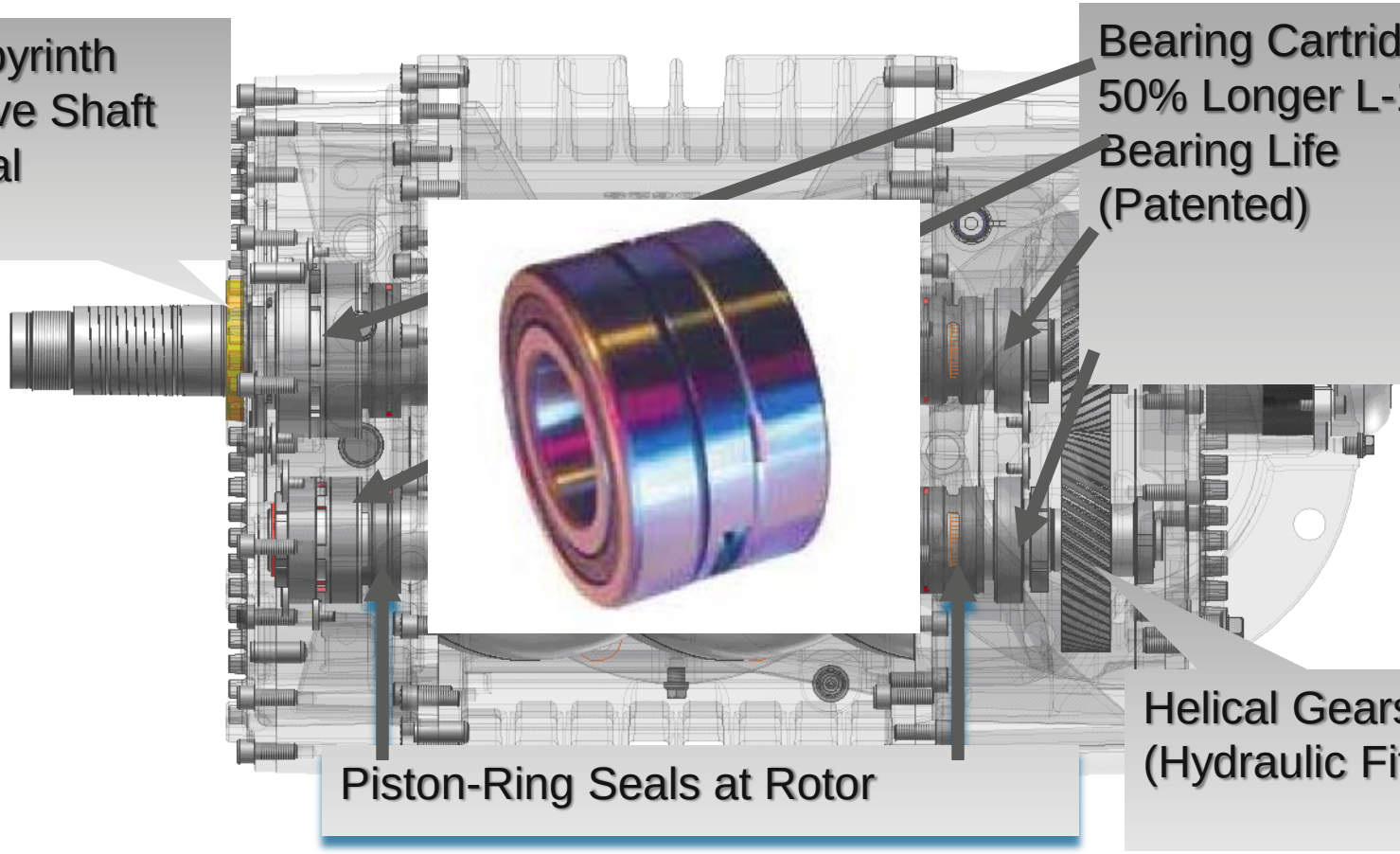
Delta Hybrid Innovations



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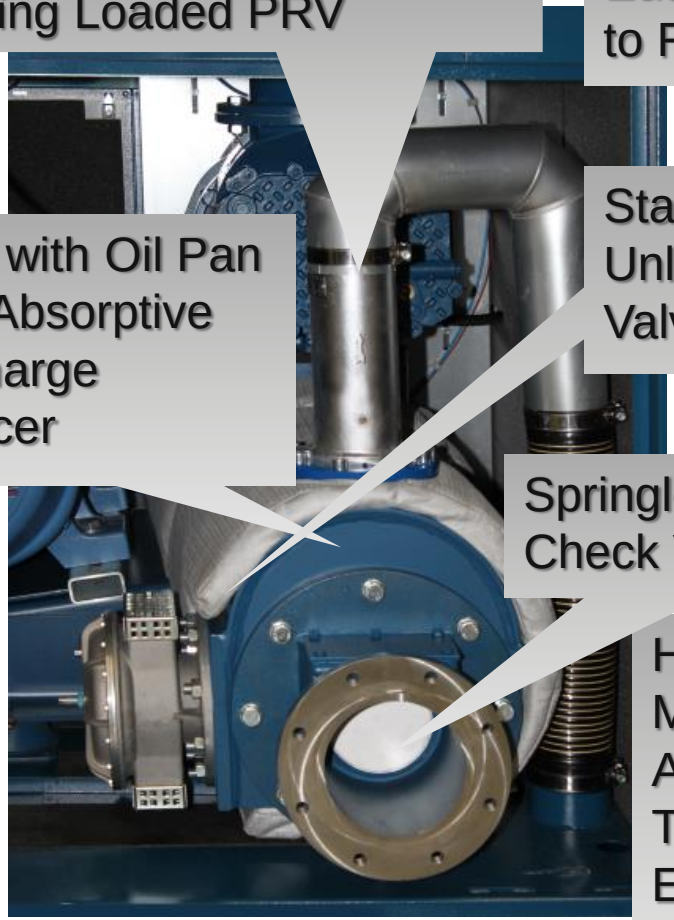
Delta Hybrid Packaging

Spring Loaded PRV

Easy Access to Filter

Quietest Package (76 dBA) Side by Side Installation



Base with Oil Pan Non-Absorptive Discharge Silencer

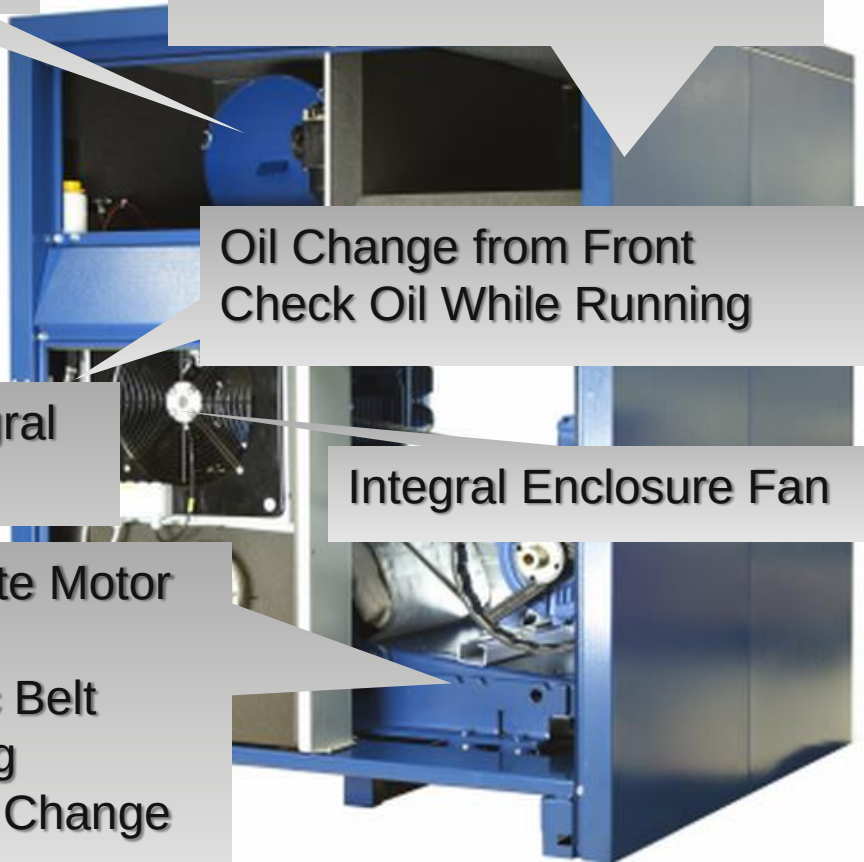
Startup Unloading Valve

Oil Change from Front Check Oil While Running

Springless Integral Check Valve

Integral Enclosure Fan

Hinge Plate Motor Mounting
Automatic Belt Tensioning
Easy Belt Change



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Centrifugal – High Speed Turbo (Air Bearing)

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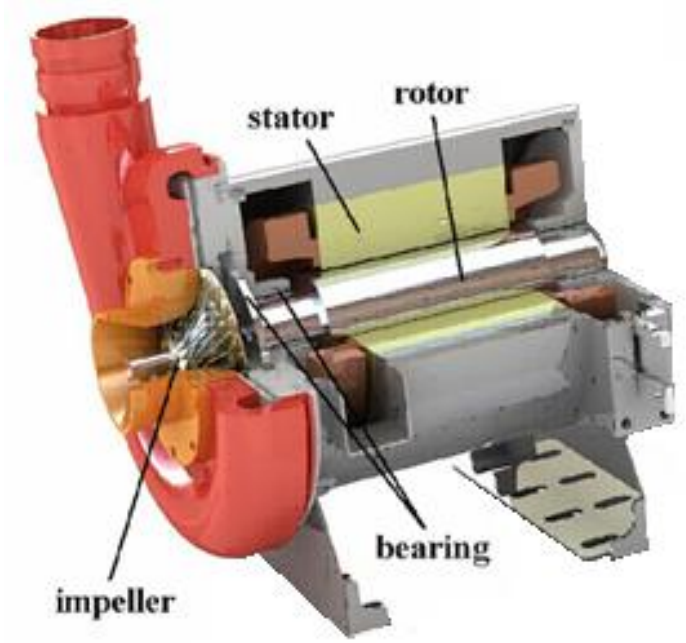
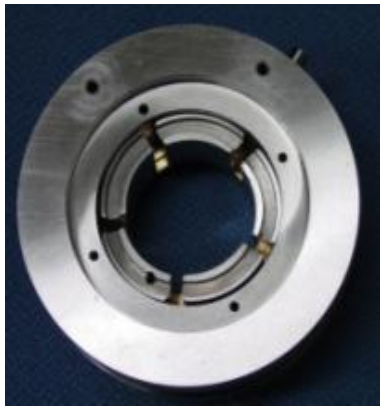
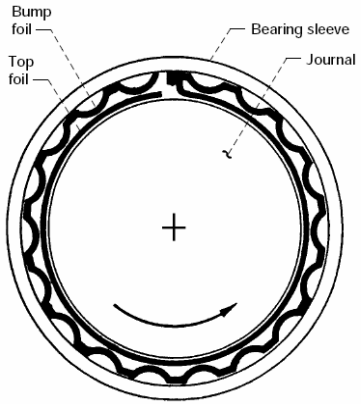
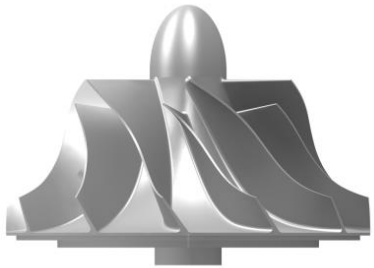
Turbo Design Principles

- **State of the Art Components**
  - Permanent Magnet Motor
  - Air Foil Bearing
  - Stainless Steel Impeller
  - CPU Controlled Inverter
  - Advanced Protection & Control









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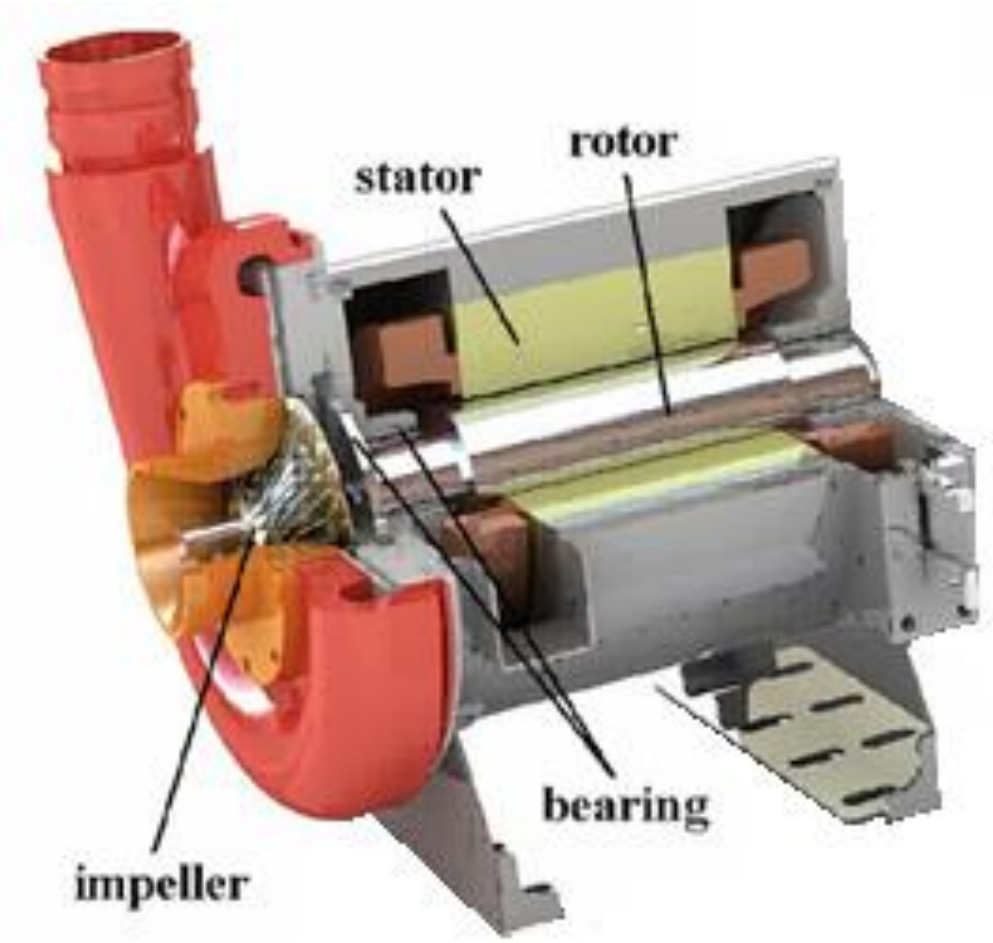
State of the Art Components



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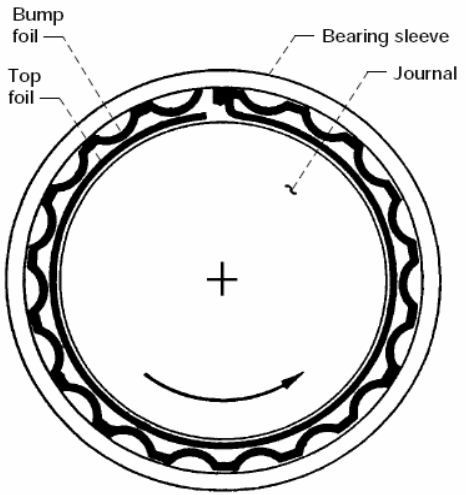
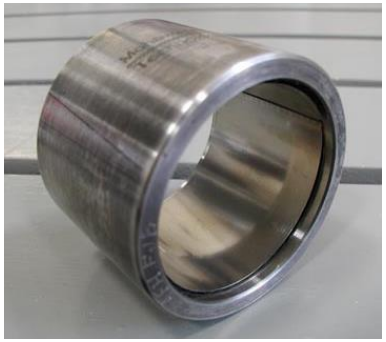
Airfoil Bearing Evolution





- **Third Generation: Simple Bump and Foil**
  - Requires high RPM when running in unloaded mode (startup or blowoff)
  - Requires discharge pressure manipulation to avoid overheat
  - 25,000 on/off cycles bearing life

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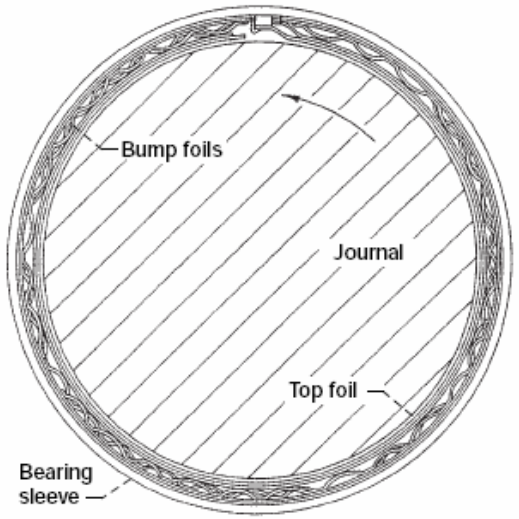
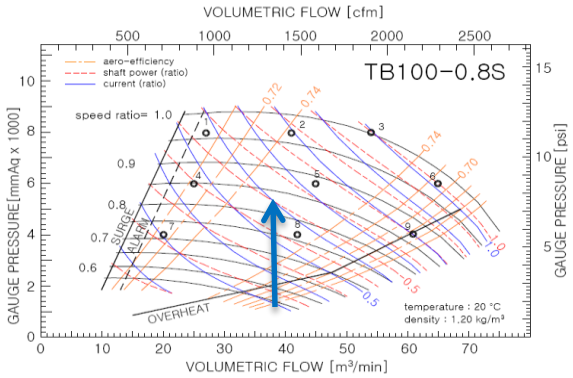
Airfoil Bearing Evolution





- **Fourth Generation (Aerzen)**
- **Multi-Pad Bump**
  - Radial and Axial Variations
  - Able to run at low RPM (Idle)
  - Able to run at low pressure without overheat (e.g. to pressurize an empty system)
  - Idling feature is unique: low RPM, low power, less electronic wear and tear
  - Filling an unpressurized system does not require control valves

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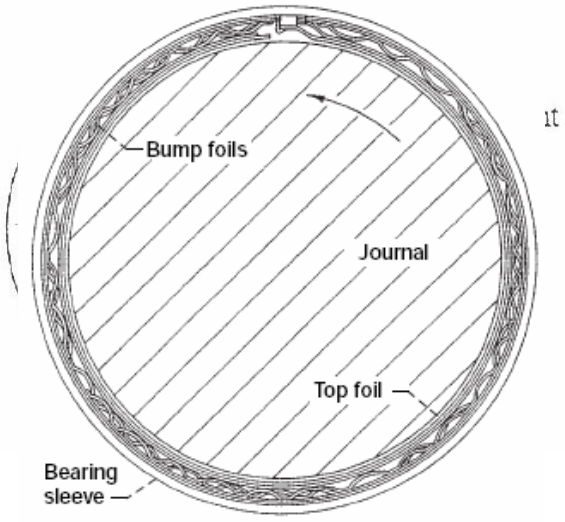
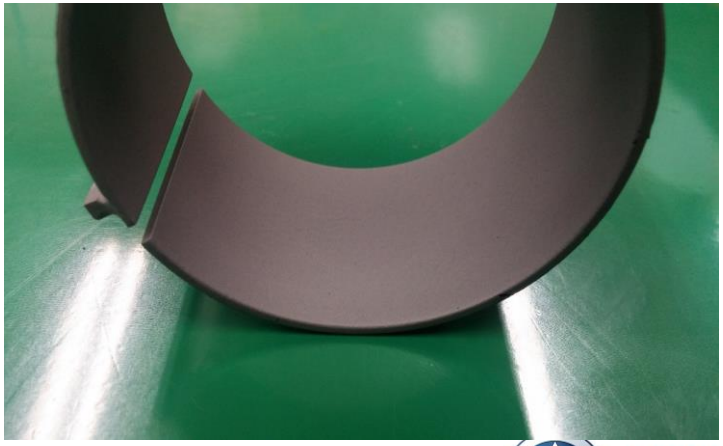
Airfoil Bearing Evolution



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



Result: 75,000 start/stops!

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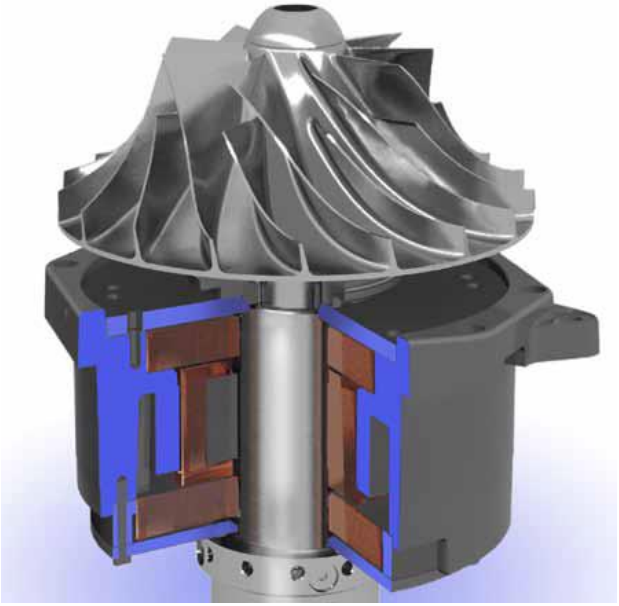
Magnetic Bearings

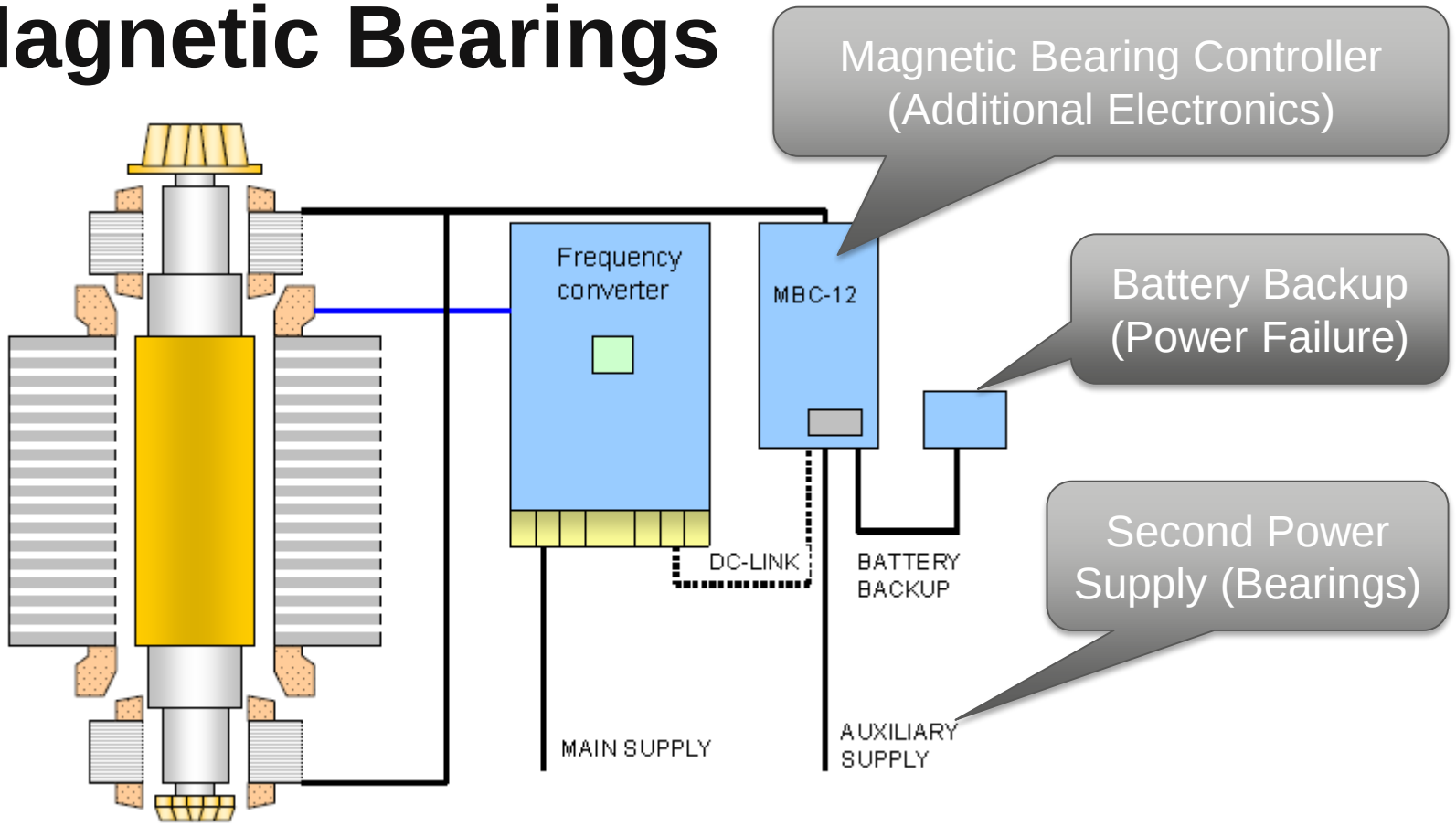


Active Design

- Magnets levitate the shaft with low friction and no mechanical wear.
- A separate controller determines shaft position and constantly adjusts magnetic distribution to keep shaft centered.
- “No Rotation” Mode enable stops without wear on bearings.

Bearing Design

Magnetic Bearings



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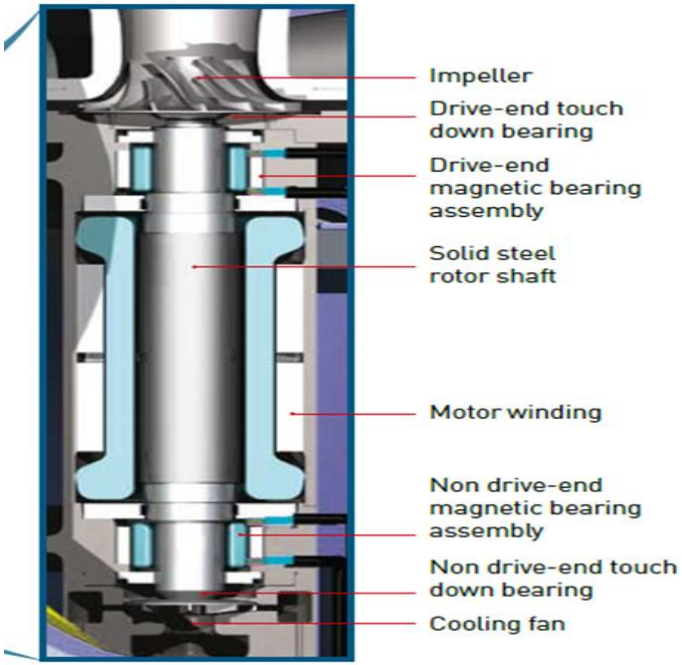
Magnetic Bearings



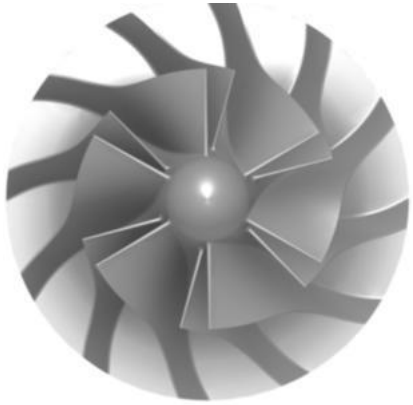
- Power failure presents an issue.
- Battery (UPS) backup keeps magnets and control system running as it coasts to a stop (~1 minute).
- Touch down bearings are not intended for repeated hard stops and must be replaced.

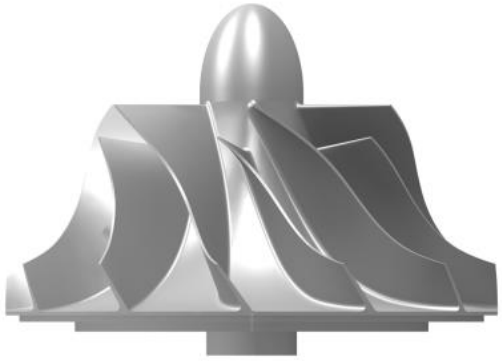
So, Airfoil or Magnetic Bearing?

	Airfoil	Magnetic
Tolerant to Cycling (No Air)	Aerzen – Yes Others – Electronic/ Bearing wear	Yes (No Rotation Mode)
Tolerant to Power Failure	Yes (Recently)	Requires touchdown bearing and battery replacement
Running unloaded	Aerzen – Yes Others – No	Yes (No Rotation Mode)
Filling Unpressurized System	Aerzen – Yes (Low RPM) Others – Needs valve	Bearing may allow it, controls might not.
Clean Air Issues	Aerzen – No (100% dual filter) Others – Sporadic issues All – Proper piping is critical	Yes- Increased Electronics and magnetic bearing cleanliness
Erratic Power Supply	Potential hard shutdowns (Recent innovations)	Can lead to bearing failure

Impeller Design

- Jet Engine Technology
- 17-4 PH Stainless
- Strength and Efficiency
- High Rise to Surge





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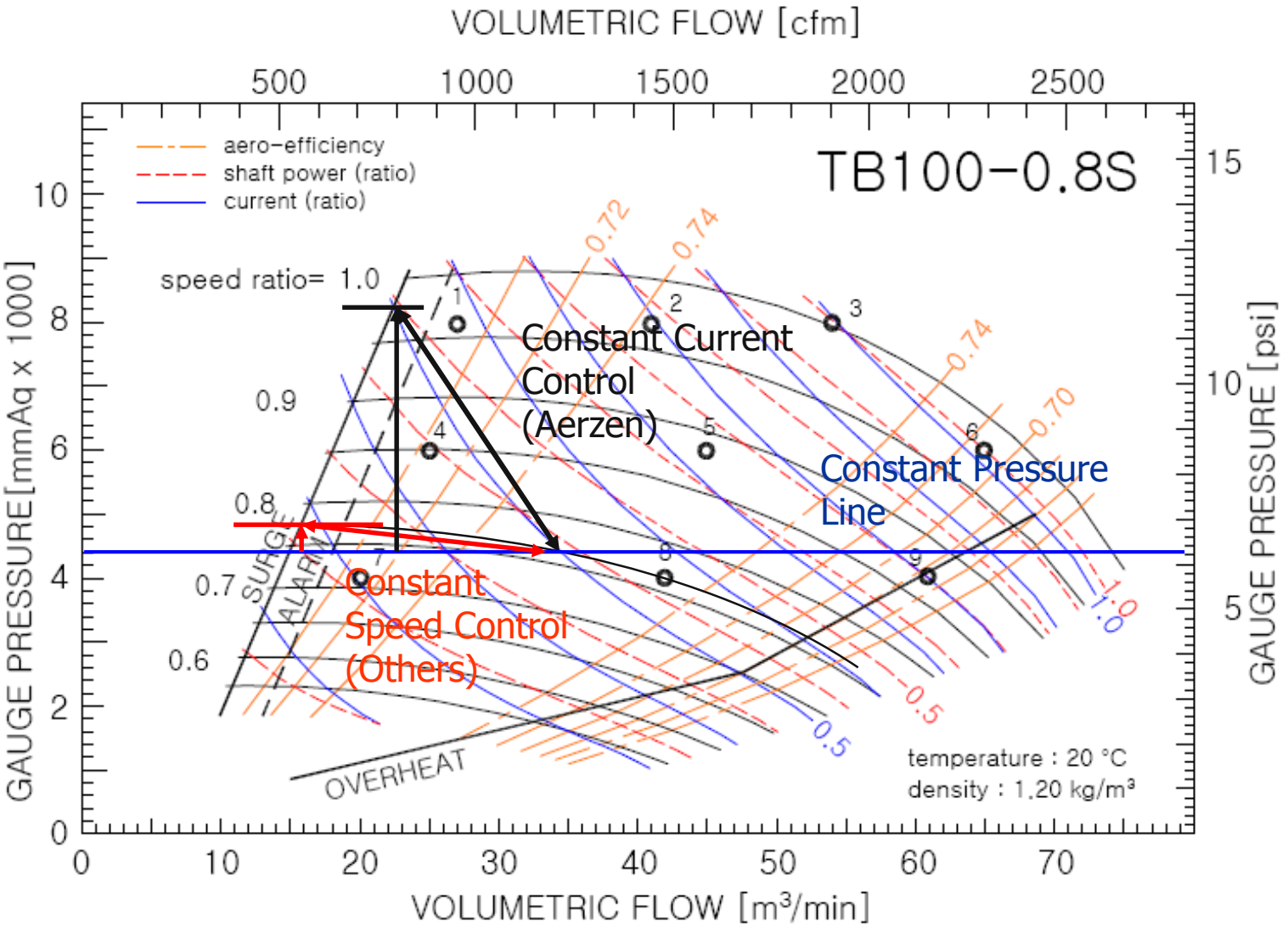
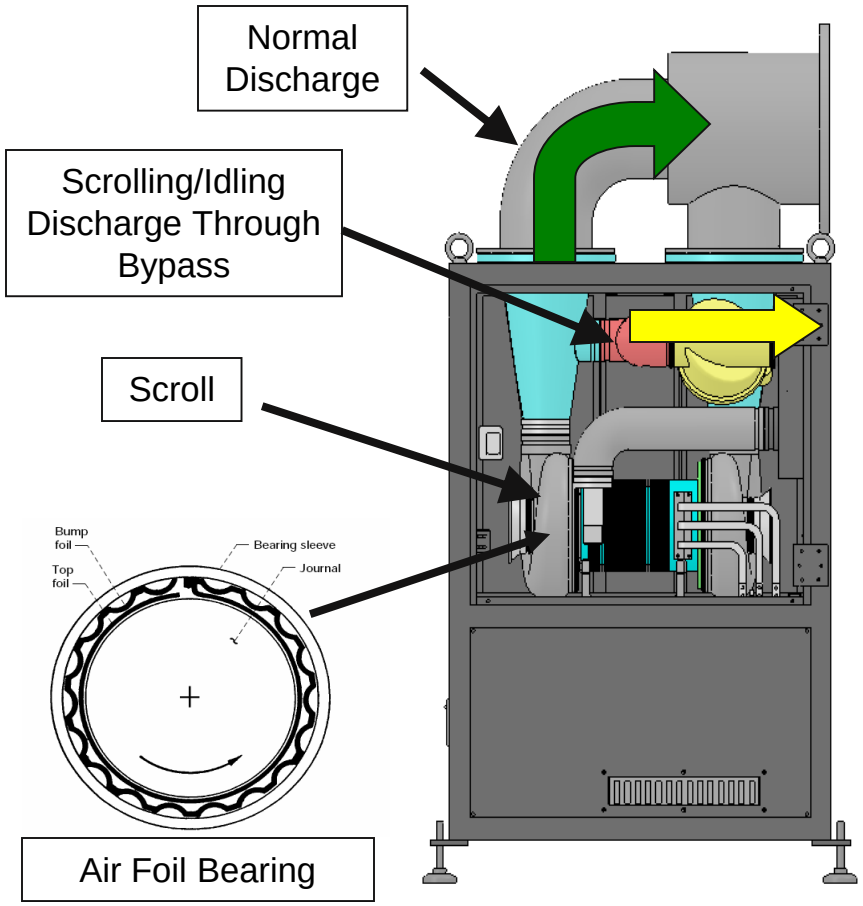
Performance Map



MANCE

Idling/Scrolling Function



- Bypass Valve Opens
- RPM Drops to ~8,000
  - Sufficient to maintain “loft” on Bearings
  - Minimal Power Draw (Avg 2%: 0 – 2 kW)
- Avoids Bearing Wear
- Avoids Start/Stop Cycles
- Useful in SBR/MBR Systems

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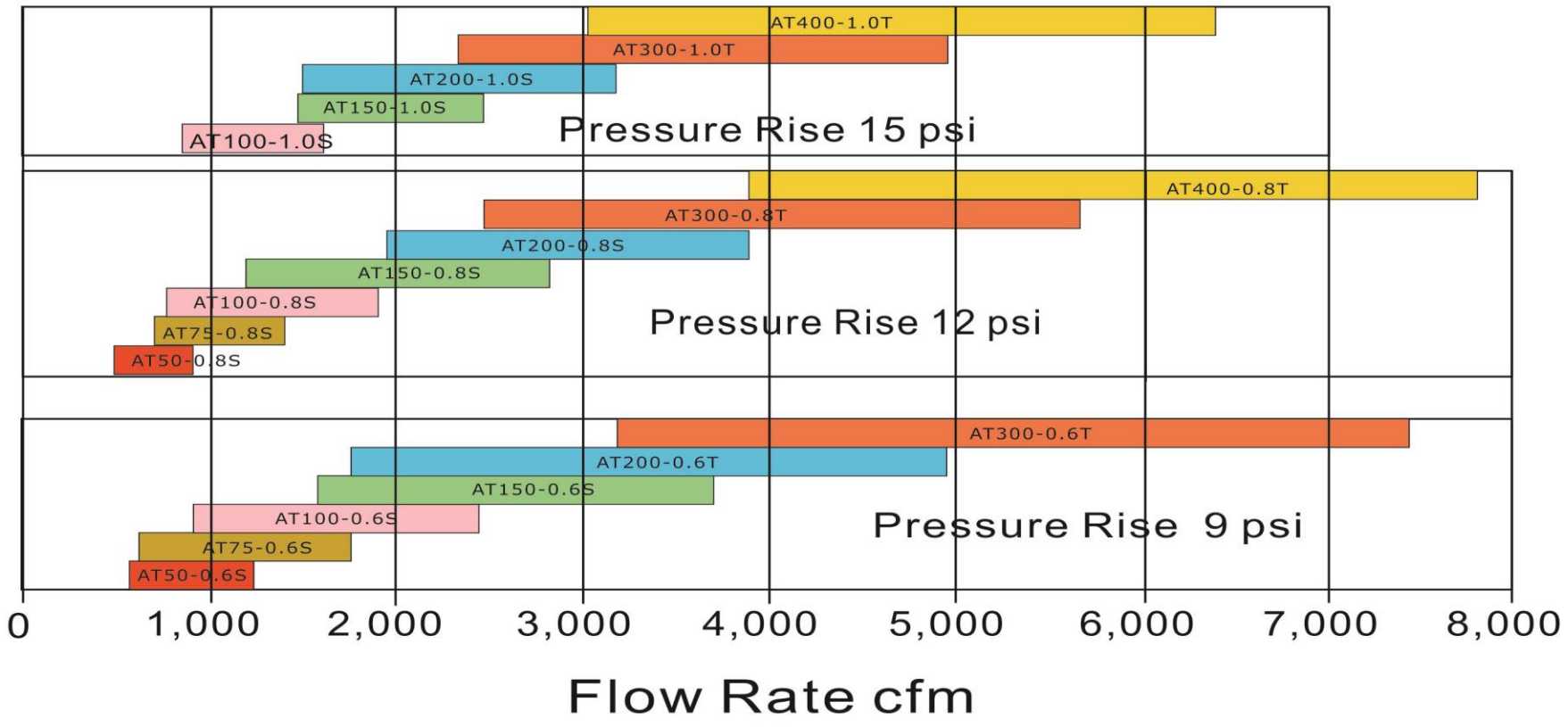
Aerzen Turbo TB/AT Series



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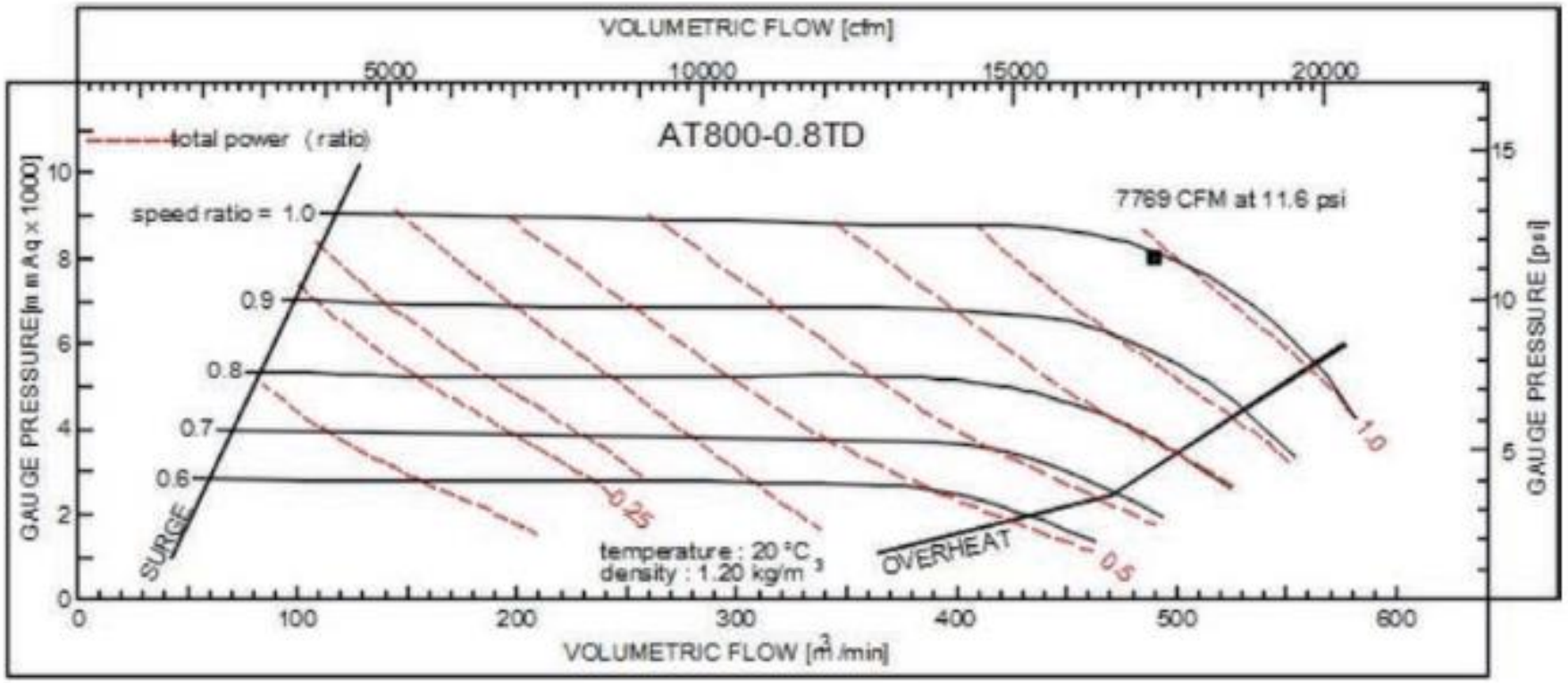
New Multi-Core Turbo!



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Which Technology to Chose?

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Proper Evaluation

- **Will Life Cycle Costs be Evaluated?**
  - Not always
    - Filter Air Scour (limited duty)
    - Smaller Sizes (Low HP)
    - Low Electrical Costs
  - Capital Costs may be the deciding factor
    - Standard PD Blowers

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Proper Evaluation

- **If Life Cycle Costs Will be Evaluated**
  - Conduct a Fair, Representative Evaluation (Aerzen Whitepaper)
    - Use Expected Operating Points
    - Not Design Point Only
  - Include ALL Package Losses
  - Compare with PD Blower, Turbo Blowers, Screw Compressors, & Hybrid Rotary Lobe Compressors

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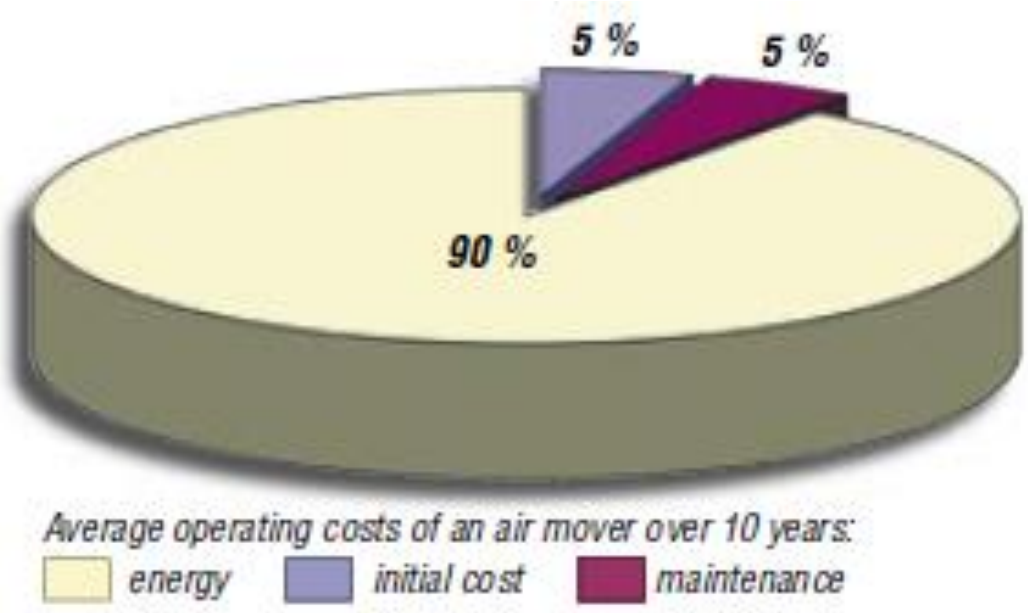
Life Cycle Costs

- **Energy Costs are the Most Significant Factor in Aeration Blower Evaluation.**
  - 60% of WWTP energy use is for Aeration
  - 80% - 90% of Life Cycle Cost is Energy



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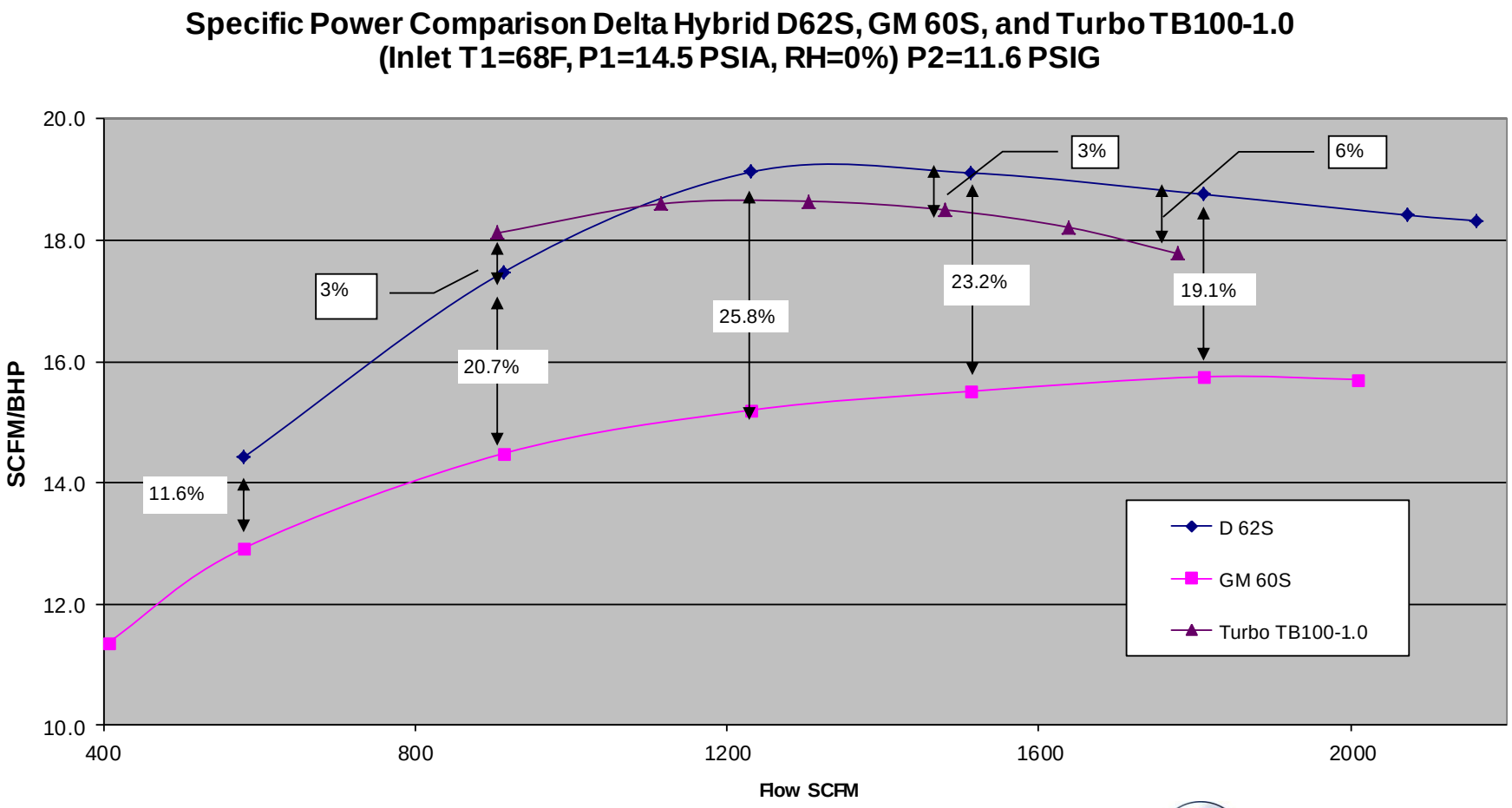
Performance Comparison



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Proper Evaluation

- **Aeration System Characteristics**
  1. Varying Water Depth (SBR/Digester)
  2. On/Off Cycling
  3. Higher Pressures
  4. Turndown Requirements

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Generation 5 Blowers

- Efficient 3 Lobe Blower
- Quiet Package (70-75 dBA)
- Easy Installation & Maintenance
- Side by Side, Indoor Outdoor

Optimal Uses:

- Capital Cost Primary Factor
- Low Electrical Costs
- Intermittent Use
- Large Turndown Requirement

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EXPECT PERFORMANCE

Delta Hybrid

- Same Packaging as Generation 5
- Superior Efficiency to Standard PD
- Similar Efficiency to Turbo
- Excellent Turndown (4:1)

Optimal Uses:

- Life Cycle Cost Primary Factor
- Flows <5,000 SCFM
- Varying Pressures
- Higher Pressures
- Large Turndown Requirement

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Turbo

- High Volume in a Compact Package
- Quiet Package, Easy Installation
- High Efficiency
- Complete Package (VFD, Control Panel)

Optimal Uses:

- Life Cycle Cost Primary Factor
- High Volumes at Low Pressure
- Flows >1,000 SCFM
- Limited Turndown Requirement (2:1)
- Relatively Stable Pressures

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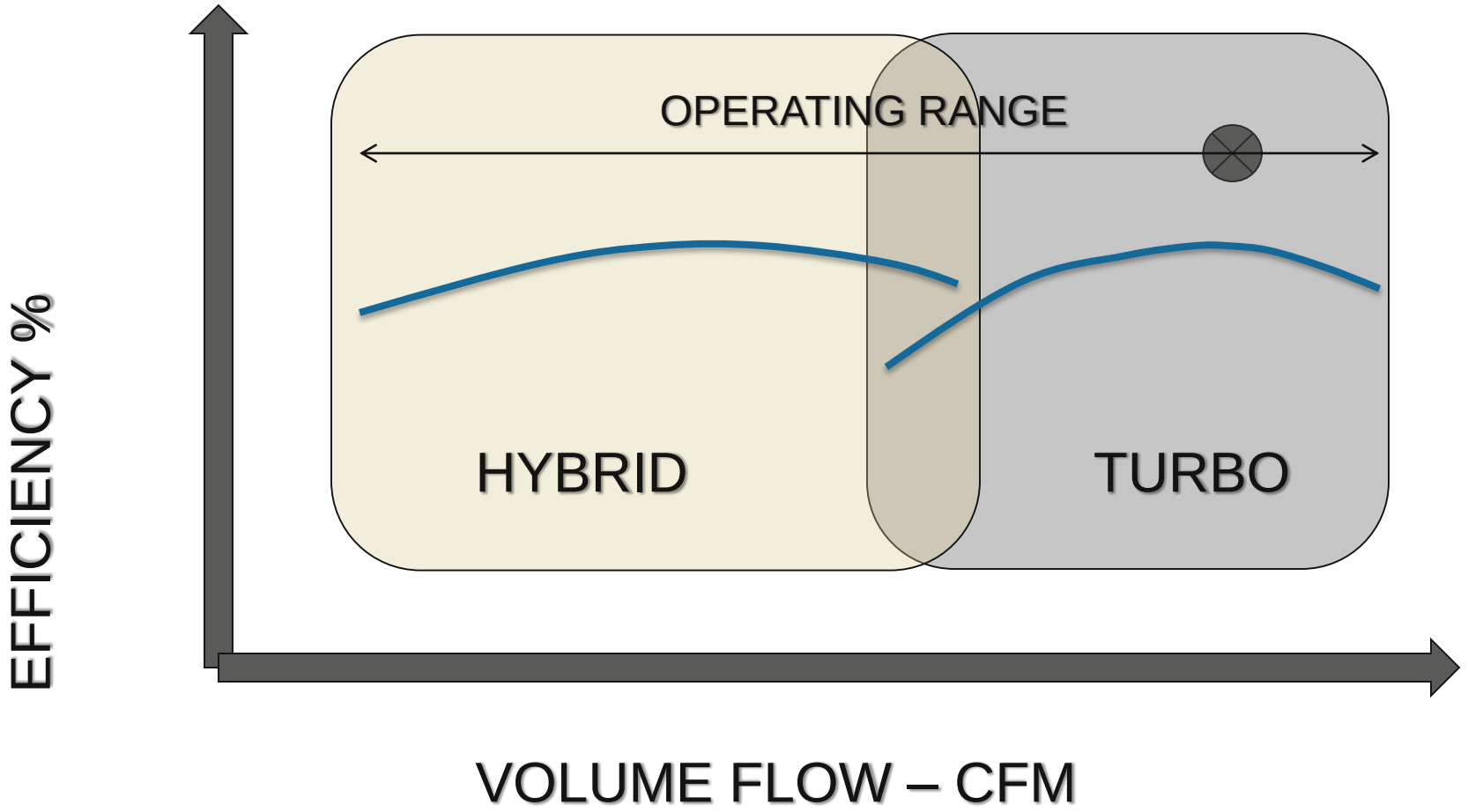
Multiple Technologies



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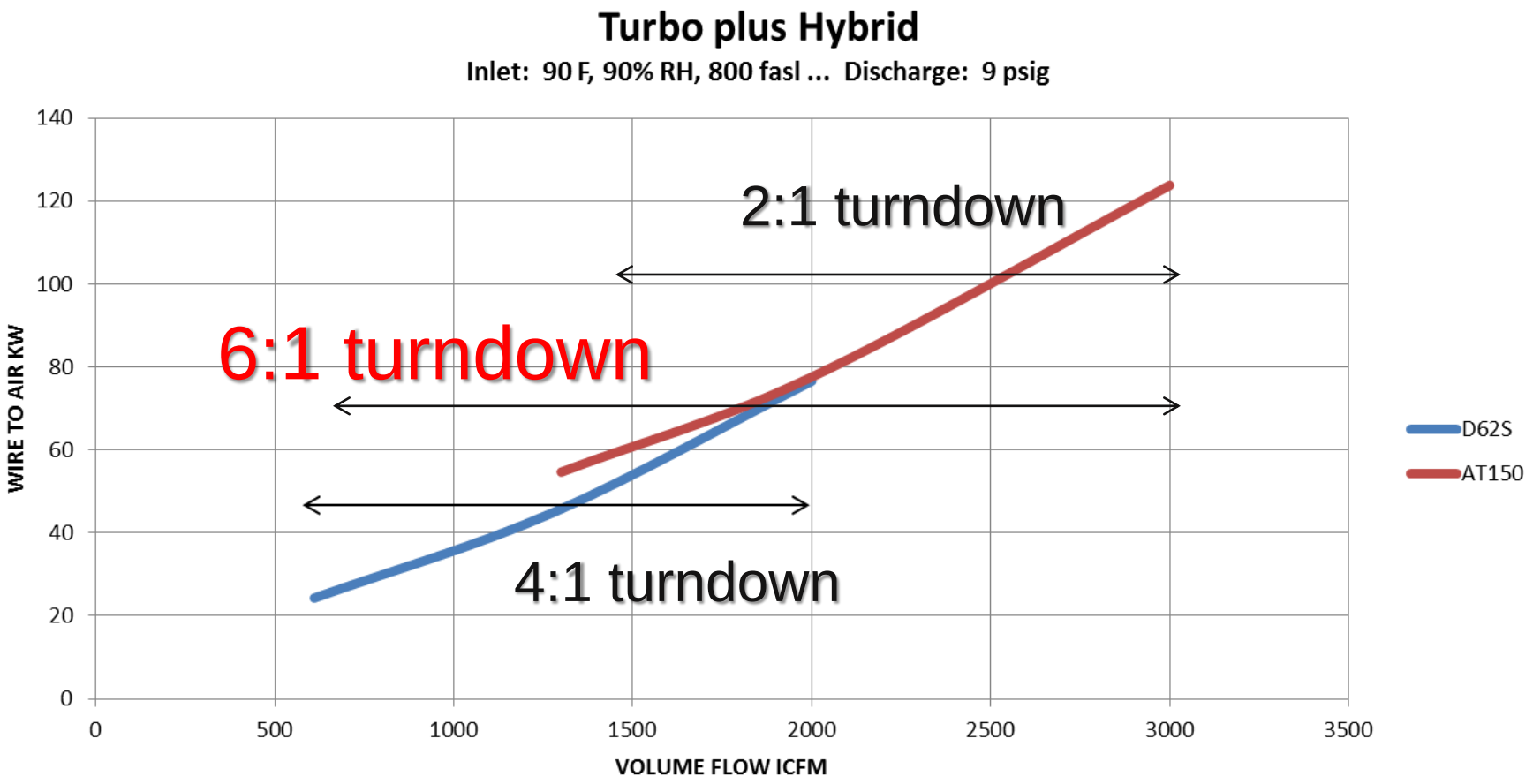
Multiple Technologies



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Thank You - Any questions?

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