Engineering Rooms for Aeration Blowers

Tom Jenkins, P.E.
Keynote Speaker

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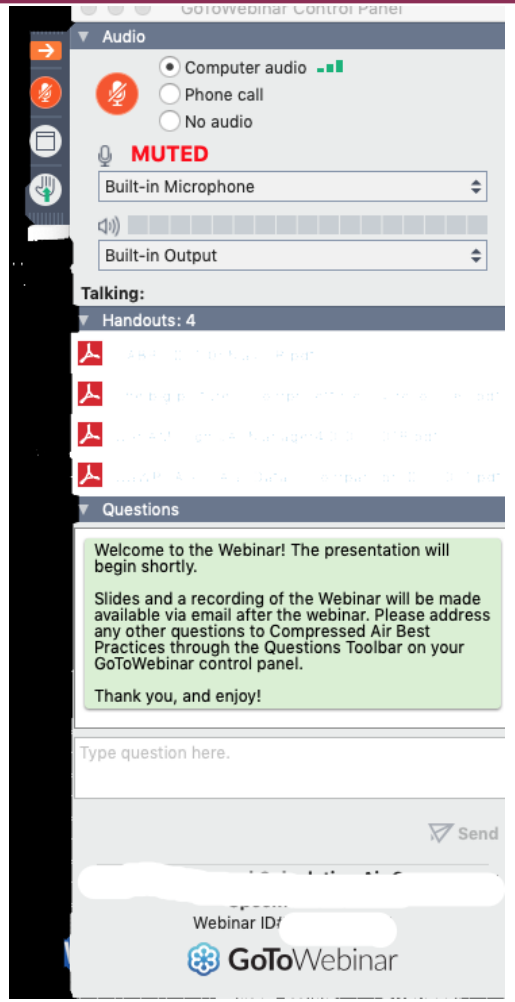
Q&A Format



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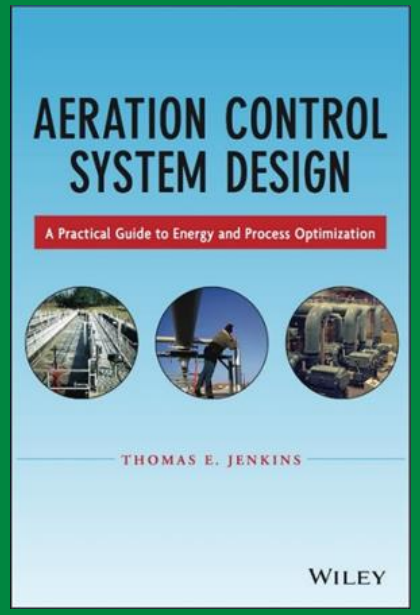

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All materials presented are educational. Each system is unique and must be evaluated on its own merits.

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Engineering Rooms for Aeration Blowers

Introduction

Blower & Vacuum Best Practices Magazine

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About the Speaker

Tom Jenkins, P.E.
JenTech Inc.

- President of JenTech Inc.
- Over 30 years of experience with aeration blowers and blower controls

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APG

Neuros

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Topics

- General Arrangement
- Heat Dissipation
- Foundations and Cranes
- Noise
- Piping
- Electrical Systems

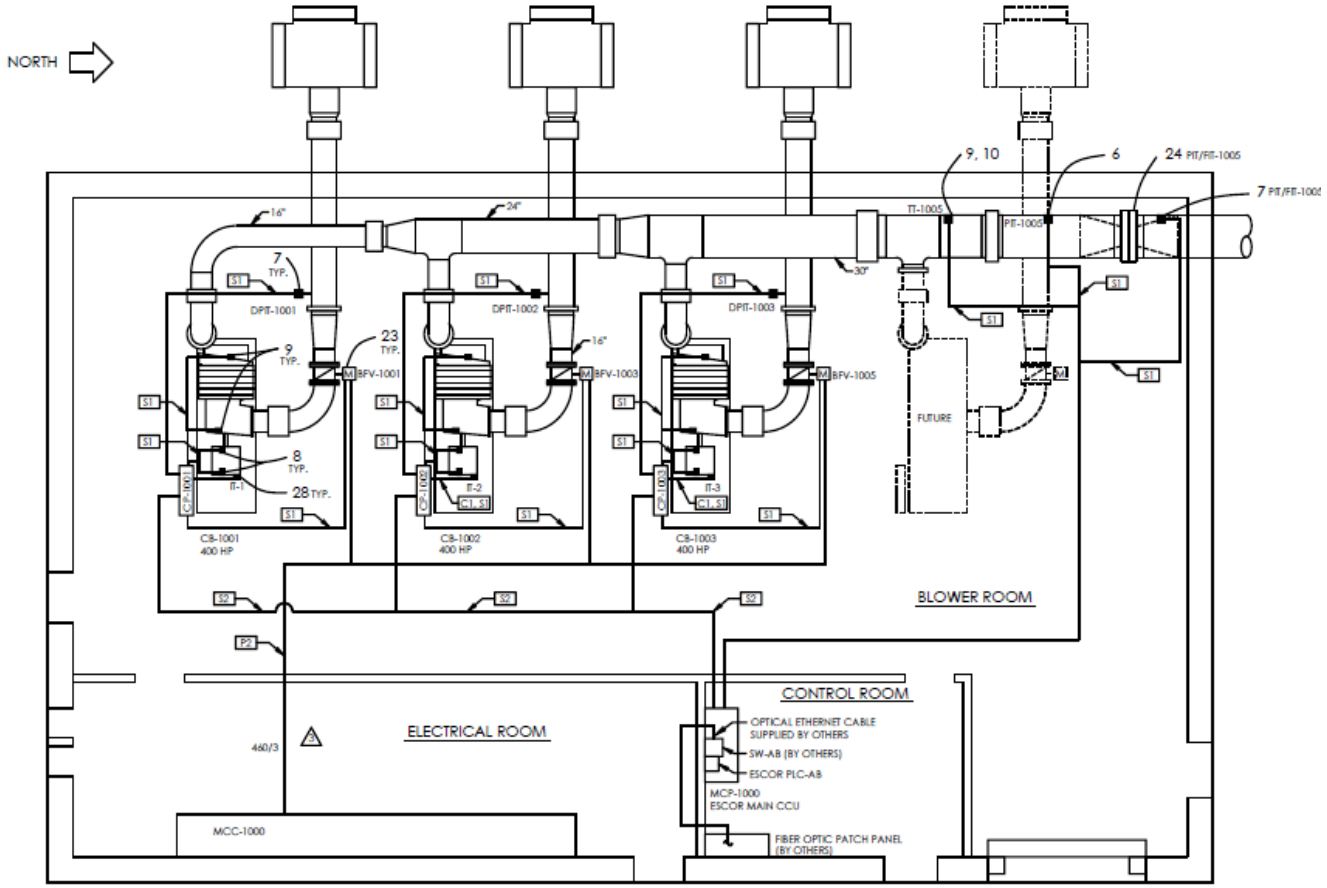
General Arrangement

- It doesn’t much matter how good the blower is if the installation is compromised
- Installation and blower room problems affect:
  - Blower performance
  - Equipment life
  - Serviceability
  - Operator satisfaction

- This is an overview and not a comprehensive design guide!

General Arrangement

- There's lots of "stuff" in a blower room
- A single row of blowers perpendicular to the wall is the most common arrangement

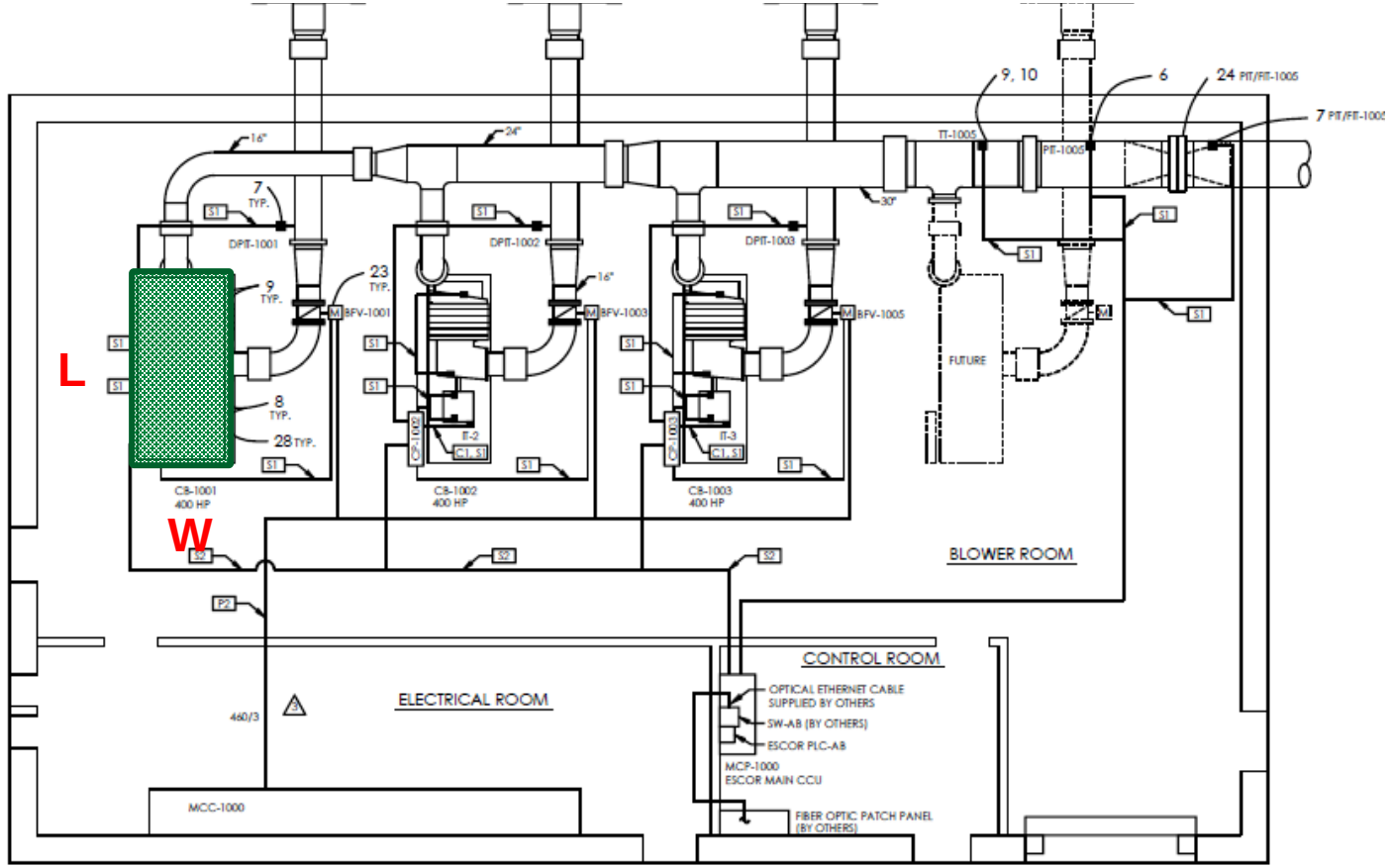


General Arrangement

- Sometimes two rows works better

General Arrangement

- Footprint: length and width in plan view
- Can be a problem to determine if multiple vendors are possible



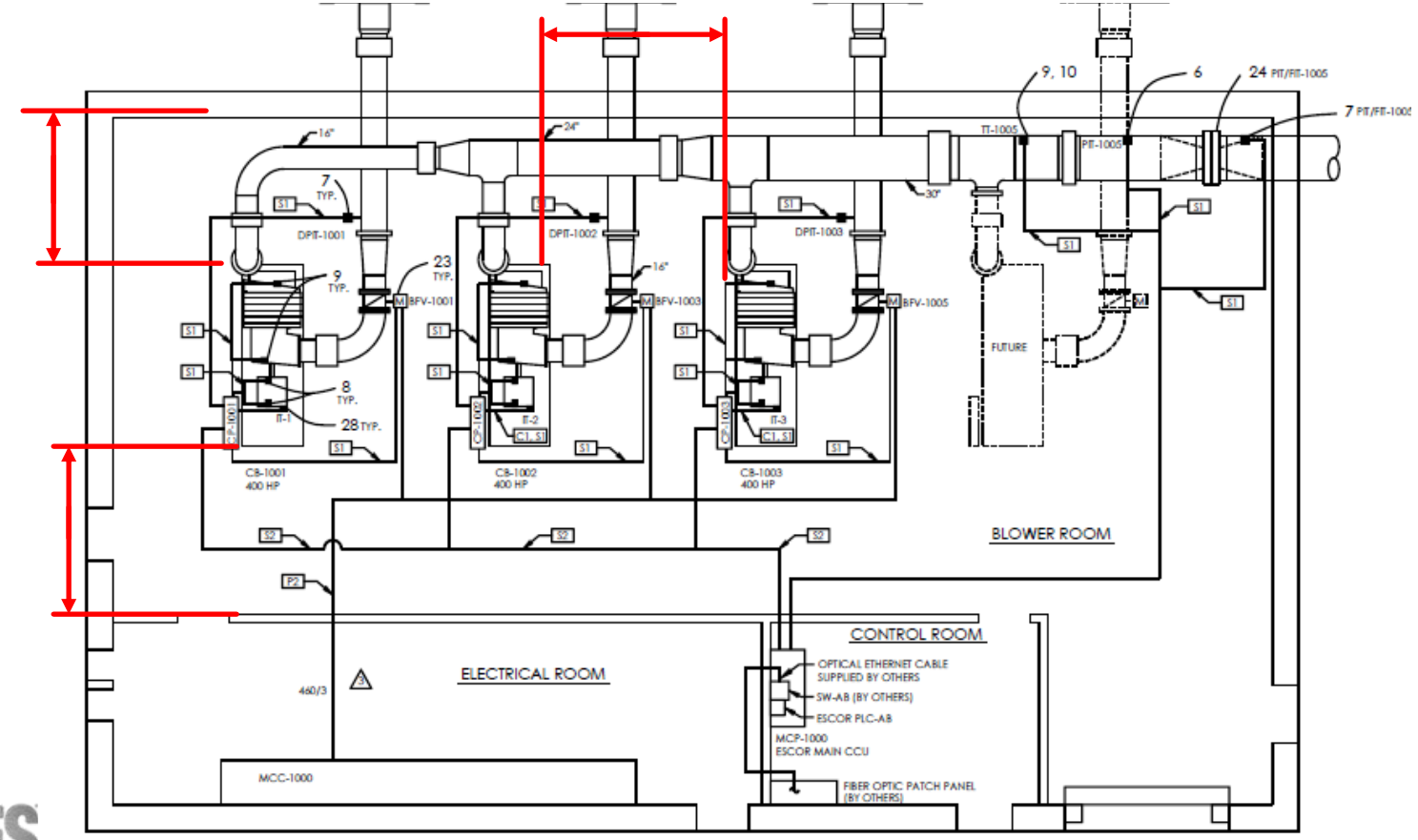
General Arrangement

- Access for service is important:

Source: TPO Magazine

General Arrangement

- Access for service is important:
- Three foot minimum unless the manufacturer indicates otherwise



Heat Dissipation

- There are many sources of heat in a blower room
  - The compression process inherently generates heat
  - Blower inefficiency increases heat generation

$$\Delta T = \frac{\left[\left(\frac{p_d}{p_i}\right)^{0.283} - 1\right] \cdot T_{in}}{\eta_b}$$

Where:

ΔT = temperature increase, °R or °F

$p_{d,i}$ = discharge and inlet pressure, psia

T_{in} = inlet temperature, °R = °F+460

η_b = blower efficiency, decimal

Heat Dissipation

- There are many sources of heat in a blower room
  - Most of the heat of compression leaves the blower room with the discharge air
  - Pipes and blower case are heated by the air, and transfer some heat to the room

$$H_{b.p} = 2.4 \cdot F \cdot A \cdot (T_d - T_a)$$

Where:

$H_{b,p}$ = Heat rejected to room from blower or piping, BTU/hr

F = Factor for surface area, $F = 1.0$ for pipes, $F \approx 1.25$ for a ribbed blower case

$T_{d,a}$ = Temperature of discharge air or ambient air, °F

- Journal bearings and ball bearings can overheat in high ambient temperature areas
  - Lubrication can be compromised

Heat Dissipation

- Inefficiency in the motor generates heat
- Inefficiency in Variable Frequency Drives (VFDs) generates heat

$$H_e = 2544 \cdot P_m \cdot (1 - \eta_m \cdot \eta_{vfd})$$

Where:

H_e = Heat rejected to room from electrical components, BTU/hr

P_m = Motor power draw, hp

$\eta_{m,VFD}$ = Efficiency of motor and VFD, decimal ($\eta_{VFD} = 1.0$ if constant speed)

- Note that elevation affects temperature ratings
  - Most electrical equipment must be derated above 3,000 feet

Heat Dissipation

- Generated heat must be removed
- Ventilation with outside air may be sufficient to maintain acceptable temperature

$$q_{fan} = \frac{H_b + H_p + H_e}{1.08 \cdot (T_r - T_o)}$$

Where:

q_{fan} = Required ventilating air flowrate, cfm

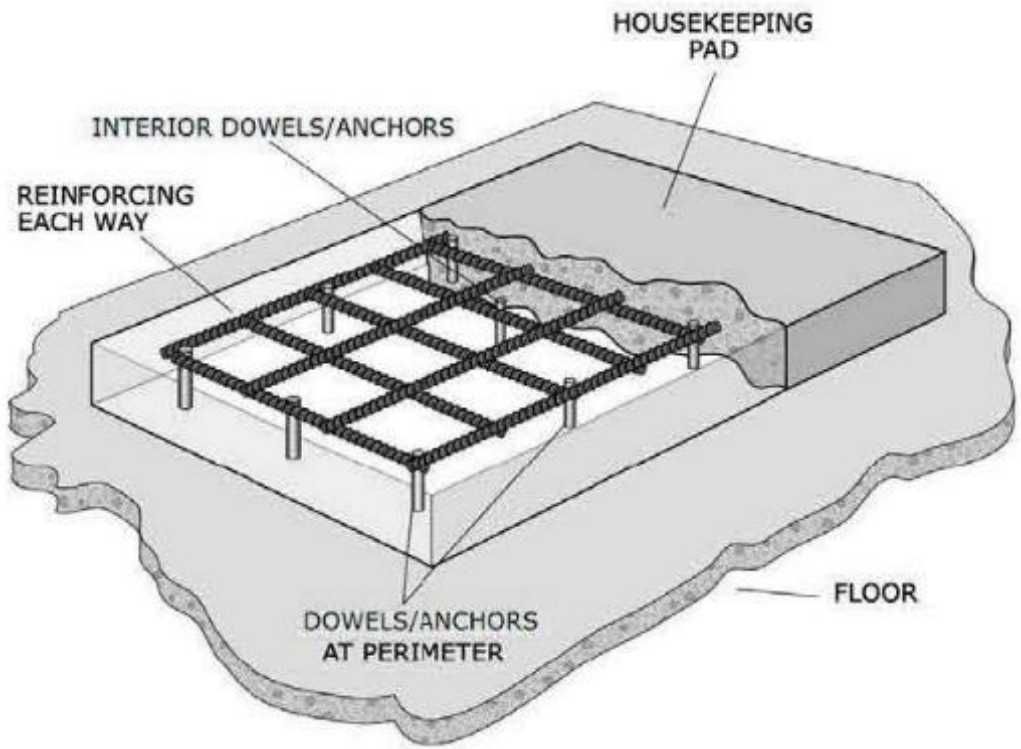
$H_{b,p,e}$ = Heat rejected by blower, piping, and electrical equipment, BTU/hr

T_r, T_o = Room and outside air temperature, °F

- Track where the heat goes:
  - With some designs heat is contained within the enclosure and warms the blower inlet air
  - With some designs heat is rejected to the blower room
  - With some designs heat is ventilated directly from a blower enclosure to the outside
- In hot climates air conditioning may be required, especially for electrical rooms

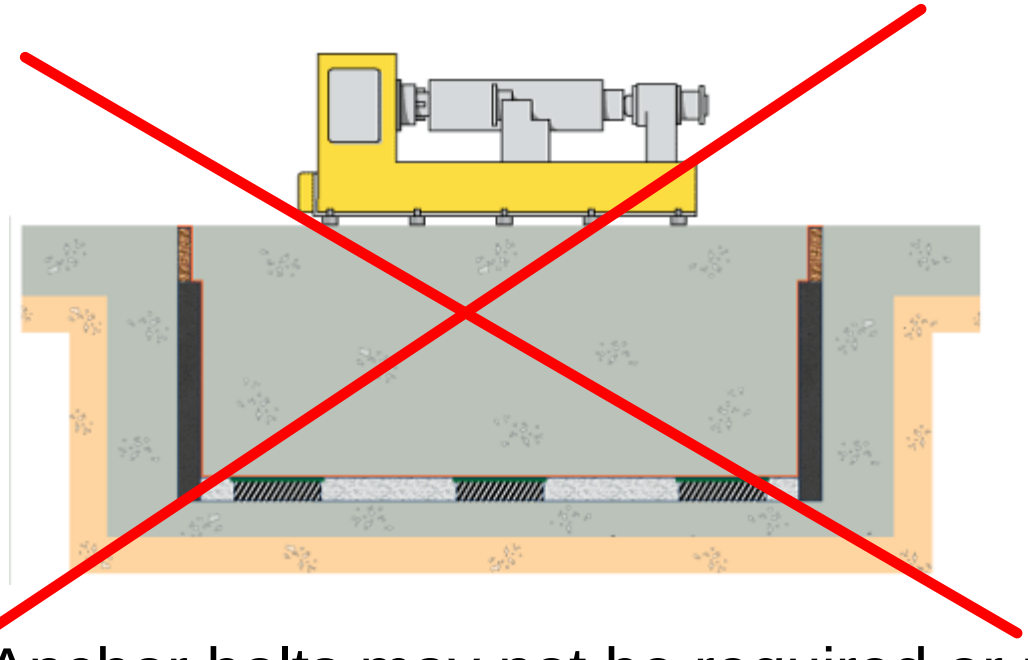
Foundations and Cranes

- Foundations must have sufficient stiffness to minimize deflection
- Foundations must have sufficient stiffness to minimize vibration transmission
- Most installations employ a housekeeping curb
  - 4” is common



Foundations and Cranes

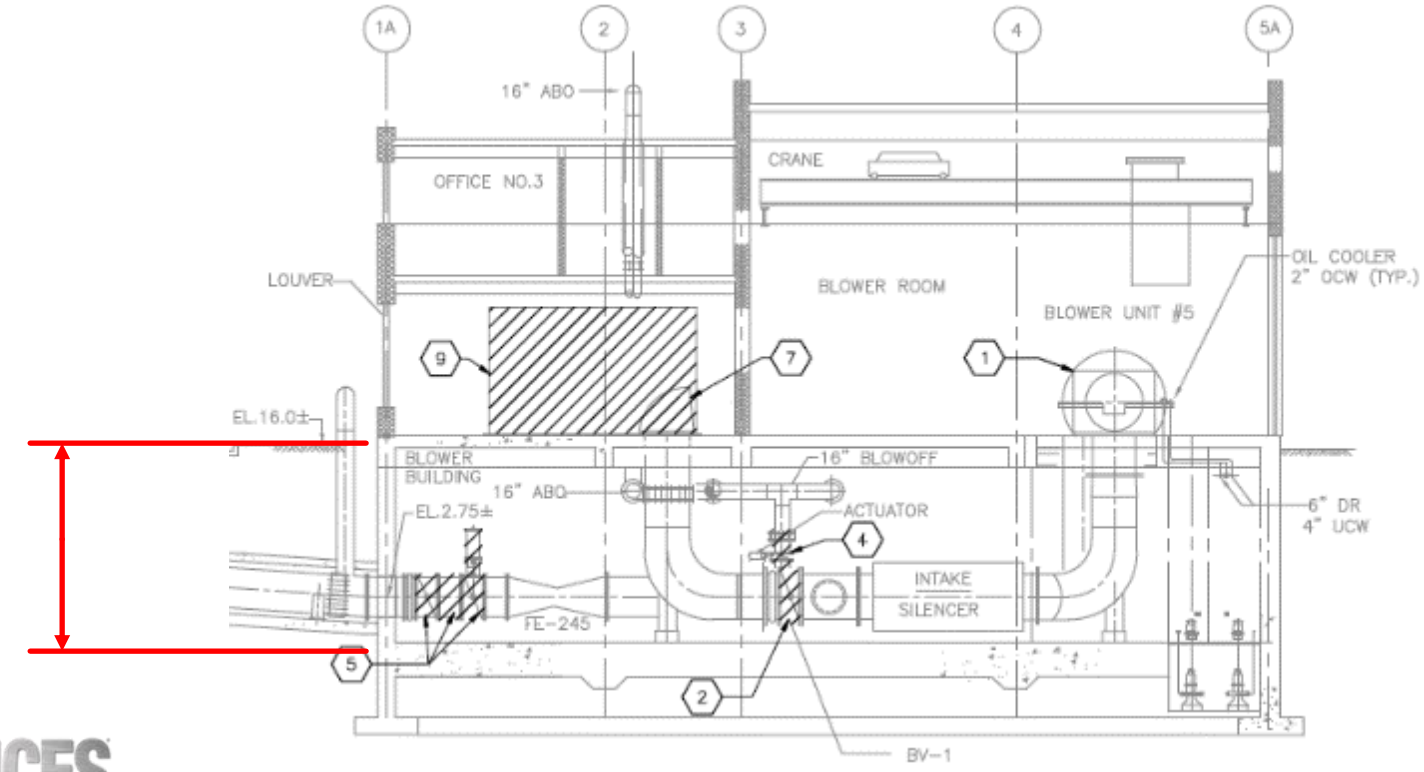
- Massive vibration isolation slabs, typical for reciprocating compressors, are <u>not</u> needed for blowers



- Anchor bolts may not be required or may not be tightened
  - Verify requirements with the blower manufacturer

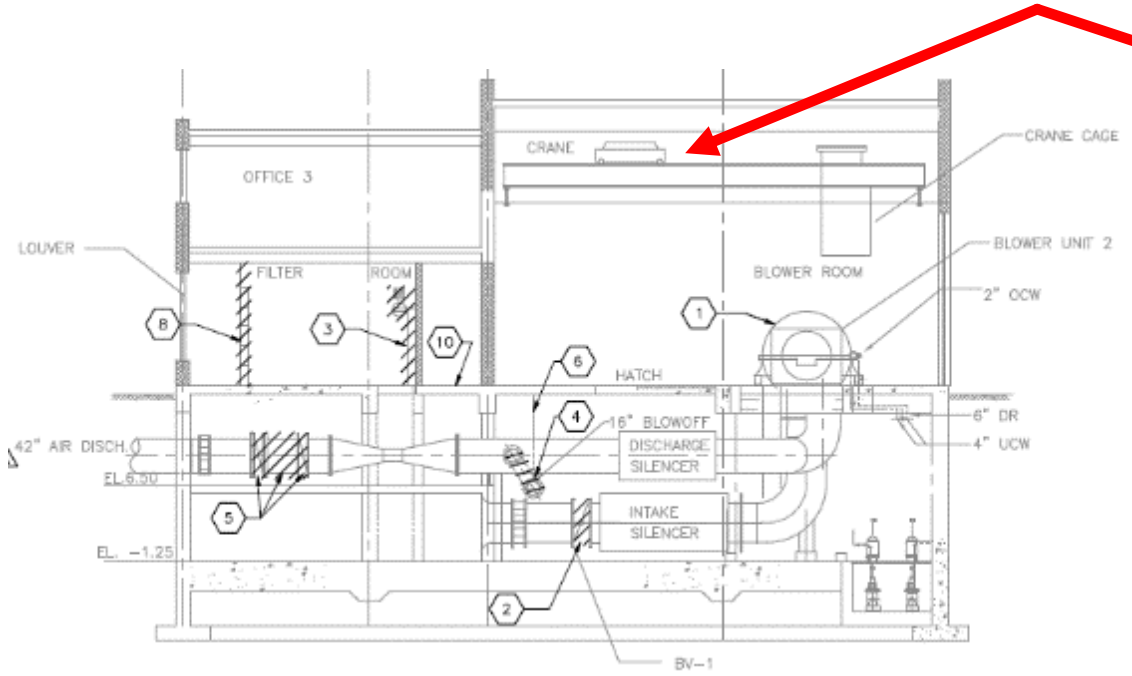
Foundations and Cranes

- Many older installations of large blowers had piping and instruments in a basement
- Structural adequacy and condition should be verified



Foundations and Cranes

- Overhead cranes may be supplied for equipment removal for replacement or service
- Cost effectiveness should be checked



Foundations and Cranes

- Doors and aisles should be large enough to accommodate fork trucks, flatbed trucks, and similar equipment needed for potential equipment removal

Noise Abatement

- Noise is always a concern
- Specific factors include:
  - Noise level produced – dB(A), a logarithmic scale for representing the noise energy
  - Distance – noise energy dissipates inversely with the square of the distance from the source
  - Frequency – high frequency noise may be more irritating but is easier to attenuate
  - Time of exposure – as exposure time increases the potential for harm to personnel increases
  - Room geometry and wall treatment – rooms with reflective walls will be louder

Noise Abatement

- Allowable exposure is a function of noise level (dB(A)) and length of exposure

$$t = \frac{480}{2^{\left(\frac{L-85}{3}\right)}}$$

Where:

$t =$ Recommended maximum exposure time, minutes

$L =$ Noise level, dB(A)

Recommended Maximum Noise Exposure	
Noise Level, dB(A)	Time
80	25 hours
85	8 hours
90	2.5 hours
95	48 minutes
100	15 minutes

Noise Abatement

- Sound attenuating enclosures are standard for many packaged blowers

Source: APG Neuros

- Sound attenuating enclosures are <u>available</u> for all types of blowers
  - Cost effectiveness should be evaluated

Noise Abatement

- A variety of noise attenuating methods can be employed:
- Thermal insulation on piping
- Sound deadening panels on blower room walls
- Acoustic wrapping of blowers
- Hearing protection earmuffs (20 to 30 dB(A) potential reduction)
- Silencers in air piping for inlet and discharge

Piping

- Piping should be sized to minimize friction losses and noise
- Preferred velocities vary with pipe diameter:

Typical Distribution Piping Air Velocities	
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

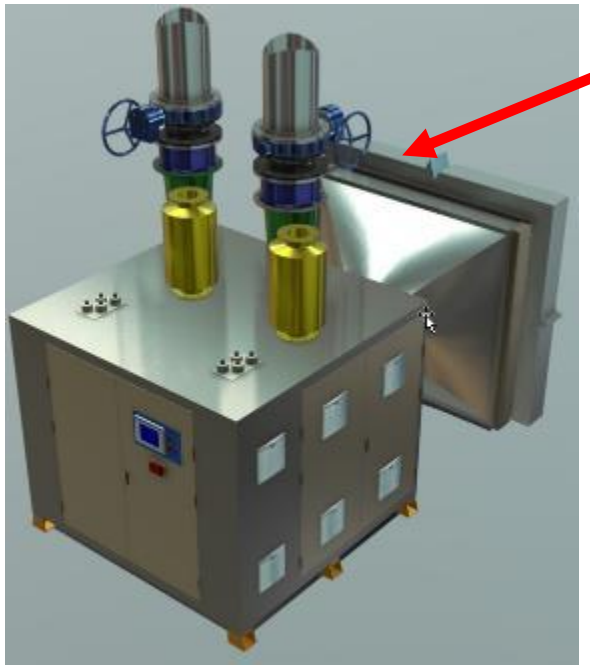
- Fittings and valves usually create more pressure drop than the pipe
  - Throttling valves can also generate significant noise
- Carbon steel is most common pipe material inside blower rooms

Piping

- Avoid putting weight of piping on the blower connections
  - Use expansion joints

Piping

- Inlet air may be piped from outside the blower room
  - This is my preferrence for extreme cold or hot climates
- Many packaged blowers are standard with louvered inlet from the room
  - Piped inlet is usually an option
  - Process air and cooling air may have different inlets



Source: APG Neuros

Electrical Systems

- Electrical systems generate heat
- Electrical systems are sensitive to heat
- Instruments are limited in ambient and process connection temperatures
  - Pigtails can be used with high process temperatures:

© CanStockPhoto.com

Electrical Systems

- Conventional motor starters do not usually have heat issues
- VFD and motors can generate significant heat
- Common VFDs ambient temperature limits are 50°C (122°F) or 40°C (104°F)
- Motor inefficiency generates heat

$$1\ \text{kW} = 3{,}415\ \text{BTU/hr}$$
$$1\ \text{hp} = 2{,}544\ \text{BTU/hr}$$

Electrical Systems

- VFDs in enclosures or MCCs may need extra cooling, such as
  - Fans
  - Air conditioning
- Cooling is of particular concern if using NEMA 12 or 4 enclosures
- It is common to provide control rooms and electrical rooms with air conditioning
- Note that if the VFD is mounted a significant distance from the motor harmonics and bearing fluting may become issues
- Package blowers typically have the VFD in the package and include cooling equipment as part of the package

Submit Questions and Comments

About the Speaker

Omar Hammoud
APG-Neuros

- President and CEO, APG-Neuros
- Founded APG-Neuros in 2005
- Spent 25 years in the aerospace and defense industries
- Passionate about the environment and sustainability

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Blower Rooms Design and Lessons

July 2023

APG-Neuros Background & Offering

APG-Neuros Company History

2005

APG, Inc. established in Montreal, QC

2006

First turbo blower installed in Saint-Pie, QC outdoors

First Turbo Blower Installed:

- U of T Austin in 2005
- WWTP in St Pie, Quebec in July 2006

2010

APG-Neuros, Inc. opens the Plattsburgh, NY production facility & new Head Office in Blainville, QC

2023

Over 18 years of experience in manufacturing direct drive Turbo blowers and & aeration systems.

Over 1600 Turbo Blowers Installed in over 600 WWTPs in US & Canada

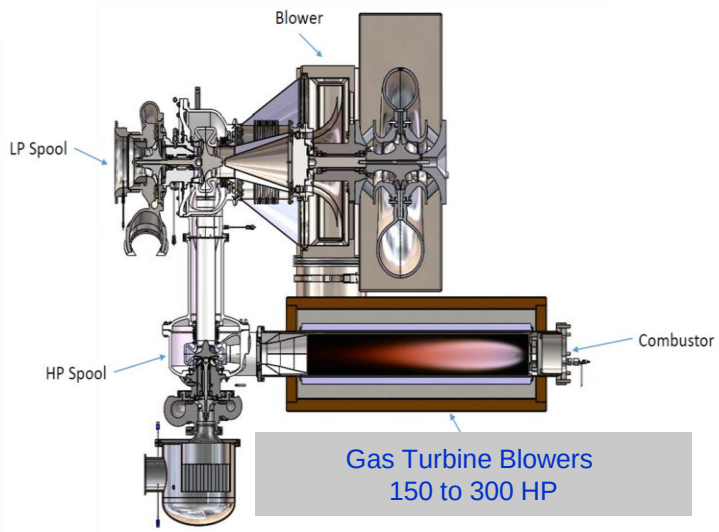
Manufacturing Facilities

- Corporate headquarters finance & administration
- Engineering and Aftermarket Support Leadership
- R & D for New Products & Innovations
- Automation Engineers Department
- Production
- Repair

High Efficiency Turbo-Machinery Products

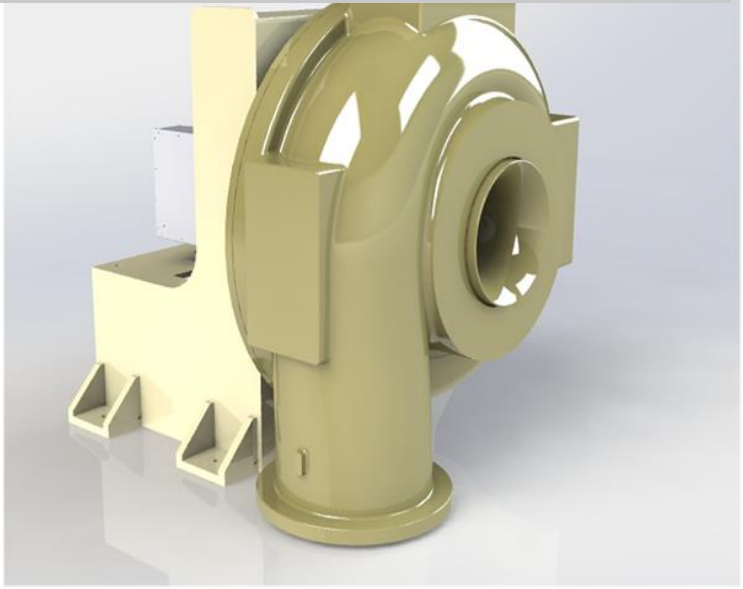
NX series 30 to 1000 HP

Magnetic Bearing :150 to 500HP



Gas Turbine Blowers
150 to 300 HP

APGN Turbo Blowers 1500 to 3000 HP



Offer Widest Continuous Range of Products

Equivalent to all other offerings combined

Product line:

- 15 HP to 1500 HP Single Core
- 60 HP to 3000 HP Dual Core
- 350 SCFM to 70,000 SCFM per Blower
- 150 to 300 HP Gas Turbine Blower
- Advance Aeration Solutions

Technologies

- Air Bearing & Magnetic Bearings
- Low Voltage (480V) & Medium Voltage 4160 or 13.8 KV
- Biogas / Natural Gas or Hydrogen fueled Blowers
- Future Gas Turbine Gensets

Core Turbo Blower Technologies

- **Air Bearing**
  - 3rd Generation Dual Layer Bump Foil;
- **Mag Bearing**
  - Fourth generation with power generation mode;
- **Permanent Magnet Synchronous Motor**
  - High efficiency with speed turn down
  - Sine Wave Filter for low heat generation
  - Low motor current – good for VFD life
- **Aeronautic Flow Path & Aero Compressor**
  - Turbofan Gas Turbine engine layout
  - Forged Impeller - highest efficiency & durability
- **High Frequency (Variable Frequency Driver) VFD**
  - High Efficiency and lowest heat generation
  - 97% efficiency throughout speed range
- **Programmable Logics Controller (PLC)**

Installations

Over 1,700 units in NA, EU and ME

More than 700 installations

More than 30% repeated customer

Wastewater Treatment Industry Recognition

FROST & SULLIVAN
2012 BEST PRACTICES AWARD
NORTH AMERICAN AERATION NEW PRODUCT INNOVATION AWARD

BEST OF CANADA
CA BUSINESS EXECUTIVE 2016

2011 & 2012
APG-Neuros
Winner of the
The Artemis Project
Top 50 Competition
&
APEX
Sustainability Prize

CANADIAN BUSINESS AWARDS 2017
Aviation And Power Group
Award for Excellence in Turbomachinery Manufacturing
CV MAGAZINE

CV MAGAZINE
2016 Mid-Market Achievement Awards
APGN Inc
Best Turbo Blower Technology Manufacturer 2016

ceo monthly
Omar Hammoud
APGN Inc
Best Turbo Blower Manufacturer
CEO - North America

APG-Neuros
Recognized by INDUSTRY TECH OUTLOOK Magazine as
INDUSTRY TECH OUTLOOK
10 MOST INSPIRING CEOs TO WATCH IN 2020
Inspiring Evolution with Turnkey Technologies
Transforming Business Demographics

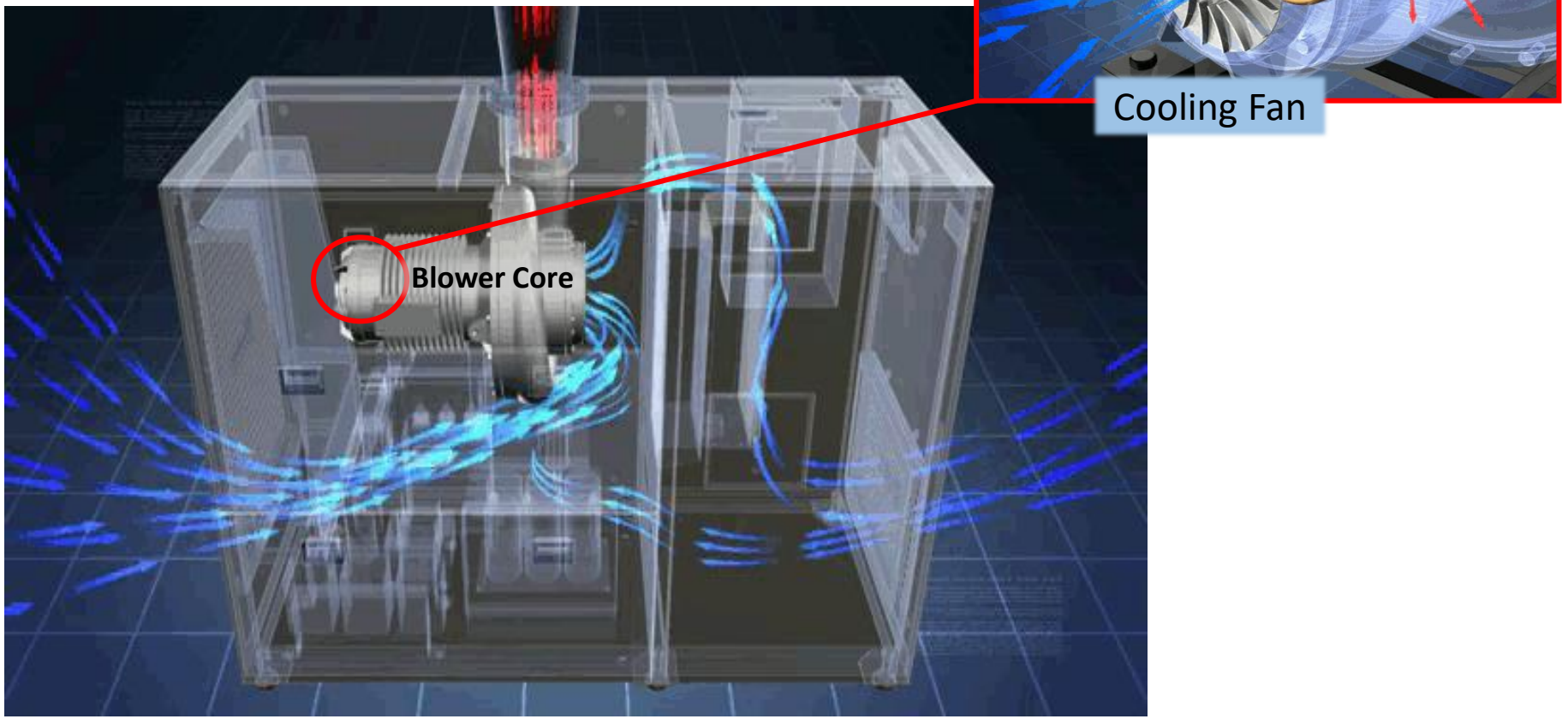
What is the Blower Core?

Assembly: non-contact motor, rotor, impeller, Air Bearings (Journal & Thrust) and Scroll

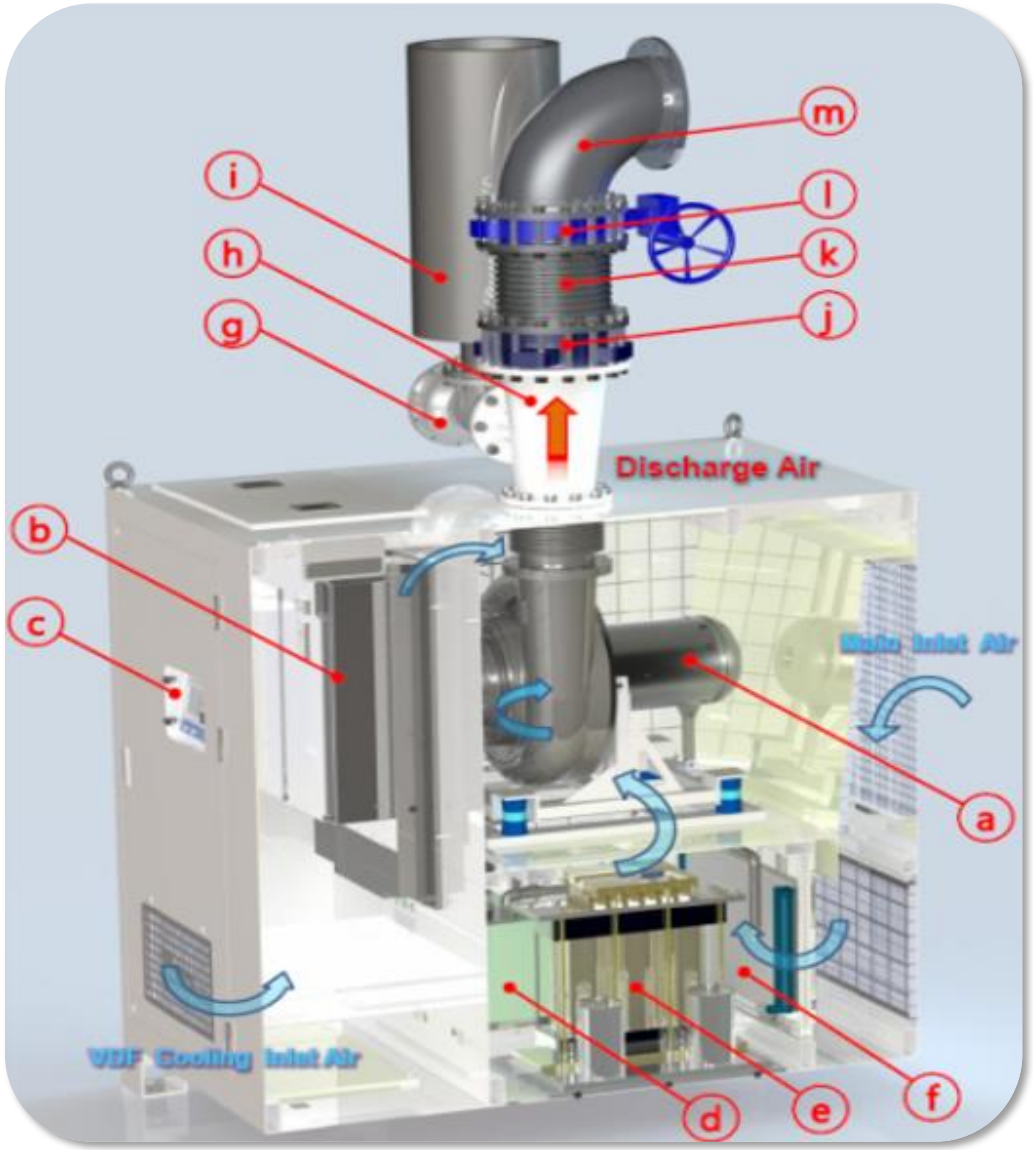
Efficient Air Flow Path

Turbo Blower Package

- Cooling air is auto controlled with blower speed
- Air cools electrical and control components
- Air is filtered before reaching blower core
- Dust is centrifuged away by built in cooling fan
- No heat is rejected/exhausted outside the blower enclosure



APGN Turbo Blower
Basic Configuration



Blower Components

A. Blower Core
B. Variable Frequency Drive (VFD)
C. Control Panel
D. Coolant System (200HP and up)
E. Sine Wave Filter
F. Radiator (200HP and up)
G. Blow-off Valve (BOV)
H. Discharge Cone
I. Blow-off Silencer
J. Check Valve
K. Flexible Joint
L. Isolation Valve
M. Elbow (Process Air Discharge)

Inlet Types

OR

Routine Maintenance by Plant Staff

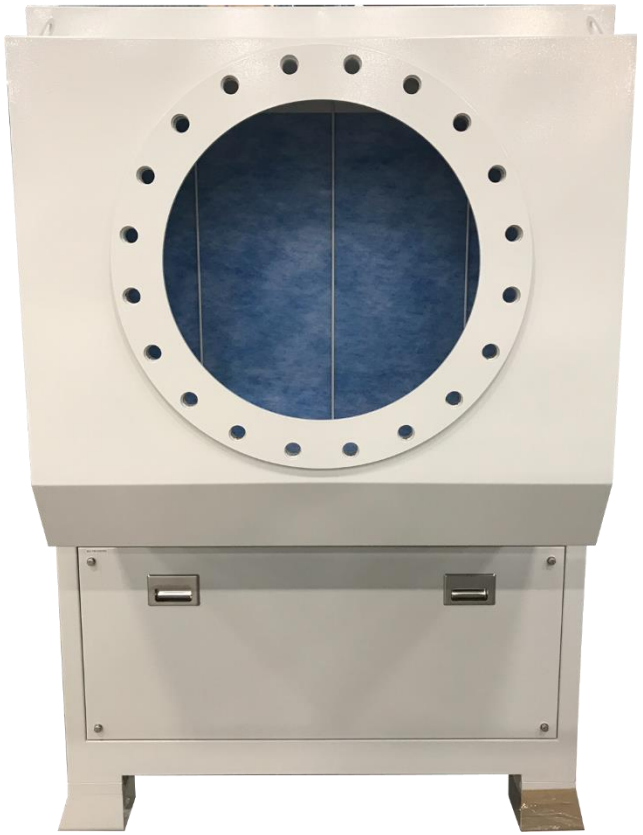
Filter Change

Filter changes take approximately 5 minutes and
can be done by the plant technician with no special tools.

Frequency: Main Panel filter Once or twice a year depending on cleanliness

Inlet Filtration

Integrated Inlet Filters are framed and gasketed.



Blower installation – Dual Core Model

Buffalo Sewer Authority, NY – Five (5) NX700D


PA-120°C
PA-120°C

Blower installation – Dual Core Model

Blower installation

Blower installation

Blower installation

Blower installation

Blower installation – Dual Core Model

Buffalo Sewer Authority, NY – Five (5) NX700D

Outdoor Installations

Tucson, Pima County, AZ

Best Practices EXPO Contest

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Please submit your answer in the upcoming poll

Which is a source for heat in a blower room?

A	• Heat from the compression process
B	• Motor inefficiency
C	• Both

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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!

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July 2023 Webinar

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Francisco Lara
Airtec Global
Keynote Speaker

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