ASME PTC 13: Efficient Blowers, Sustainable Systems

Tom Jenkins, P.E. and John Conover
Keynote Speakers

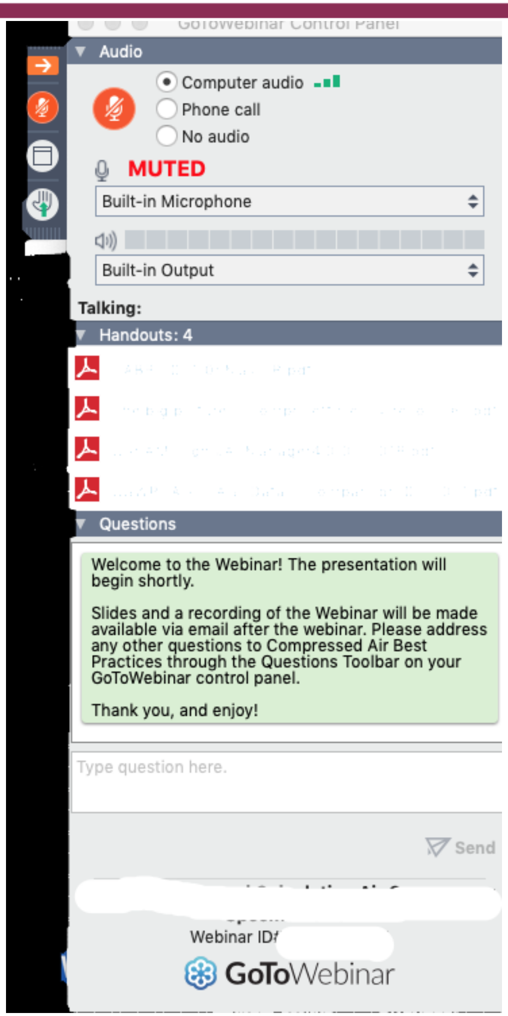
Sponsored by

ONTRA®

The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to attendees by within 2 days.

Q&A Format



- Panelists will answer your questions during the Q&A session at the end of the Webinar.
- Please post your questions in the Questions Window in your GoToWebinar interface.
- Direct all questions to Blower & Vacuum Best Practices® Magazine

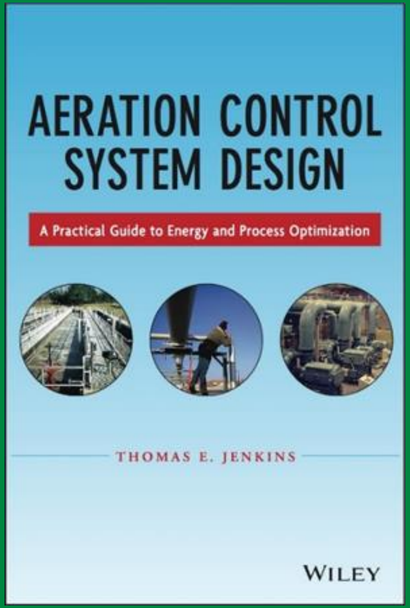
Sponsored by

ONTRA®

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

BEST PRACTICES EXPO & CONFERENCE CABPEXPO.COM COMPRESSED AIR / VACUUM / COOLING

Handouts



THOMAS E. JENKINS, P.E.

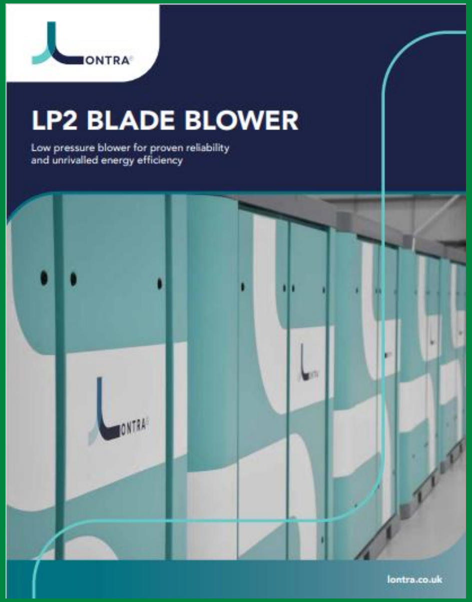
PRESIDENT AND FOUNDER OF JENTECH INC.

It is often difficult to bridge the gap between theory and practice. For a project to be successful, though, that is exactly what is required. Theoretical engineering analysis must be combined with "real world" considerations. There is no substitute for hands-on experience to anticipate problems and eliminate them in the design stage of a project.

As president of JenTech Inc., Tom Jenkins has made the combination of theory and real world experience the company's fundamental philosophy. He combines expert analysis and field experience into efficient and workable systems. Creative engineering and practical experience are used to develop solutions. Analysis validates the function and cost effectiveness. Consultation with operators verifies that the technology appropriately addresses their needs. Solutions are coordinated with manufacturers, contractors, and operators from concept to installation and commissioning.

Tom is enthusiastic about sharing his expertise and experience with other professionals. He has taught classes covering a variety of topics across the country. The venues have included wastewater operator conferences, universities, manufacturers, and consultant's offices.

JenTech has unique expertise in designing and implementing instrumentation, control, and energy conservation for aeration and blower systems. The technology developed by JenTech has been proven to optimize process performance while reducing energy consumption.



BLOWER COMPONENT FOCUS:
WEG ultra-premium efficiency permanent magnet motor

The design of Lontra's LP2 Blade Blower started from a clean sheet. Every component of the blower has been designed to be durable, reliable, and energy-efficient as part of the 'plug and play' package - this includes the motor. The LP2 Blade Blower is powered by a WEG WMagnet IE5 ultra-premium permanent magnet motor.

In this article, we take an in-depth look at Lontra's WEG IE5 permanent magnet motor, covering:

- Specification
- Features
- Why a custom-designed motor?
- Why a Permanent Magnet motor?
- Motor regulations for blowers with a variable speed drive (VSD)

lontra.co.uk

Disclaimer

CAGI CCASS Exam Offered at Best Practices EXPO!

COMPRESSED AIR SYSTEM SPECIALIST
CAGI
Compressed Air & Gas Institute
CERTIFIED

ONLY $275 (discounted from $450) plus receive a discount code for $275 off a conference/expo hall pass!

At the end of the webinar, we are having a fun contest for a chance to win a free full conference pass valued at $675!

EARLY BIRD RATES END OCTOBER 2nd

cabpexpo.com

CAGI CCASS Exam Schedule at the Best Practices 2023 EXPO & Conference

Monday, October 23, 2:00 pm

Tuesday, October 24, 2:00 pm

Wednesday, October 25, 8:30 am & 2:00 pm

BLOWER & VACUUM BEST PRACTICES
blowervacuumbestpractices.com

BEST PRACTICES
EXPO & CONFERENCE CABPEXPO.COM
COMPRESSED AIR / VACUUM / COOLING

ASME PTC 13: Efficient Blowers, Sustainable Systems

Introduction

Blower & Vacuum Best Practices Magazine

Sponsored by

ONTRA®

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

BEST PRACTICES EXPO & CONFERENCE CABPEXPO.COM
COMPRESSED AIR / VACUUM / COOLING

About the Speakers

Tom Jenkins, P.E.
JenTech Inc.

John Conover
Air Clean USA

Sponsored by

ONTRA®

Note:

This presentation emphasize wastewater treatment applications. However, the concepts are applicable to a broad range of blower applications.

Topics

Matching Process Demand

- Automating Controls
- Most Open Valve (MOV)
- Providing Range and Turndown
- Sizing for Channel Aeration and Aerobic Digestion

Optimizing Blower Discharge Conditions

- Reduce the Number of Tanks In Service
- Air Line and Valve Sizing
- Preventive Maintenance

Its An Aeration SYSTEM

- There is a lot of attention paid in design to getting efficient blowers
- Testing per ASME PTC 13 will verify blower performance
- That’s important, but:
  - Too much air at high efficiency still wastes power
  - Poor piping design or improper operation increases power demand without improving process performance
  - Failure to maintain systems will degrade energy AND process performance
  - Life cycle cost is discussed in PTC 13 Appendix F

- A SYSTEM APPROACH IS REQUIRED

Automatic Control

Dissolved Oxygen (DO) control provides good ROI

- Much of the hardware is usually already installed
- Savings of 25% to 35% are common

Enhances process performance

- Verifies adequate air is being supplied
- Enhances MLE process

Multiple algorithms are used

- PID (Proportional-Integral-Derivative)
- Floating Control

DO Control Refinements

Zone control

Taper aeration level to match demand

Direct flow control

Constant pressure control can waste power

(≈ 10% savings)

Ammonia Based Control

Adjust DO setpoints to optimize nitrification

2.0 mg/l may not be optimum

Most-Open-Valve

Operate at the minimum pressure needed to provide required airflow

(≈ 10% savings)

Most-Open-Valve

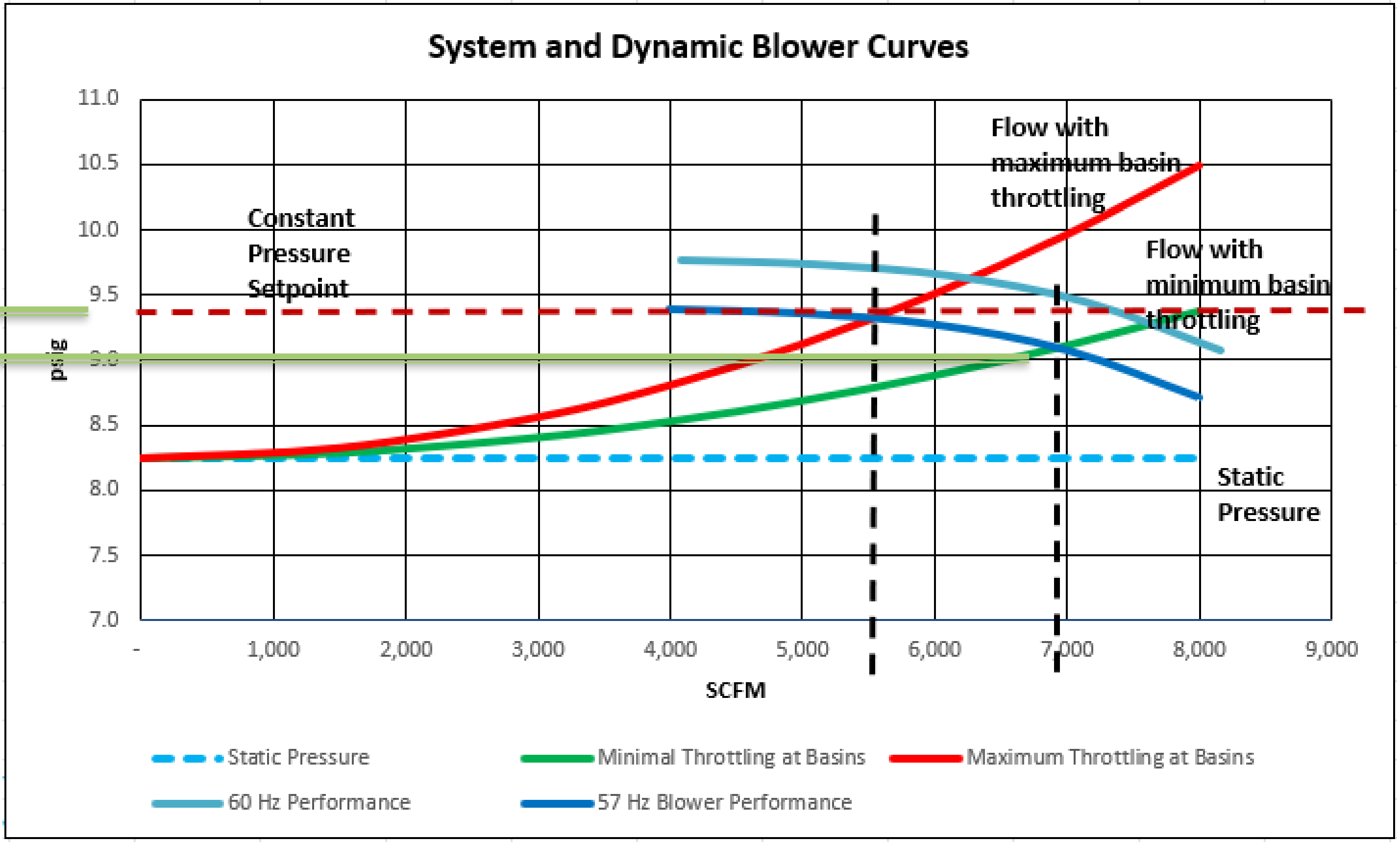
Most-Open-Valve (MOV) is a method for minimizing the throttling of the control valves at the aeration basins

It will always maintain one valve at maximum allowable open position

- Used with blower pressure control it manipulates the pressure setpoint
- Used with direct flow control it manipulates the valve position directly

Most-Open-Valve

Wasted Power



Providing Blower Turndown

- The process demand for airflow and pressure rarely matches design point
  - WRRFs are designed for worst case loads 20 years in the future
  - Diurnal flows and loads vary 2:1 (See PTC 13 Appendix F for typical duty cycles.)
  - Industrial loads cause dramatic swings in demand
  - Internal sidestreams can create sudden and severe load swings

$$\text{Turndown\%} = \frac{\text{MaxFlow} - \text{MinFlow}}{\text{MaxFlow}} \cdot 100$$

- Turndown ratio of 80% (5:1) is minimum recommended for the blower system
- PTC 13 Testing can verify individual blower turndown

Providing Blower Turndown

Individual blower turndown varies

- 50% turndown is common
- Varies with blower model, control method, and selection
- PD turndown usually limited by thermal concerns
- Centrifugal turndown usually limited by surge

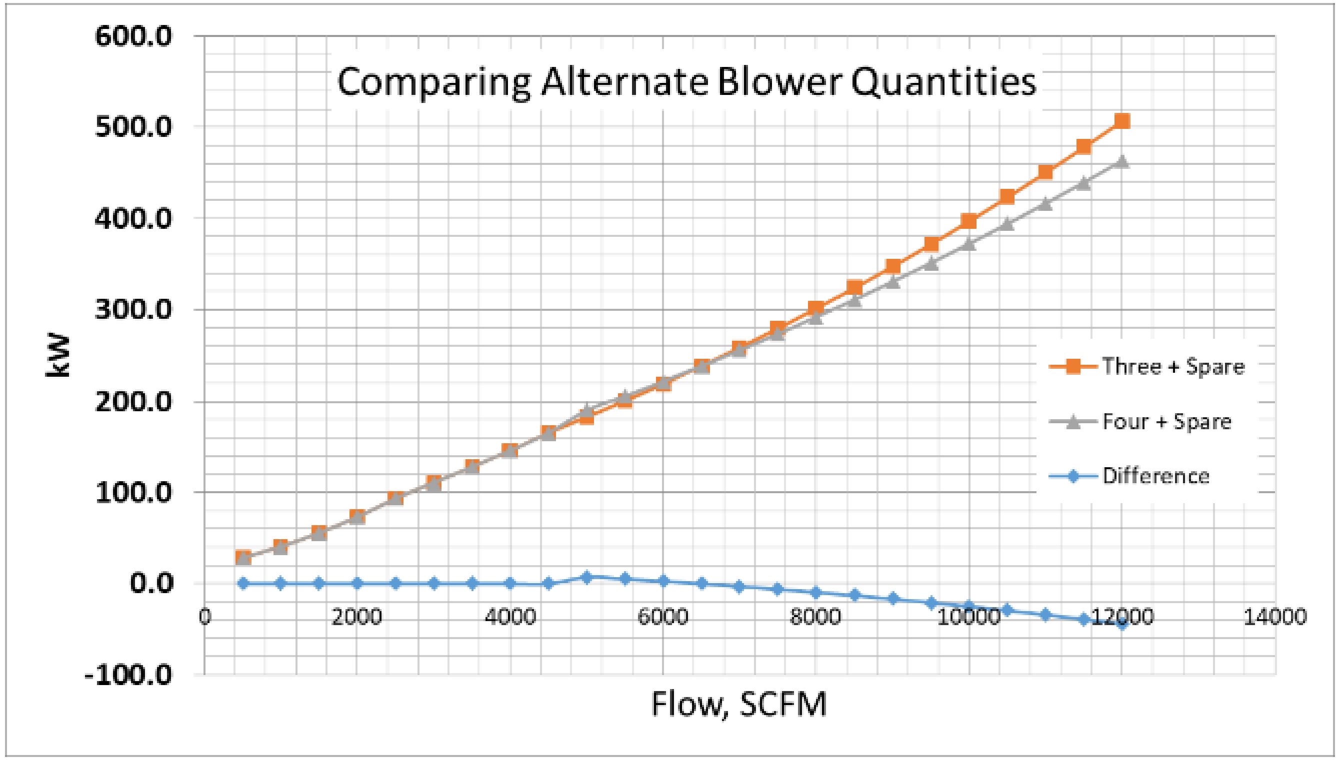
Specify min and max operating points, verify per PTC 13

System turndown depends on sizing

- WRRFs require standby blowers
- Two blowers @ 100% design flow is not acceptable
- Three blowers @ 50% design flow is marginal (but common)
- Four blowers @ 33% design flow is good
- Two blowers @ 50% design flow and two blowers at 25% design flow is my preference

Providing Blower Turndown

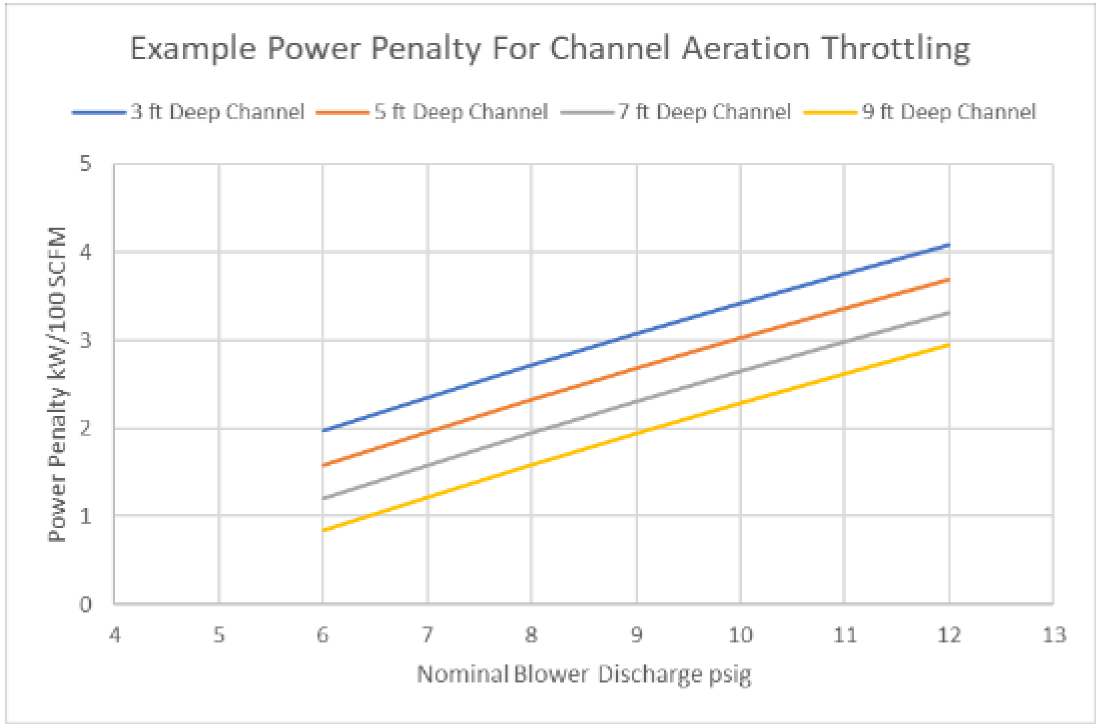
- Power savings can be achieved by optimizing the number of blowers installed
- Power savings can be achieved by optimizing which blowers are run



Sizing Blowers for Channel Aeration and Aerobic Digestion

- A common practice is tapping air for channels and digesters from the aeration blower system
- Channel depth is often much less than aeration basin depth
- Aerobic digesters typically have variable depth
- The result is wasted power from throttling

- The solution:
  - Use small dedicated blowers for channels
  - Use dedicated blowers for aerobic digesters
- Capital expense is a small part of total life cycle cost



Reduce the Number of Tanks in Service

Most plants operate at loads much lower than design

Tanks are underloaded

↓

Air flow is at minimum allowable

Min airflow per diffuser	Minimum mixing air flow

↓

Dissolved Oxygen is very high for all or some of the day

Power is wasted	Not all aeration tanks are needed

↓

Tanks can be taken out of service for long periods

Reduce the Number of Tanks in Service

Operator concerns

- Floating tanks
- UV damage to diffusers and plastic piping
- Ice damage to diffusers and plastic pipe
- Algae growth
- Water in headers, diffuser grid purge system

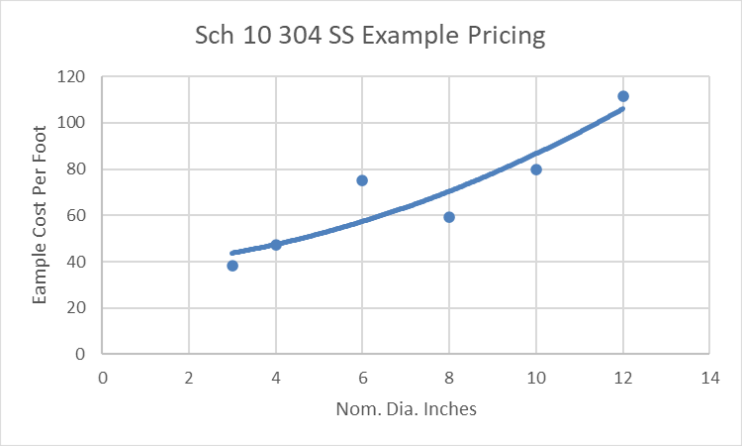
Preventive measures

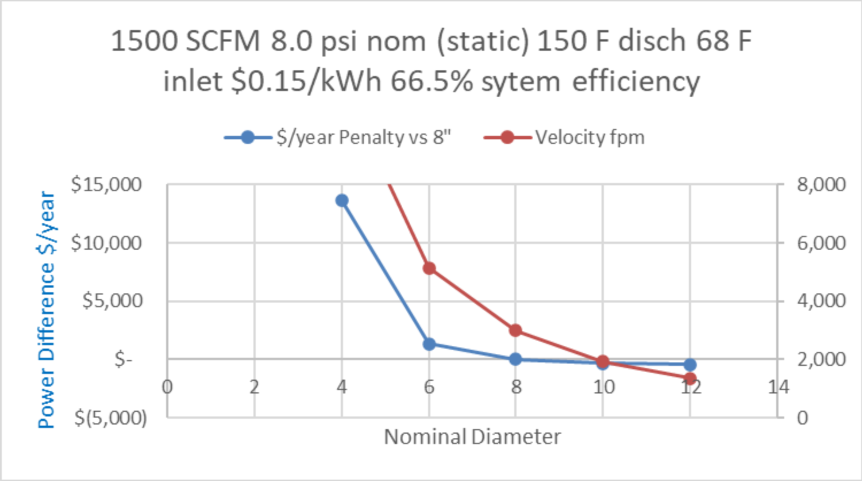
- Keep 2-3 ft. of water over diffusers
- Bleed air into system at low rates (especially in cold weather)
- Use stainless steel drop pipes
- Let algae grow (clean diffusers before returning tank to service)

Air Line and Valve Sizing

- Piping should be sized to minimize cost, friction losses, and noise
- Oversizing has little benefit
  - Cost of pipe is proportional to nominal diameter
  - Pressure drop is inversely proportional to diameter **5**
- Fittings and valves usually create more pressure drop than the pipe
- Oversizing valves makes control more difficult during operation

$$\Delta p = 0.07 \cdot \frac{Q^{1.85}}{d^5 \cdot p_m} \cdot \frac{T}{528} \cdot \frac{L}{100}$$





Air Line and Valve Sizing

- Preferred velocities vary with pipe diameter:

Typical Distribution Piping Air Velocities (At Actual Temperature and Pressure)	
Nominal Pipe Diameter	Design Velocity, feet per minute
1" to 3"	1,200 to 1,800
4" to 10"	1,800 to 3,000
12" to 24"	2,700 to 4,000
30" to 60"	3,800 to 6,500

Preventive Maintenance

- Good preventive maintenance is essential to meet the process requirements
- Good preventive maintenance minimizes energy use
  - Filter changes when required
    - Based on time is OK
    - Based on filter Δp is better
  - Proper lubrication of bearings
  - Proper tuning of control loops
    - Minimize pressure settings on pressure-based systems
    - Minimize hunting
    - Minimize DO setpoints

Summary

Optimization requires a system approach

Matching process demand optimizes energy

Design of discharge conditions and proper maintenance are important

Submit Questions and Comments

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

BEST PRACTICES EXPO & CONFERENCE CABPEXPO.COM
COMPRESSED AIR / VACUUM / COOLING

About the Speaker

Clive Hudson
Lontra

- Engineering Director, Lontra
- Lead Lontra's Engineering team to develop the award-winning Blade Compressor® technology
- Extensive use and understanding of engineering methods and their applications

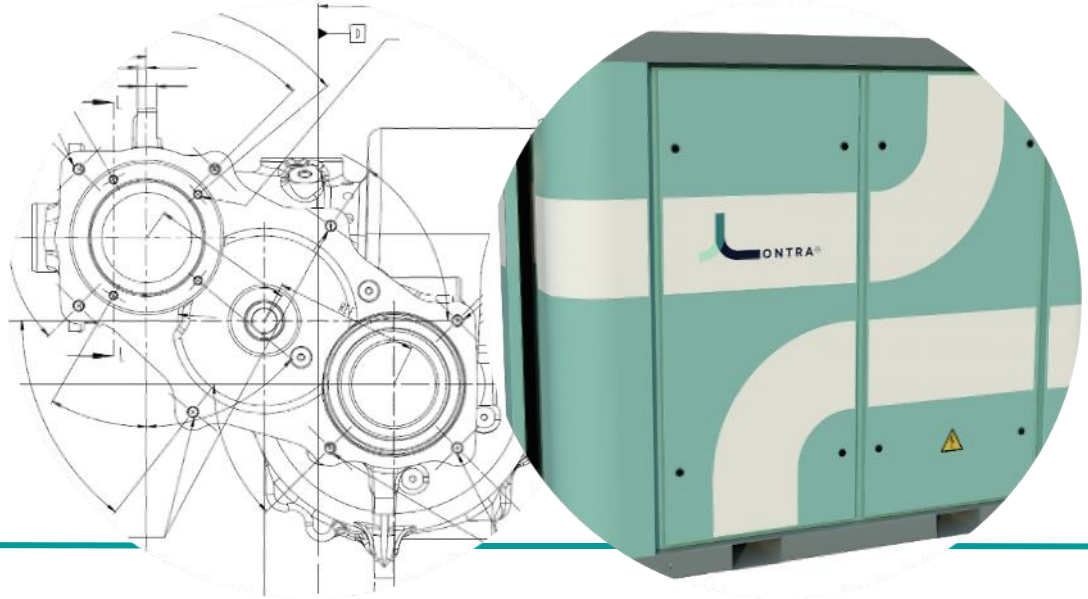
Sponsored by

LONTRA®

BLOWER & VACUUM BEST PRACTICES

THINKING DIFFERENTLY ABOUT ENGINEERING

LONTRA®



Blower Selection for Best Efficiency

Clive Hudson

Engineering Director, Lontra

Contents

- Understanding the need
- Targeting lowest cost
- Blower features
- Controlling the blower
- Introduction to the Blade Blower

Understanding the need

- Flow and pressure at point(s) of delivery
- Variation in demand
  - Daily
  - Seasonal
  - Future intent
- Flow and pressure at the blower outlet
- Potential errors in estimating demand
- Redundancy

QUESTIONS TO ASK

1. What does the process really need?
2. Am I guessing, or do I know for sure?

   Do I need more detail?
3. What's the impact if a blower goes down?

Cost targets

- What cost factors are most important
  - Capital cost
    - Cost of equipment
    - Cost of installation
  - Total cost of ownership
    - Capital cost, energy cost, maintenance costs
    - Expected life
  - Cost of downtime
    - In the event of a breakdown
    - During routine maintenance
    - Reputational cost

CONSIDERATIONS

- There are several ways of getting the job done, so how do I decide?

- Try to be practical and put a value on everything – don't be swayed by 'savings' in the wrong area.

- In some cases, cost is not the decisive factor – for example, on offshore oil rigs, it's all about space – but most requirements (e.g. noise, breakdowns) can be costed.

Blower features:
Minimum needs

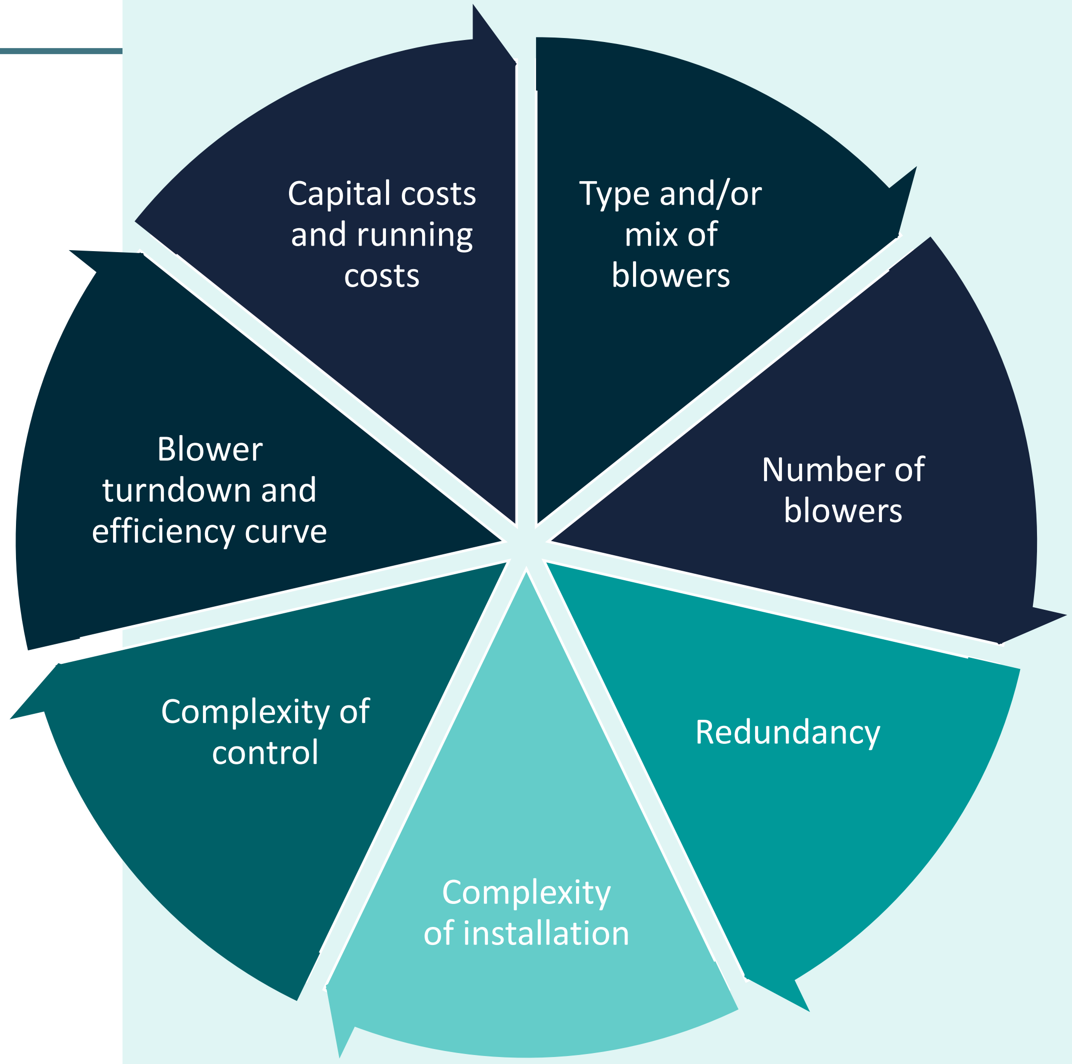
- Match the peak demand
  - Based on best estimate without contingency
  - Options if demand is greater than expected
- Environmental requirements
  - Specifications to function, for example:
    - Maximum and minimum temperature
    - Altitude
    - Humidity
    - Air contamination
    - Accessibility for service
- A level of redundancy

PRACTICAL CONSIDERATIONS

- The first requirement is to deliver enough air!
- Should I play safe and add 10% capacity?
- What happens in 10 years?
- Over-capability is wasted $$
- How do I estimate cost?
- Will it pay back later?

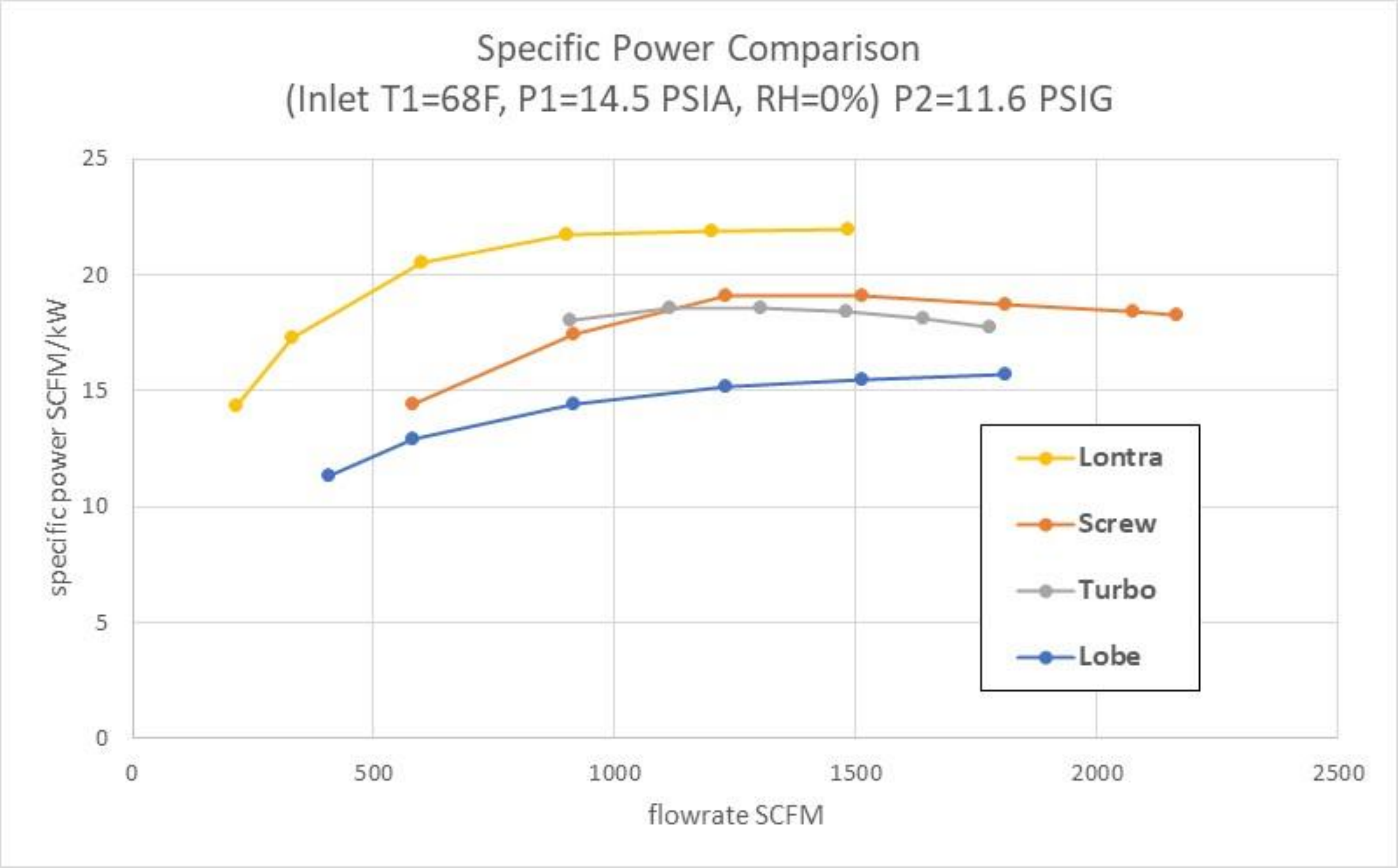
Blower features:
Decisions

- Many ways to meet the minimum needs
- Optimum solution depends on the application
- Start with expert guidelines:
  - Four blowers @ 33% design flow is good
  - Two blowers @ 50% design flow and two blowers at 25% design flow is my preference



Blower features:
Efficiency

- Ensure comparison is fair
- Some blowers are better than others
- Turbos can be good in large sizes

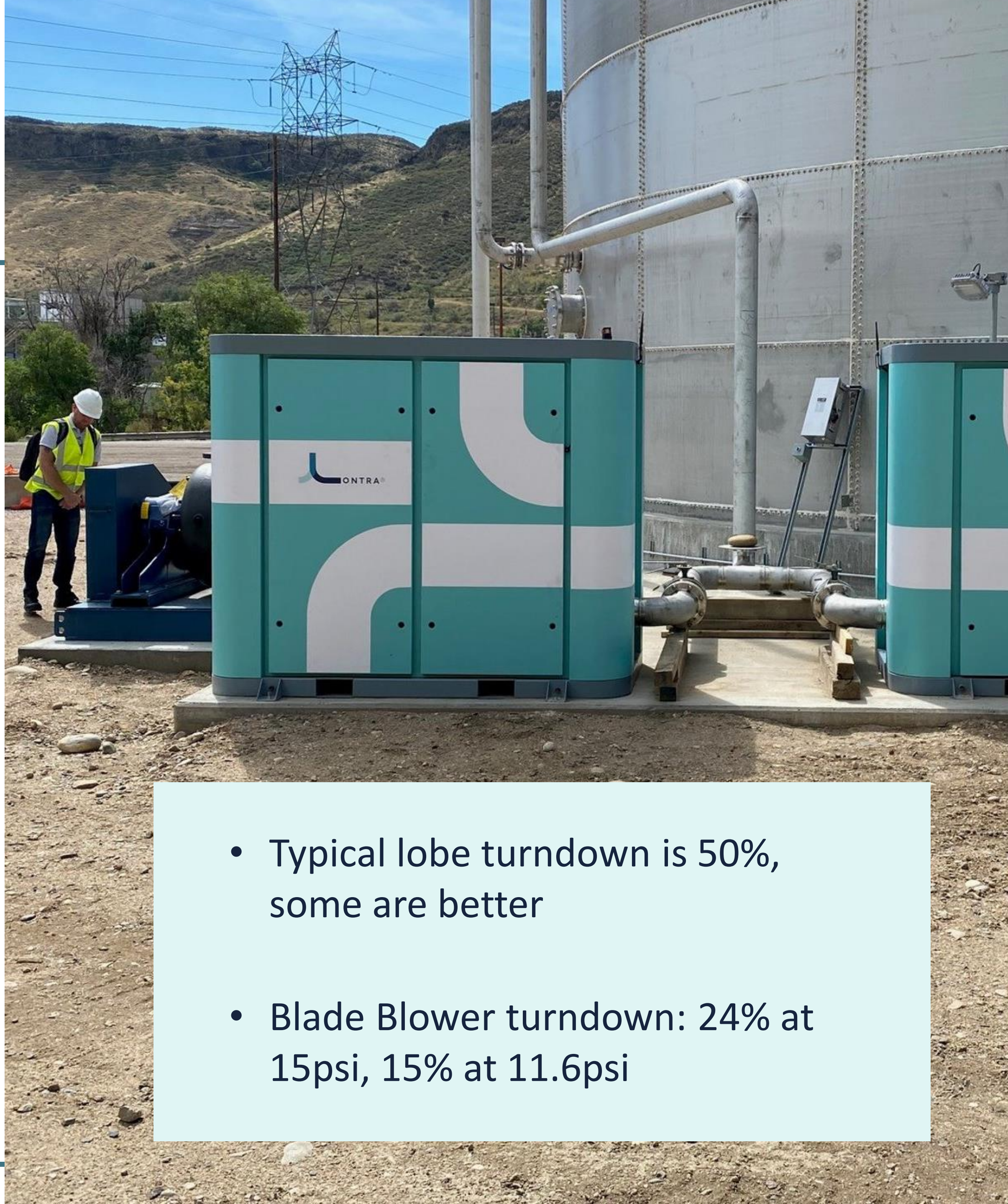


Screw, turbo, and lobe data from a 2014 whitepaper by a premium blower manufacturer

ONTRA®

Blower features:
Turndown

- Delivering no more air than is required saves energy
  - Despite blower efficiency falling at reduced speed
- Delivering at the lowest possible pressure saves energy
  - Don’t use constant pressure as blower speed control
- Estimating value of turndown needs good information on demand variation
- PD blowers are much better than turbo for turndown, but below a certain speed they recirculate excessively and overheat, particularly at higher pressures

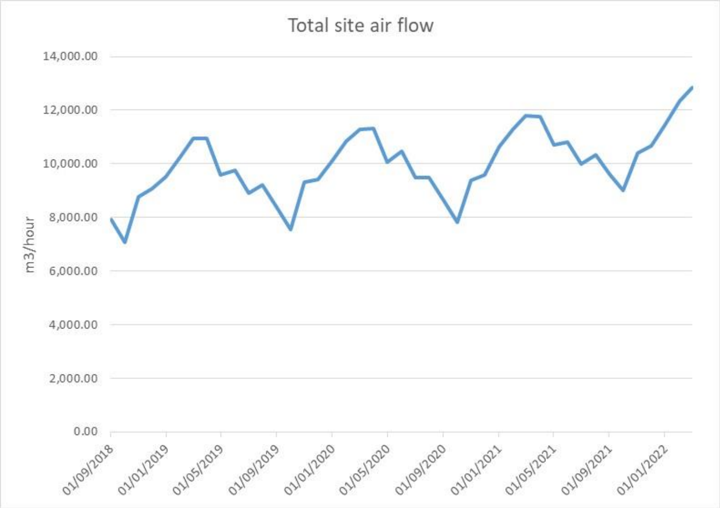


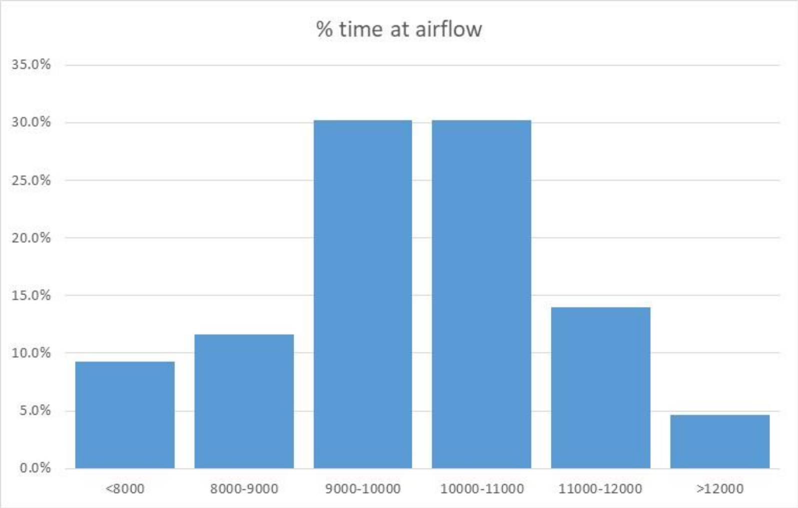
- Typical lobe turndown is 50%, some are better
- Blade Blower turndown: 24% at 15psi, 15% at 11.6psi

ONTRA®

Analysis of options

- Try a few scenarios
- Look for sensitivity to changes
- A few hours to gain an understanding can save problems and $1000s



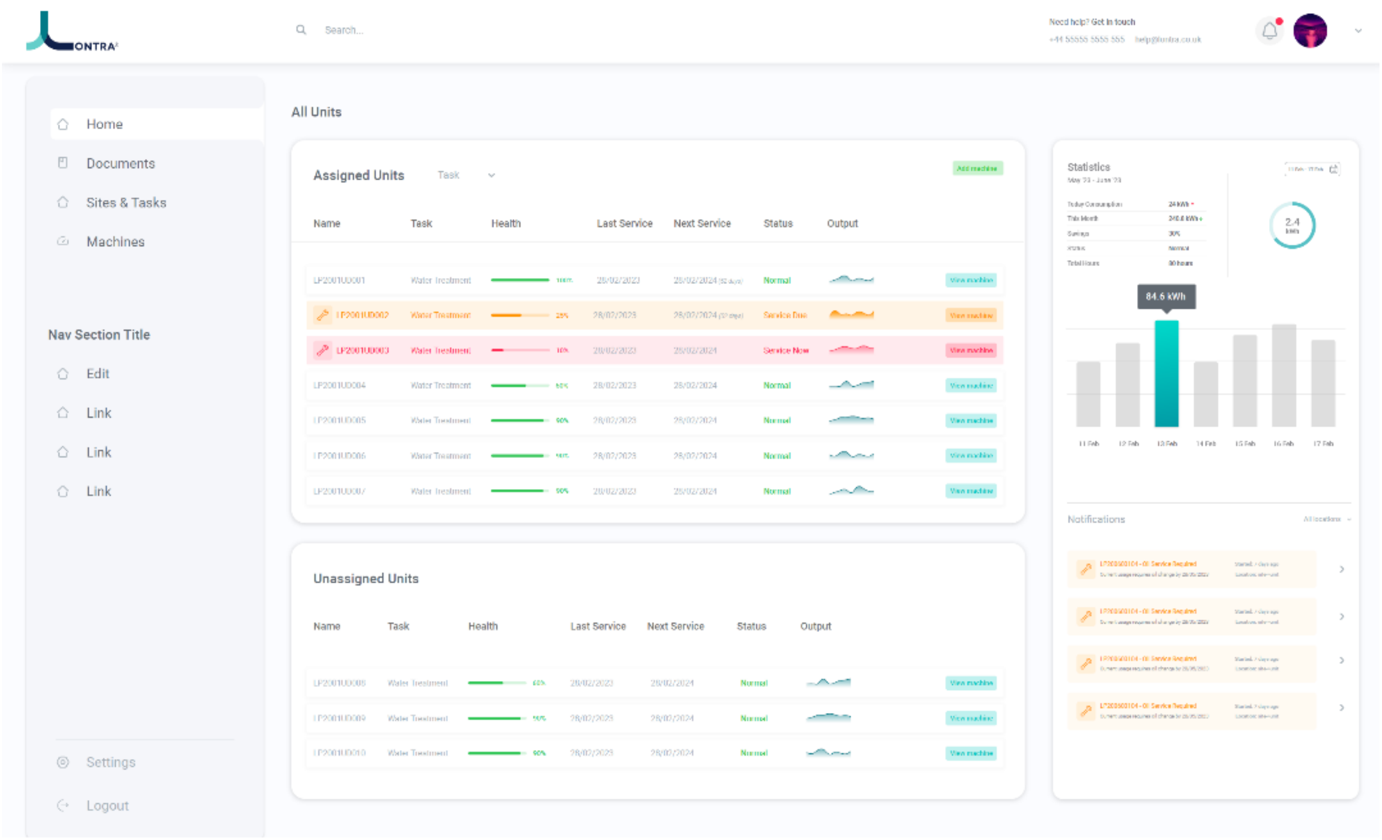


				Option 1	**Max flowrate**	**% of max required flow**	**Capital cost**	**Electricity cost**
				Blower 1	4000	25.9%		
Max air flow in sample	m3/hour	12,853		Blower 2	4000	25.9%		
Projected max air flow	m3/hour	15424		Blower 3	4000	25.9%		
				Blower 4	4000	25.9%		
Air flow range	**samples**	**% time in this range**	**% of projected max flow**	**Number of blowers running at full speed**	**% of required flow from full speed blowers**	**One blower at speed**	**kW used at this condition**	**kWh at this condition annually**
<8000	4	9.3%	48.6%	1	53.3%	87.5%	379.3	299,905
8000-9000	5	11.6%	55.1%	2	94.1%	12.5%	279.1	275,836
9000-10000	13	30.2%	61.6%	2	84.2%	37.5%	322.1	827,651
10000-11000	13	30.2%	68.1%	2	76.2%	62.5%	370.0	950,737
11000-12000	6	14.0%	74.6%	2	69.6%	87.5%	421.5	499,912
>12000	2	4.7%	81.0%	3	96.0%	12.5%	284.0	112,269
							Total kWh	**2,966,311**

ONTRA®

Controlling the blowers

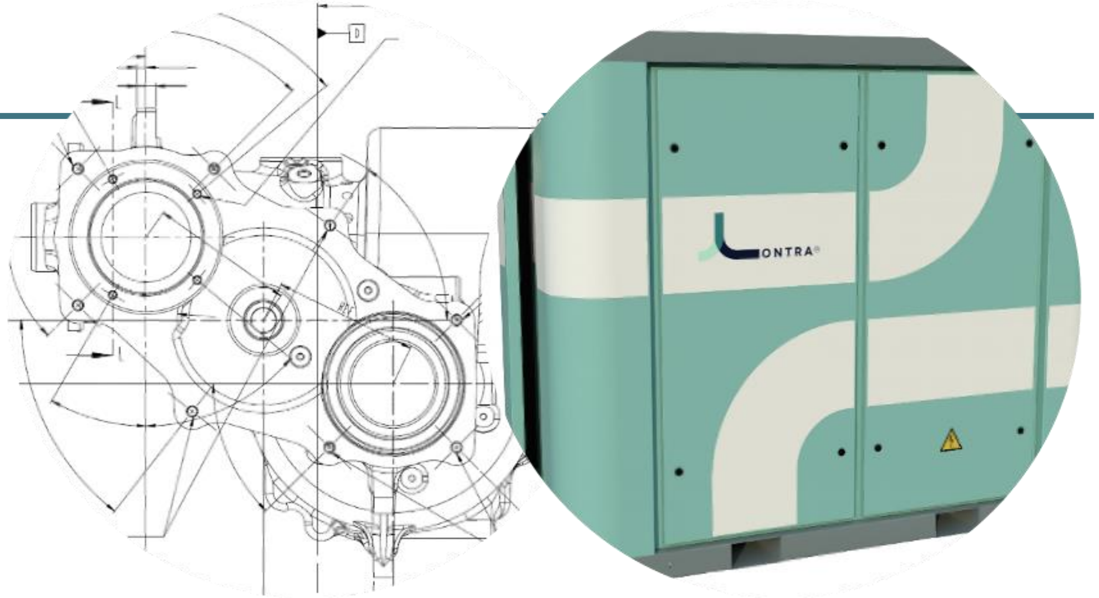
- Blowers are part of a system
- Blower cycling
  - Switching on and off wastes energy
  - Switching in an additional blower can affect other blowers
    - Increase in pressure
    - Possible surge in dynamic blowers
- Identify in advance what control methods will work best
- Good reporting enables better control



Introduction to the Blade Blower

- PD blower, as are lobe and screw, easy to use
- Has internal compression, like a screw, with low compression losses
- Has inherently good sealing, enabling
  - Low wasted air
  - Low speed, reducing parasitic friction and improving life
- Only one of the two rotating elements drives the air
  - Very low 'pinching' losses
  - Almost zero geartrain losses
- Packaged in a premium acoustic enclosure complete with VFD
- State-of-the-art controls with fintech-level security

Thank you



Any questions?

clive.hudson@lontra.co.uk

Lontra.co.uk

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2023 EXPO & Conference!! This is a $675 value! This contest is open to factory personnel, compressed air distributors, utility incentive programs and engineering firms. Exhibiting and sponsor companies are not qualified. Winners will be randomly selected from those who submitted a correct answer and notified tomorrow via email.

Please submit your answer in the upcoming poll

What is the minimum recommended turndown ratio for a blower system?

- **A** — 80%
- **B** — 90%
- **C** — 100%

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

*By entering you are giving permission to announce your name if you are a winner

BEST PRACTICES EXPO & CONFERENCE CABPEXPO.COM
COMPRESSED AIR / VACUUM / COOLING

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2023 EXPO & Conference!! This is a $675 value! This contest is open to factory personnel, compressed air distributors, utility incentive programs and engineering firms. Exhibiting and sponsor companies are not qualified. Winners will be randomly selected from those who submitted a correct answer and notified tomorrow via email.

Please submit your answer in the upcoming poll

What is the minimum recommended turndown ratio for a blower system?

- A ✓ • 80%
- B • 90%
- C • 100%

BLOWER & VACUUM BEST PRACTICES blowervacuumbestpractices.com

BEST PRACTICES EXPO & CONFERENCE CABPEXPO.COM COMPRESSED AIR / VACUUM / COOLING

*By entering you are giving permission to announce your name if you are a winner

ASME PTC 13: Efficient Blowers, Sustainable Systems

Q&A

Please submit any questions through the Question Window on your GoToWebinar interface, directing them to Blower & Vacuum Best Practices Magazine. Our panelists will do their best to address your questions and will follow up with you on anything that goes unanswered during this session.

Thank you for attending!

Sponsored by

ONTRA®

Thank you for attending!

The recording and slides of this webinar will be made available to attendees via email later today.

PDH Certificates will be e-mailed to Attendees by within 2 days

September 2023 Webinar

Information Required to Specify an Air Compressor

Loran Circle
Consultant
Keynote Speaker

Sponsored by VAISALA

Thursday, September 21, 2023– 2:00 PM EST
Register for free at
www.airbestpractices.com/webinars