

Vacuum Pump Maintenance

Tie Duan
Keynote Speaker

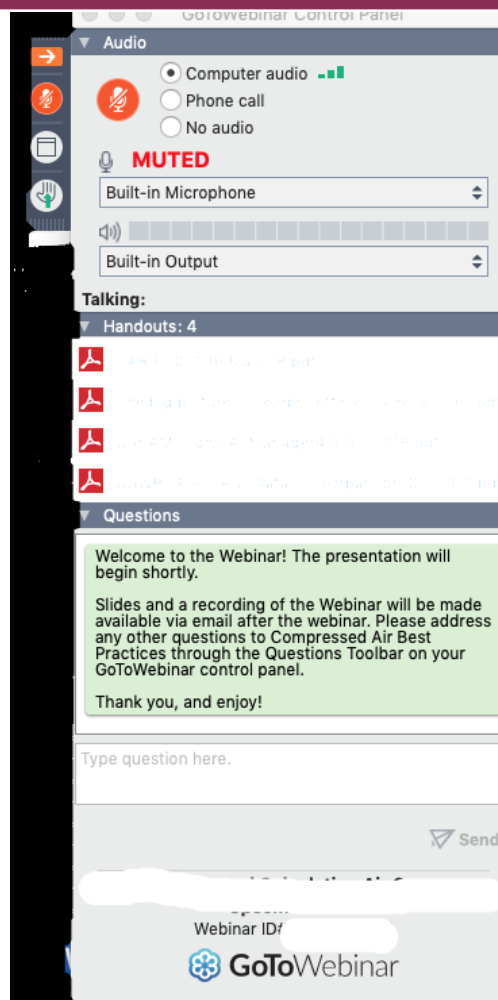
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Q&A Format



- Panelists will answer your questions during the Q&A session at the end of the Webinar.
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SCFM to ACFM Calculator	
SCFM	100
Vacuum Level	27 in-HgV
ACFM	1025
User Input	
Data Output	

NASH **Elmo Rietschle** **ALFA LOM**
 by Gardner Denver A Gardner Denver Product

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 22 Six Steps to a Tailor-Made Vacuum Solution
 26 Technology News

AERATION BLOWER SYSTEMS
 5 Industry News
 14 Energy-Saving Industrial Wastewater Projects

May 2023

Sustainable, Safe & Reliable On-Site Utilities Powering Automation

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Energy Conservation

24 CheeseCon 2023 Show Report

18 Ceramics Plant Deploys New Air Compressor Heat Recovery
 22 Centrifugal Air Compressor Maintenance: OEM Parts
 30 Deep Dive into Compressed Air Dew Point Measurement
 34 Hannover Messe 2023 Show Report

June 2023

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

Registration is Now Open for the Best Practices 2023 EXPO!

Track 2: On-Site Utility Reliability, Safety and Quality

1. Learn techniques to improve production up-time
2. Discuss the establishment of compressed air specifications and compliance verification
3. Receive maintenance check-lists and training

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!

**SUPER EARLY
BIRD RATES END
TUESDAY AUGUST
1!**

Vacuum Pump Maintenance

Introduction

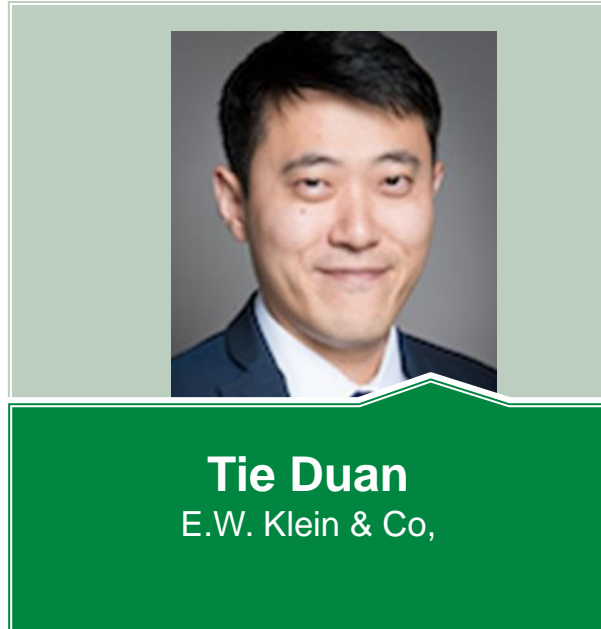
Blower & Vacuum Best Practices Magazine



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About the Speaker



- Solutions Engineer, E.W. Klein & Co
- 4 years with industrial vacuum and heat transfer equipment
- Spent 10 years in the plastics industry managing plant engineering and R&D

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Vacuum Pump Maintenance

Keeping Your Vacuum Systems Running

June 8, 2023
Tie Duan

Real Stories, Names Hidden to Protect the Innocent

- Liquid Ring Vacuum Pump – Gushing Water
- Oil-Lubricated Rotary Vane Pump – Burning Up
- Claw Vacuum Pump – Chucking Water
- Regenerative Blower – Can't breathe

Liquid Ring Vacuum Pump – Carpet Drying

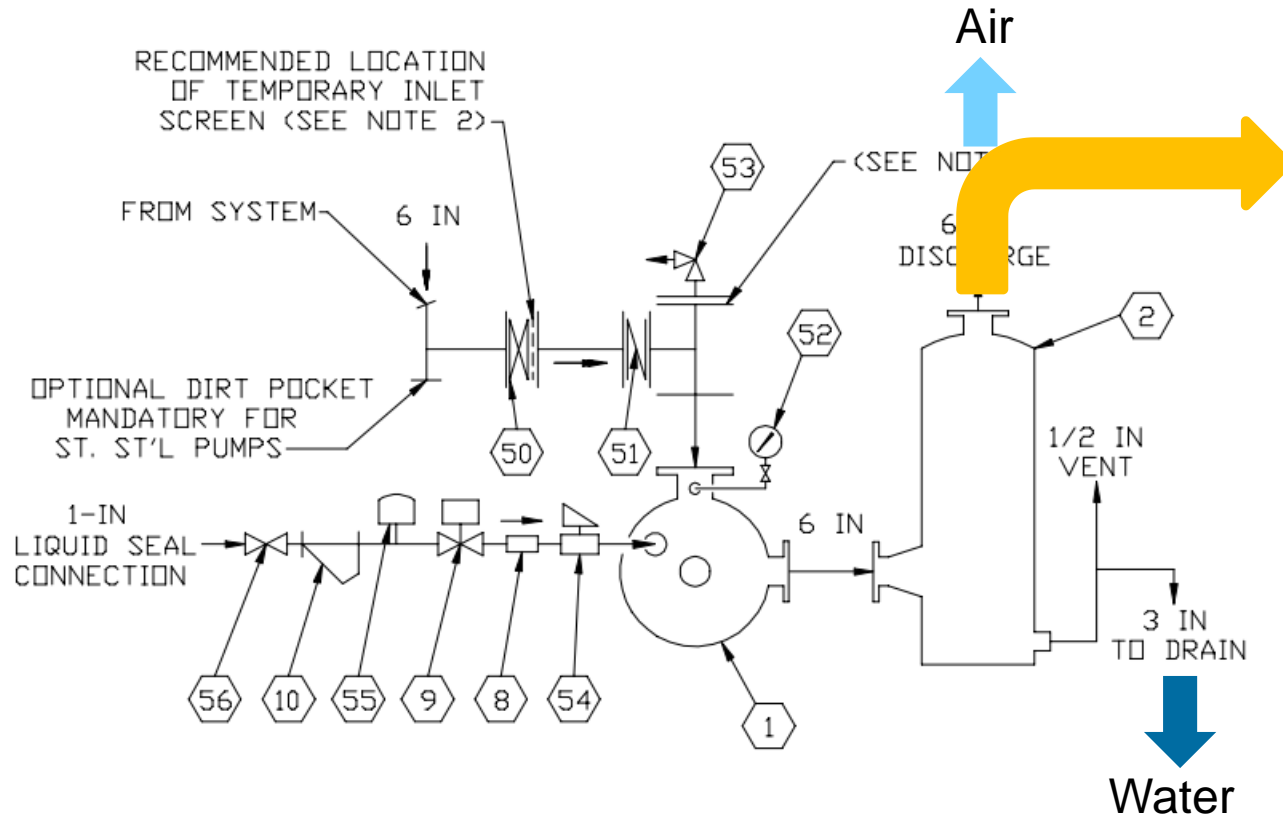
Vacuum Extraction

- Use vacuum to remove water from carpet after dyeing
- More efficient than using heat alone



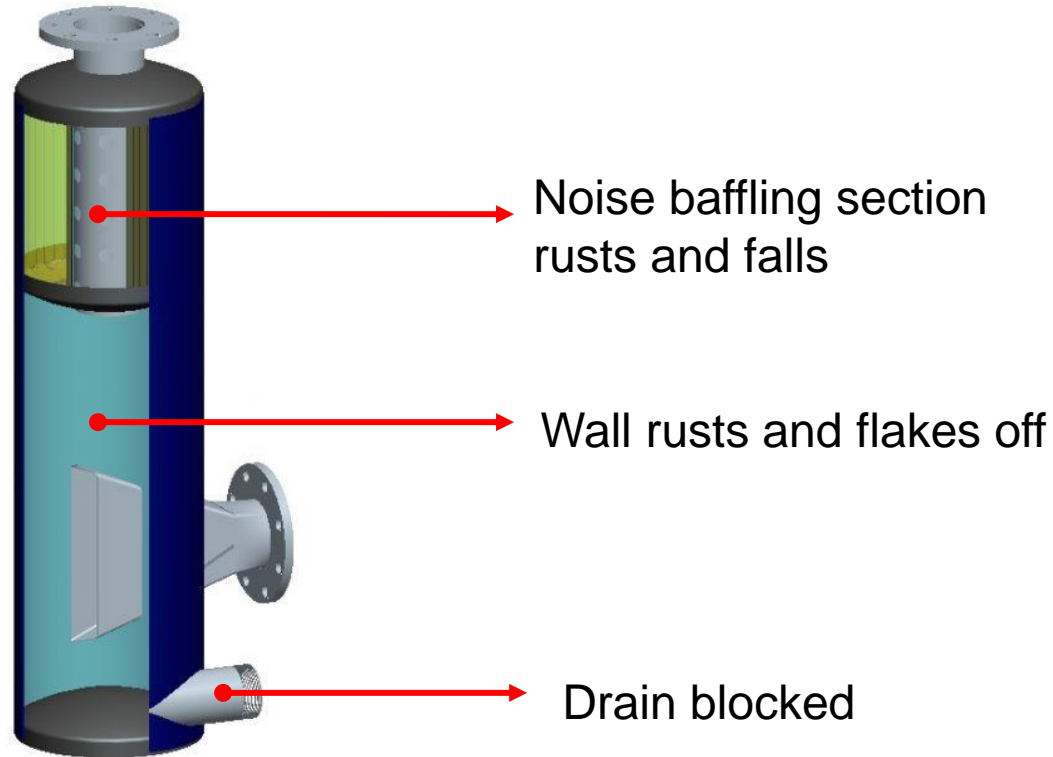
Liquid Ring Vacuum Pump – Carpet Drying

FLOW DIAGRAM



Liquid Ring Vacuum Pump – Carpet Drying

Standard Carbon Steel
Water Trap Silencer



HDPE Water Trap Silencer



Oil-Lubricated Rotary Vane Pump – CNC Routing



CNC Router Hold Down

- An oil-lubricated rotary vane vacuum pump used
- Holds down product while it's being cut

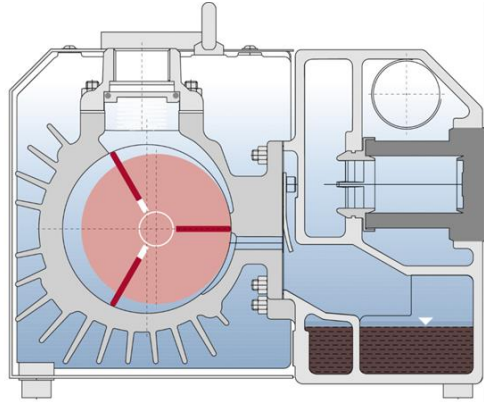
Oil-Lubricated Rotary Vane Pump – CNC Routing



- Pumps runs hot and fails often
- CNC bed is not zoned
 - Inlet filter not well maintained
 - Operator does not turn off vacuum pump in between jobs



Oil-Lubricated Rotary Vane Pump – CNC Routing

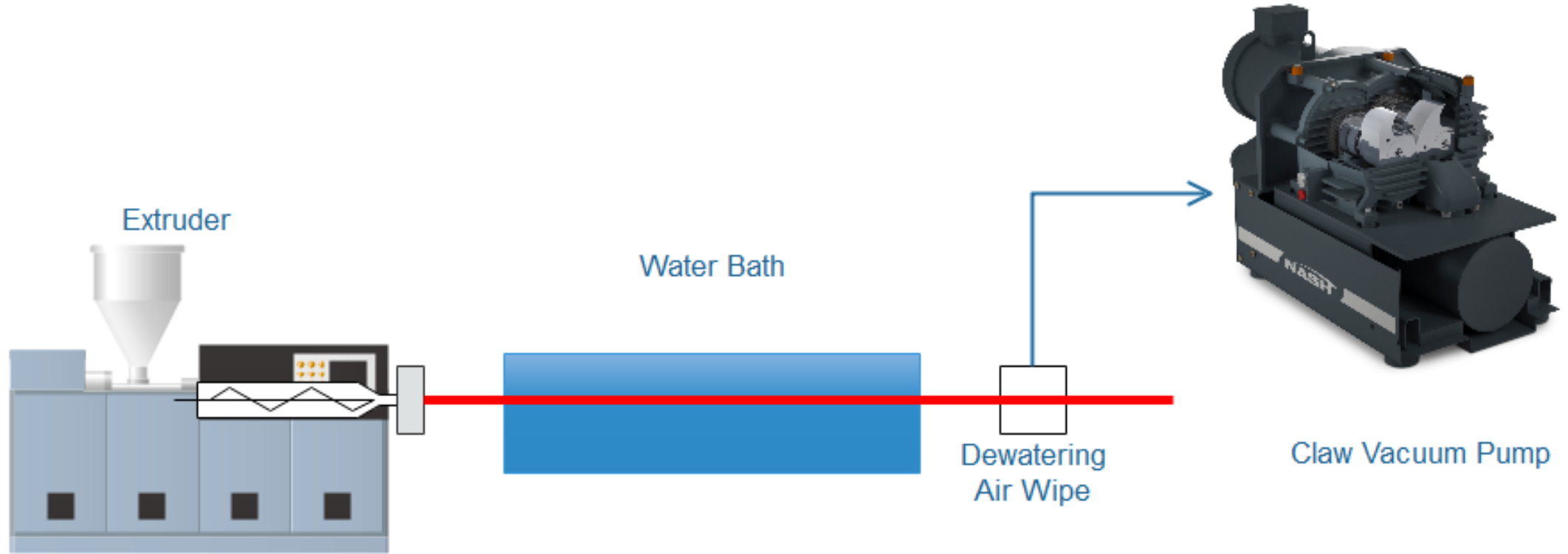


Oil-Lubricated rotary vane pump needs a minimum vacuum level to circulate the oil ~ 10 to 15 in-Hg.
- Turn off Vacuum Pump when not routing



Additional inlet separation: centrifugal-forced inlet separator

Claw Pump – Extrusion Dewatering



Claw Pump – Extrusion Dewatering



The bucket is not emptied frequently enough.

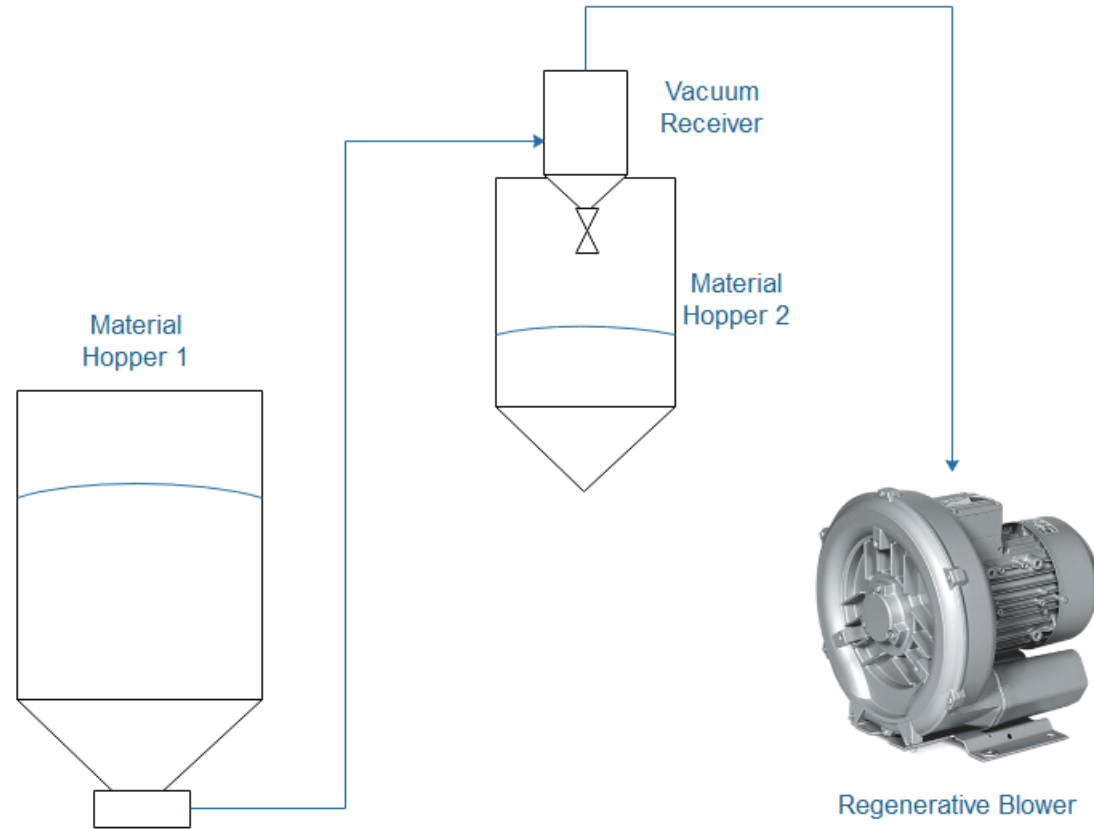
Water gets into the claw pump, locking it up

Claw Pump – Extrusion Dewatering

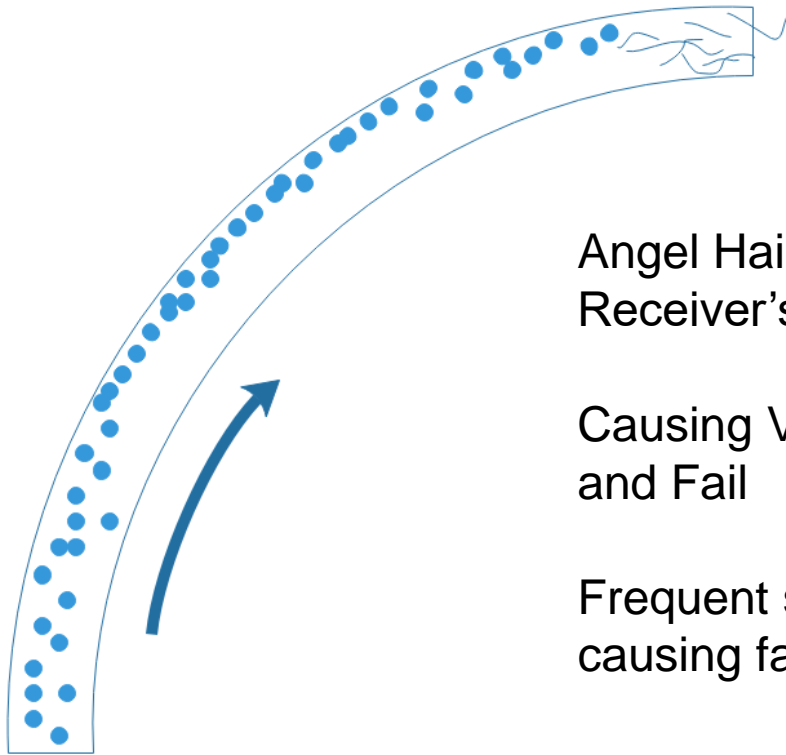


- Auto Drain Kit
- A drain pot between two valves
- Creates an air-lock
- Runs on either timer or level switch
- May need to equalize pressure

Regenerative Blower – Material Conveying



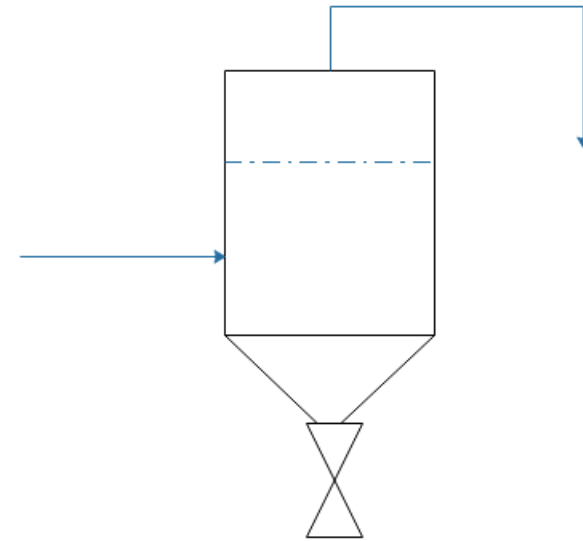
Regenerative Blower – Material Conveying



Angel Hair Clogs Up Vacuum Receiver's Internal Screen

Causing Vacuum Pump to Run Hot and Fail

Frequent start & stop of motor causing failure



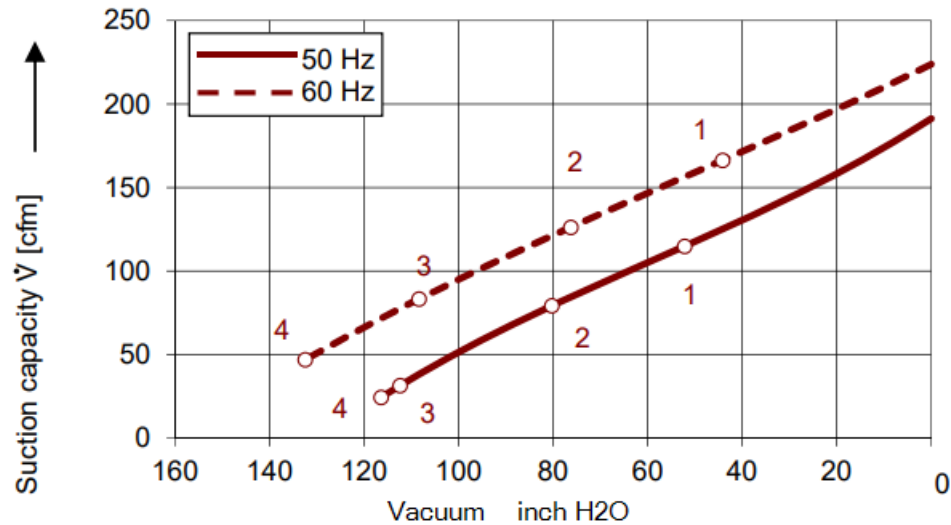
Vacuum Receiver

Regenerative Blower – Material Conveying



Performance curves

Vacuum operation (acfm)



Inlet Vacuum Relief valve to prevent overheating

Vacuum breaker valve to keep motor running

Thank You
For Coming to My

TIE Talks

About the Speaker

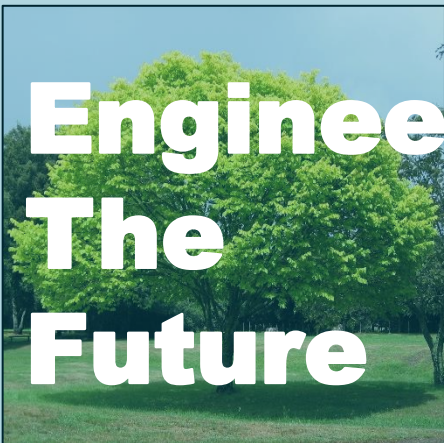
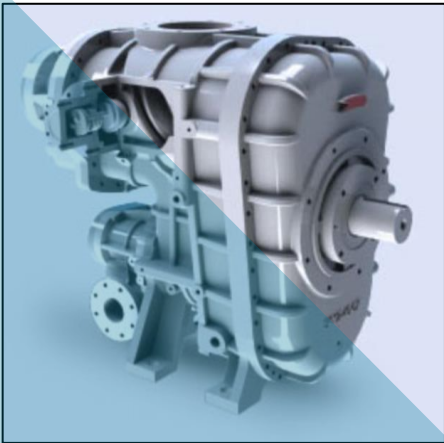


Brandon Dial
Kaishan

- Western Regional Manager, Kaishan
- Bachelor's of Science in Electrical & Computer Engineering
- 18 years of experience in manufacturing of compressors and vacuum pumps

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**Engineering
The
Future**



Rotary Screw Vacuum System Setup & Maintenance

June 2023

*Brandon Dial
Western Regional Manager
Kaishan USA*

Rotary Screw Vacuum Systems

- ❖ System Setup
- ❖ Installation
- ❖ Start-Up
- ❖ Safety
- ❖ Maintenance

System Setup: Which type of Vacuum Pump?

- ❖ Previous CABP webinar:
How to Select the Right Vacuum Pump
 - <https://www.airbestpractices.com/webinars>
- ❖ We will discuss lubricated rotary screw vacuum
 - Centralized vacuum systems
 - Various flows and vacuum levels
 - Atmospheric Air



System Setup: What to consider

❖ Filtration

■ Inlet Filtration

- ✓ *Most rotary screw vacuum units will include a high efficiency inlet filter to increase protection while having low restriction – saving energy*

■ Additional Filtration

- ✓ *Knock Out Tank with Drain*
- ✓ *In-line filters*
 - Liquid, vapor and solid filtration

■ Exhaust Demister

- ✓ *Depending on where you are piping the discharge, you may consider a demister to keep the area clean.*



System Setup: Where to Install

- ❖ Ideally indoor with proper ventilation and lighting
 - Ducting hot air out of room very common
- ❖ Flat, level concrete capable of supporting system weight
 - No special foundations are required
 - Anchors are not required or recommended
 - Rubber pad under base if surface uneven
- ❖ Space for maintenance access
 - 3' around sides
 - 4' above for cooling air discharge

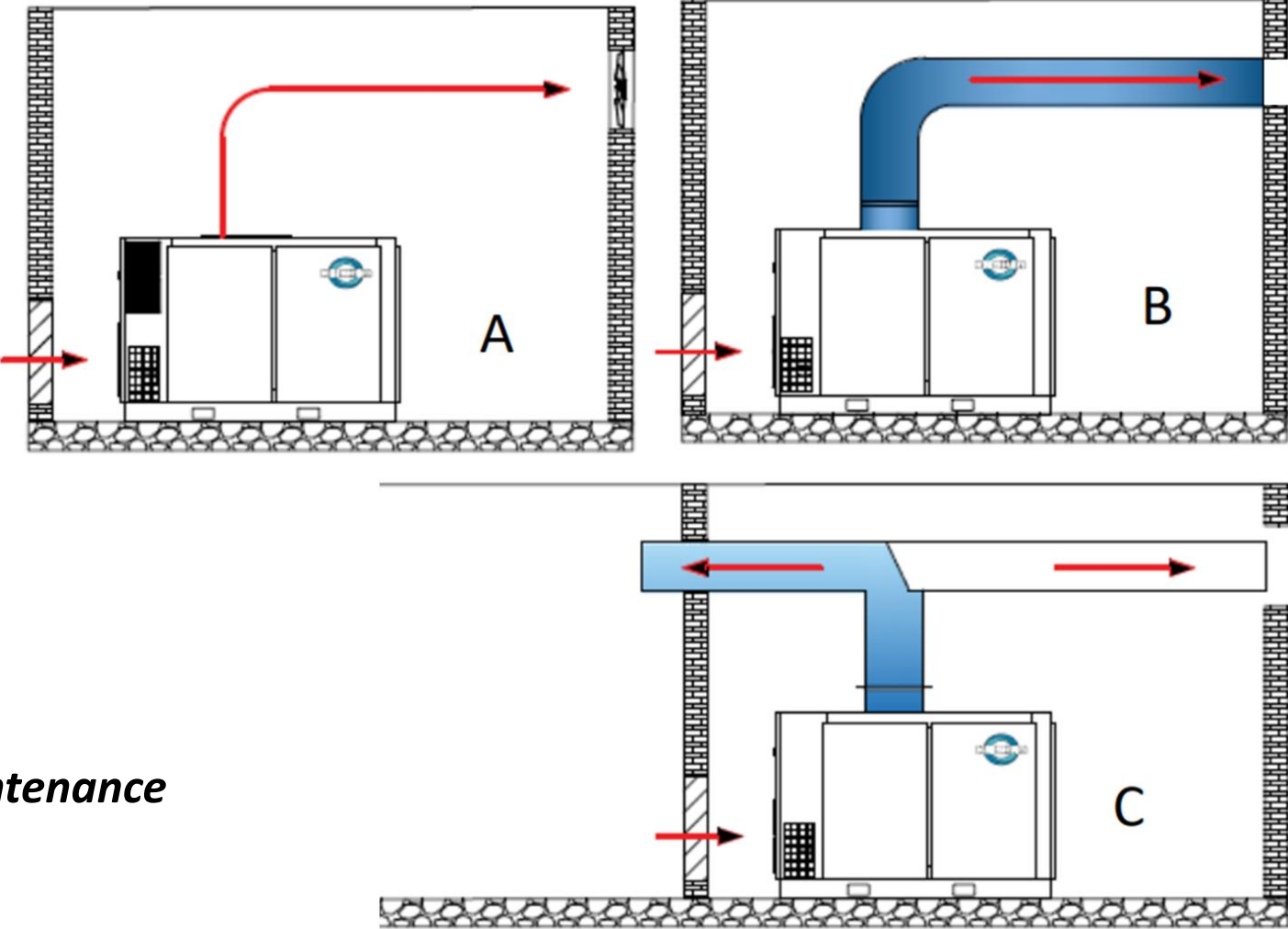


System Setup: Ducting Hot Air

A. Fan Assisted Air Flow

B. Exhaust Air Outside

C. Heat Recovery Option



Duct work should be easily removable for maintenance

System Setup: Piping

- ❖ Use a rigid pipe designed for vacuum use
 - Sized for air flow
 - Loop when possible
 - PVC not recommended
- ❖ Use a flexible connection on pump discharge
- ❖ Shutoff valve for each pump



Equipment Delivery

- ❖ Thoroughly inspect equipment before taking delivery
- ❖ Heavy damage – REFUSE
- ❖ Minor damage
 - Detail on BOL, take pictures / video for freight claim



Start-Up

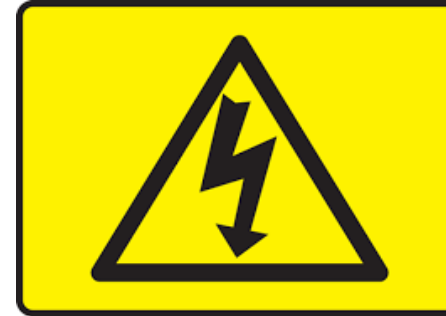
- ❖ Checking all connections
- ❖ Safety checks
- ❖ Proper power readings
- ❖ Basic training on pump operation
- ❖ Register warranty

COMPRESSOR INFORMATION:	
Model Number	_____
Serial Number	_____
Start-up Date	_____
CHECK LIST BEFORE START-UP:	
Overall check for any damage	_____
Shipping Brackets Removed?	_____
Unit Properly Ventilated?	_____
Unit Voltage Changed? (y/n) (200, 230,460)	_____
Motor leads secure	_____
Fan leads secure	_____
Belts Properly Tensioned	_____
Primary voltage	_____
Controller Factory Settings Changed	_____
Air end rotation checked	_____
Fan motor rotation checked (Show if VSD)	_____
Vacuum environment	Good _____ Fair _____ Poor _____
START-UP CHECK LIST:	
Incoming voltage	L1-L2 _____ L2-L3 _____ L3-L1 _____
Motor amps at full load	L1 _____ L2 _____ L3 _____ @ _____ Torr
Compressor pressure setting	Load _____ Unload _____
Oil Level OK	_____
Discharge temperature	_____
Ambient temperature	_____
Start-up Procedure	
<input type="checkbox"/> Ensure the inlet and outlet pipe are not obstructed	
<input type="checkbox"/> Check for loose connections (electrical, mechanical & hoses/pipes)	
<input type="checkbox"/> Check to ensure the oil level is between the two lines of the oil level gauge.	
<input type="checkbox"/> Check for wiring errors	

Rotary Screw Vacuum Safety

Safety Features of a Rotary Screw Systems

- ❖ Typical Safety threats:
 - Electrical Power
 - Air Pressure
 - Temperature – Hot Surfaces
 - Mechanical Movement



Electrical Safety

- ❖ Properly sized breaker/fused disconnect
 - Use datasheets from manufacturer for FLA / power
- ❖ Overload protection for motors
 - Main & Fan Motor
- ❖ Verify all electrical lines are organized and all connections are properly secure
- ❖ Make sure unit is properly grounded



Air Pressure - Safety



Tank Safety Relief Valve



Oil fill port
with pressure weep hole

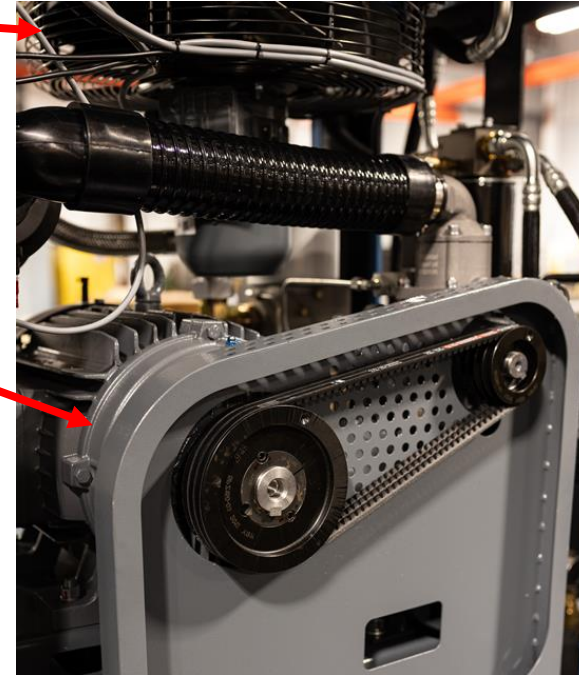
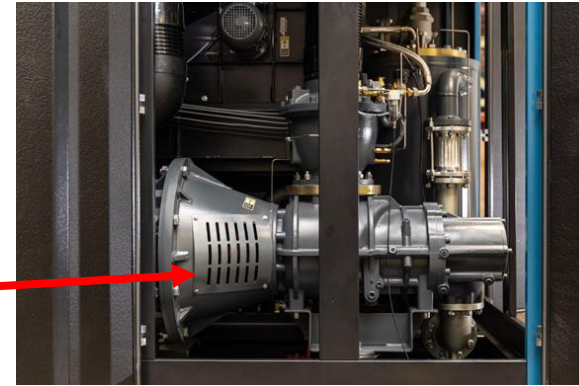
Thermal Safety

- ❖ Use proper safety gloves when working on hot equipment!



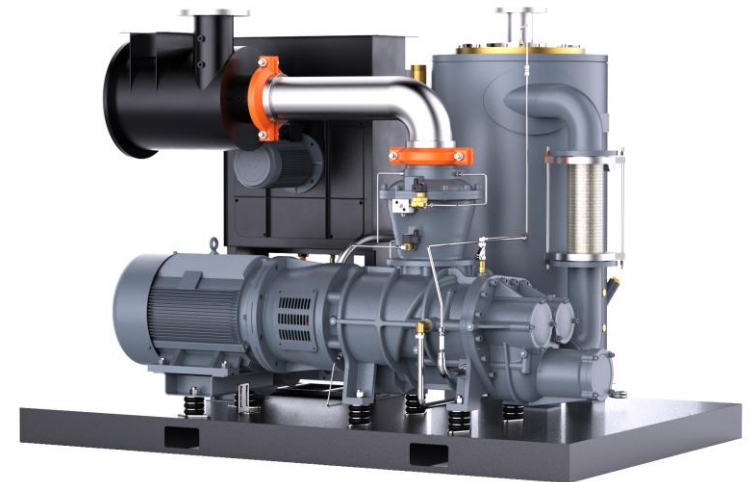
Mechanical Safety

- ❖ Coupling guards
- ❖ Fan guards
- ❖ Belt guards



How are Safety and Maintenance related?

- ❖ A well-maintained system is generally a safe system
- ❖ What does good routine maintenance entail?
- ❖ Key maintenance points and frequency.
- ❖ Who is qualified to perform maintenance?



Pre-Preventative Maintenance

- ❖ Review oil sample reports (check for water!)
- ❖ Check controller fault history
- ❖ Inspect the machine: smell, look, listen, touch.
- ❖ Check for obvious leaks
- ❖ Check amperage and voltage



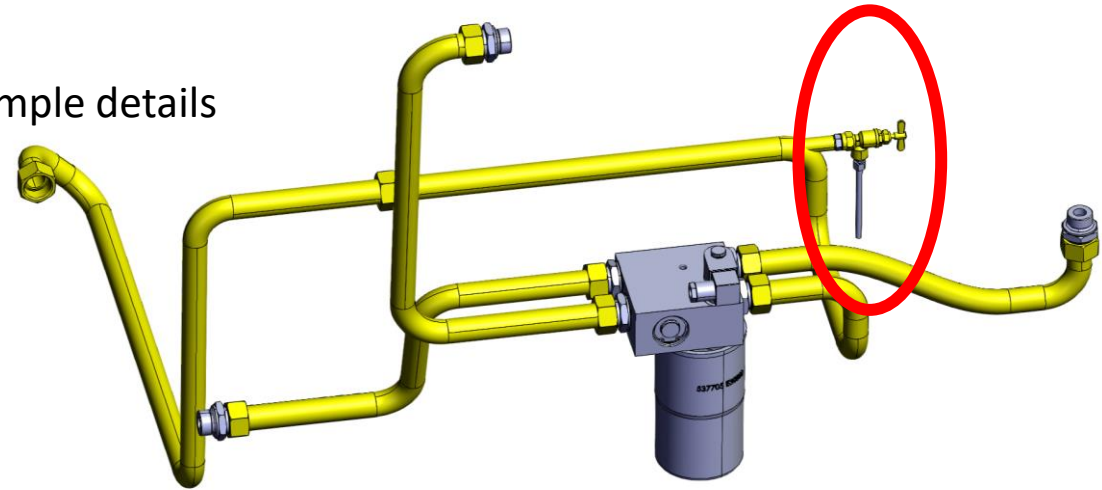
Preventative Maintenance - Filters

- ❖ OEM Filters that support long oil life
 - Oil filter – 2k
 - Inlet air filter – 4k
 - Package air filtration – 4k
 - Air/oil separator element – 8k
 - Upstream Filtration – 8k



Preventative Maintenance - Oil Samples

- ❖ Oil/fluid maintenance is critical
 - Oil Sampling Quarterly
 - ✓ *Health Check-up*
 - TAN (total acid number) critical
 - Particle contamination
 - Water contamination
 - Chemical contamination
 - ✓ *Use the sample valve on clean side of oil filter*
 - Reduces “nuisance” bad reports for high water/particle count
 - Make sure bottles are labelled with full sample details



Preventative Maintenance – Check Oil Level

- ❖ Too much oil
 - High oil carryover
- ❖ Too little oil
 - Runs hot / shortens oil life
 - Risk under lubricating bearings

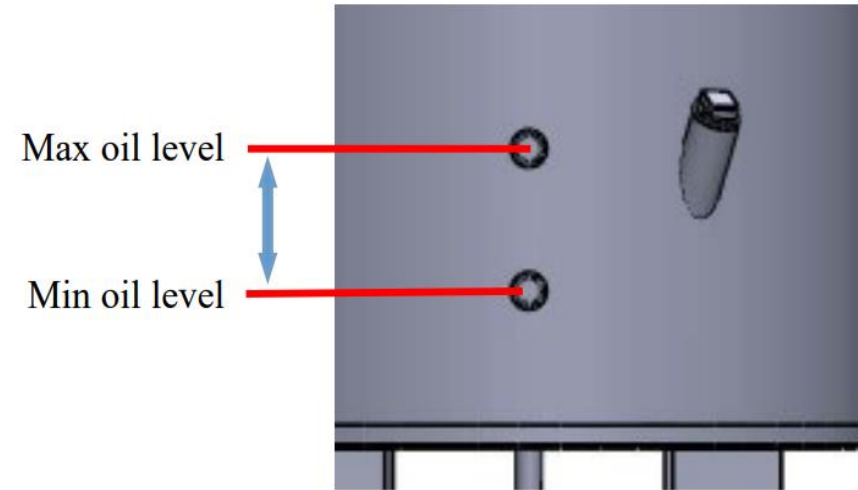
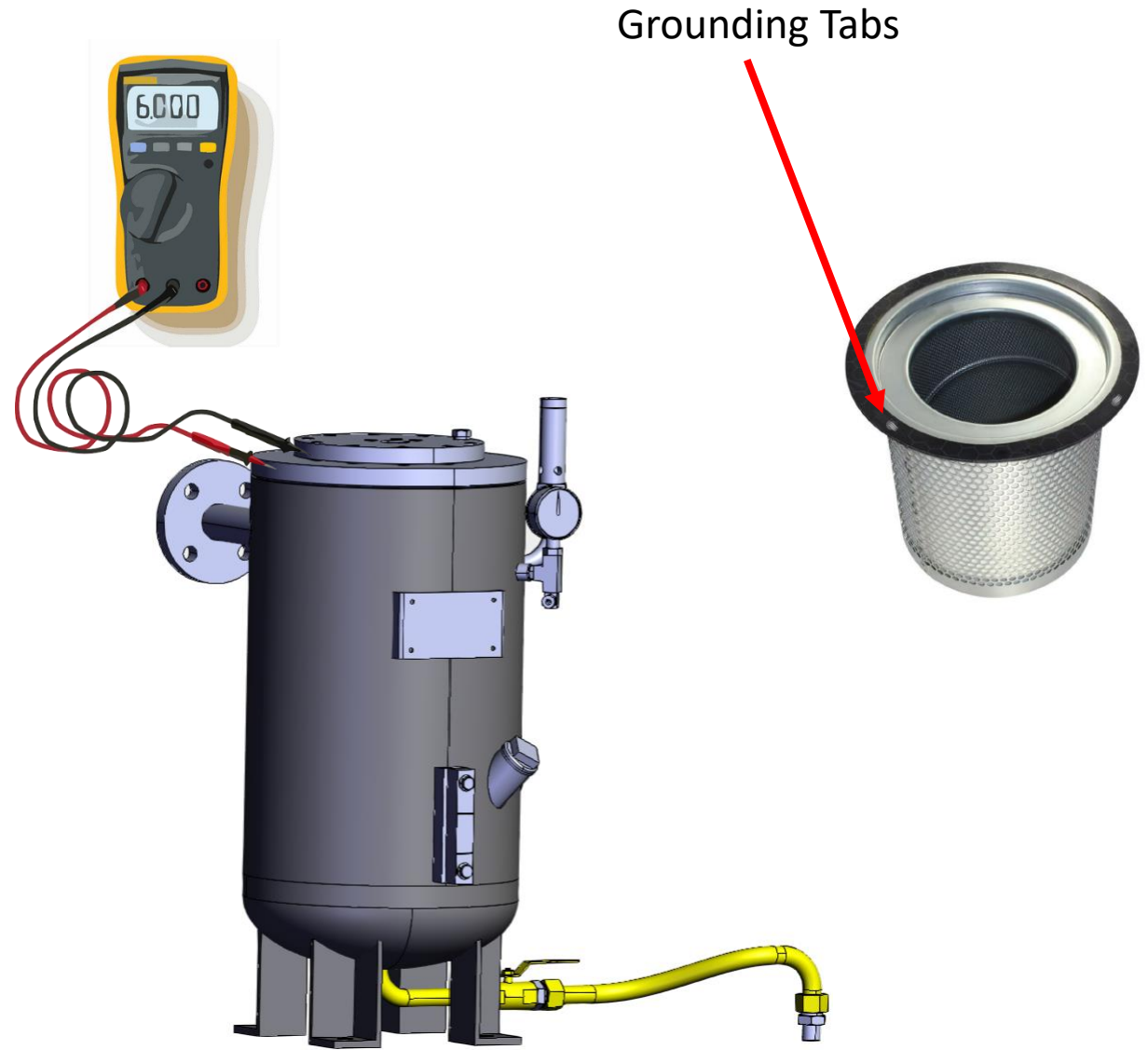


Figure 7 – Sight glass

Separator

- ❖ Less than 3PPM oil carryover
- ❖ Change every 8,000
- ❖ Gaskets require staples or metal tabs!
- ❖ Removable Roof
- ❖ Hinged Lid



Motor Greasing

- ❖ Grease the motor using the data tag's specific interval and amount

MADE IN BRAZIL 12714027	WEG	HGF	CE	NR-17094-1	
	~ 3 kW(IP-2) 370(500)	CARC FRAME 315C/D/E	380 V		
	MOTOR INDUCAD - GAIOLA INDUCT. MOTOR-SQUIRREL CAGE	IS SF 1.00	Hz 60	380 V	
	V 380	A 680	380 V		
	1784	n/h 6.8	P.F. 0.86	380 V	
	REG DUTY S1	RENDIMENTO 96.1	AMB. 40°C	380 V	
	RESOL F Δt 80 K	CAT DES N	U.F.S. S.F.A.	380 V	
	IP55 Alt 1000	M.A.M.M. 2161 kg	380 V		
			380 V		
			380 V		

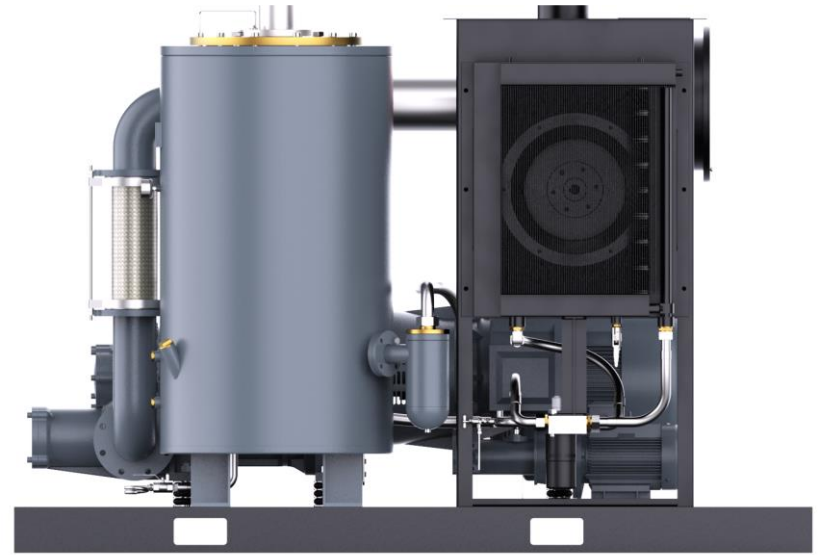
Wiring diagrams for 380 V: Δ (L1, L2, L3) and Y (L1, L2, L3). Terminal labels: W2, U2, Y2, U1, Y1, W1, L1, L2, L3.

Greasing instructions (highlighted in red):
→ 6320-C3(51g) MOBIL POLYREX EM
→ 6316-C3(34g) 2,000 h



Oil Cooler

- ❖ Inspect regularly
- ❖ Blow out quarterly
- ❖ Power wash as needed



Preventative Maintenance - Safety Checks

- ❖ Safety device checks
 - High discharge temperature shutdown
 - Pressure relief devices
 - Electrical connections

FLIR thermal image
phone accessory

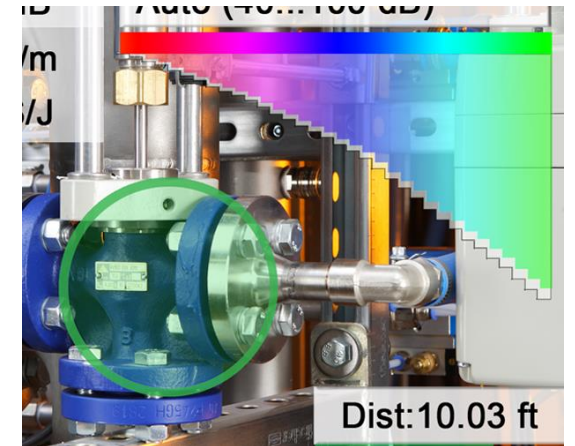


Discharge Temp probe

Preventative Maintenance – Fix Leaks!

❖ Are you adding more pumps but same demand side equipment? **LEAKS!**

- We recommend a leak analysis on a regular basis
 - ✓ *Monthly to Quarterly on compressed air and vacuum systems*
 - Good habits keep system healthy
 - Identify minor problems before they become major
 - ✓ *Newer visual models can save time locating the leak*
 - Easier to determine if its actual usage or a leak
 - Easier to follow up on repair with actual photos
 - ✓ *Can also be used on nitrogen, argon, etc. as well as steam*



- **How to Hunt for Vacuum Leaks: Is it Worthwhile?**

Presenter Ron Marshall, Chief Auditor, Marshall Compressed Air Consulting

Who is qualified to perform maintenance?

- ❖ Certified Technicians
- ❖ Trained in house maintenance
- ❖ PM contracts
- ❖ Extended warranties
- ❖ Use OEM filters, separators and fluids!



Frequency of Maintenance

❖ Weekly

- Visual inspection
 - ✓ *Operating Temps*
 - ✓ *Leaks*
 - ✓ *Check oil level*
 - ✓ *Airflow of Room*
 - ✓ *Sounds & Smells*
 - ✓ *Amps*



❖ Quarterly

- Oil sample
- Oil filter
- Filter DP
- Check Drains
- Blow out coolers

❖ Semi-Annually

- Inlet Air Filter
- Package Filtration
- Grease Motor
- Clean Strainers

❖ Annually

- Oil change
- Separator change
- Safety Checks
- In-line filter changes
- Connections check
- Electrical inspection
- Thermal imaging

Conclusions:

- ❖ Setup your system properly
- ❖ Maintain it regularly & adjust
- ❖ Work with an expert vendor or local distributor trained in vacuum systems.
- ❖ I'll be glad to help you with your questions – contact me.

Thank You

Brandon Dial – Kaishan USA
903-452-8242
bdial@kaishanusa.com
www.kaishanusa.com

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Please submit your answer in the upcoming poll

Which of these are NOT a good vacuum pump maintenance technique?

A

- Regular oil & filter changes

B

- Leak testing

C

- Ignoring unusual sounds

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B

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C

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Vacuum Pump Maintenance

Q&A

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Paul Edwards

Compressed Air Consultants
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