Optimize your Compressed Air System with Proper Maintenance

Ron Marshall
Marshall Compressed Air Consulting
Keynote Speaker

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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 within 2 days

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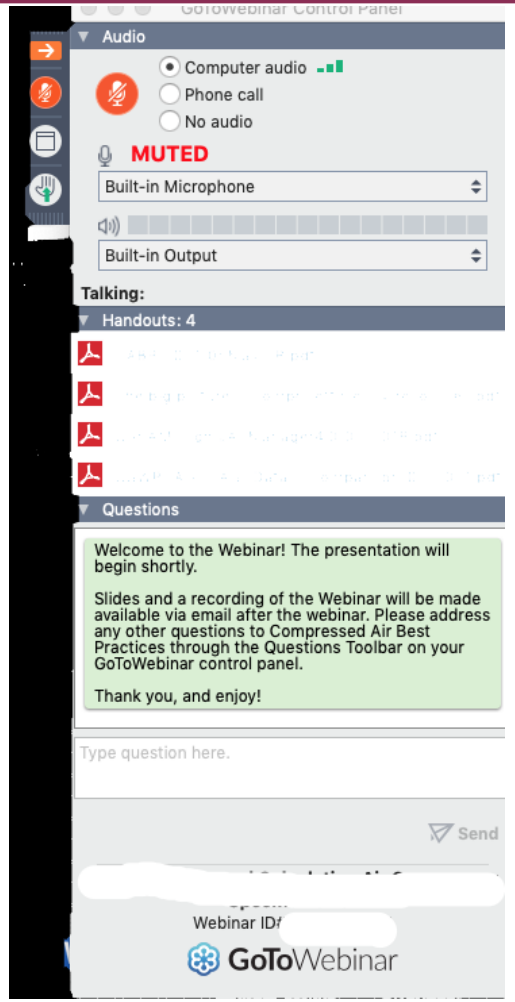
Q&A Format



- 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 Compressed Air Best Practices® Magazine

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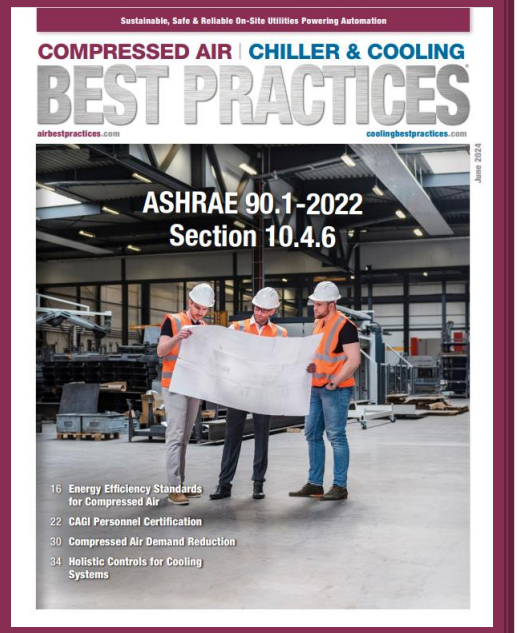
Handouts



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Disclaimer

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

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Optimize your Compressed Air System with Proper Maintenance

Introduction by

Compressed Air Best Practices® Magazine

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About the Speaker

Ron Marshall
Marshall Compressed Air Consulting

- Consultant MCAC
- 38 years with Power Utility
- 27 years Technical CA Support
- CAC Level 2 Instructor
- International Trainer UNIDO
- 600+ projects completed

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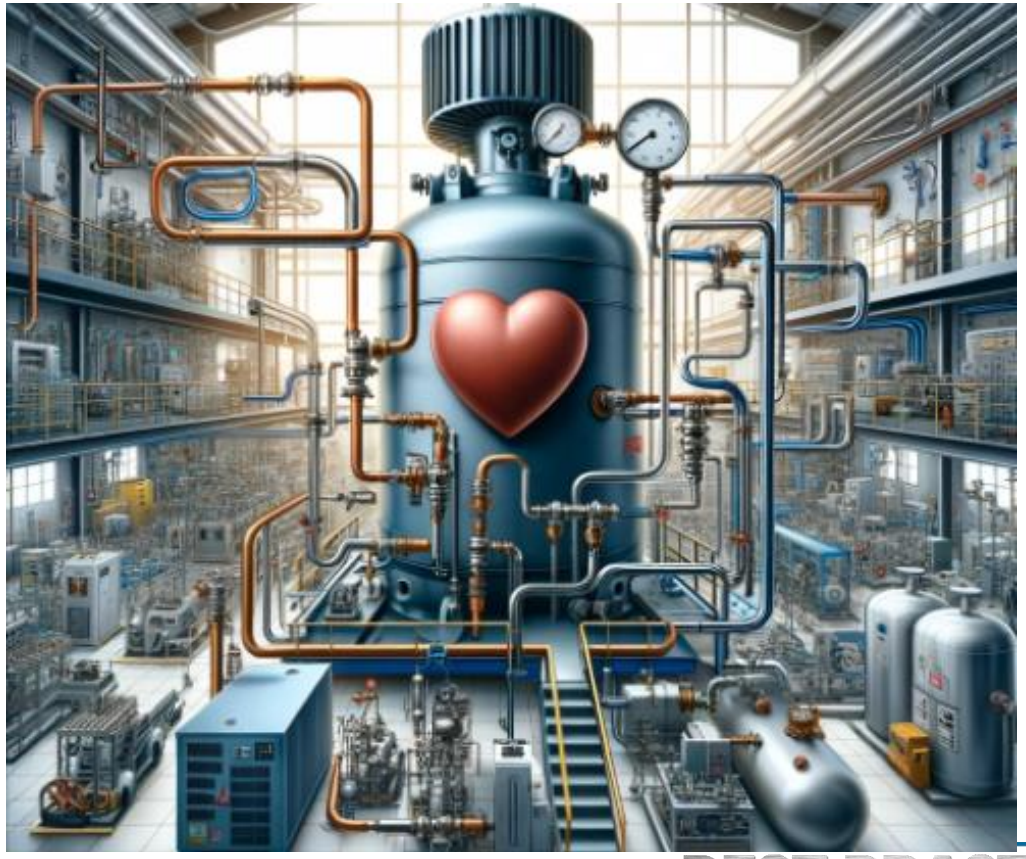
The Air Guy

Coming Up

- The importance of maintenance
- Six important maintenance items
  1. Leaks
  2. Filters
  3. Dryers and traps
  4. Ventilation and cooling
  5. Operating temperatures
  6. Lubricant maintenance/analysis
- Summary

Air system is the heart of the plant

- A failed system take can down the whole plant and stops production.
- Impending failure usually has detectable warning signs.
- Often failure is often caused by lack of maintenance.
- Timely maintenance can detect warning signs and prevent failure

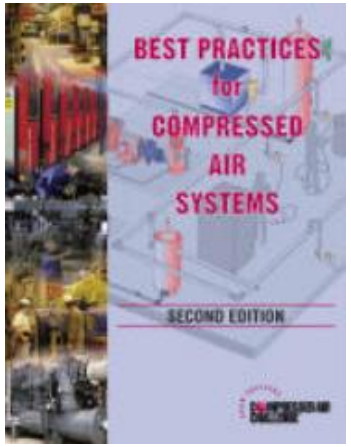


Symptoms of poor maintenance

- Unstable or inadequate air pressure
- High operating costs and inefficiency
- Frequent breakdowns
- Equipment overheating
- Moisture problems
- Contaminated air supply

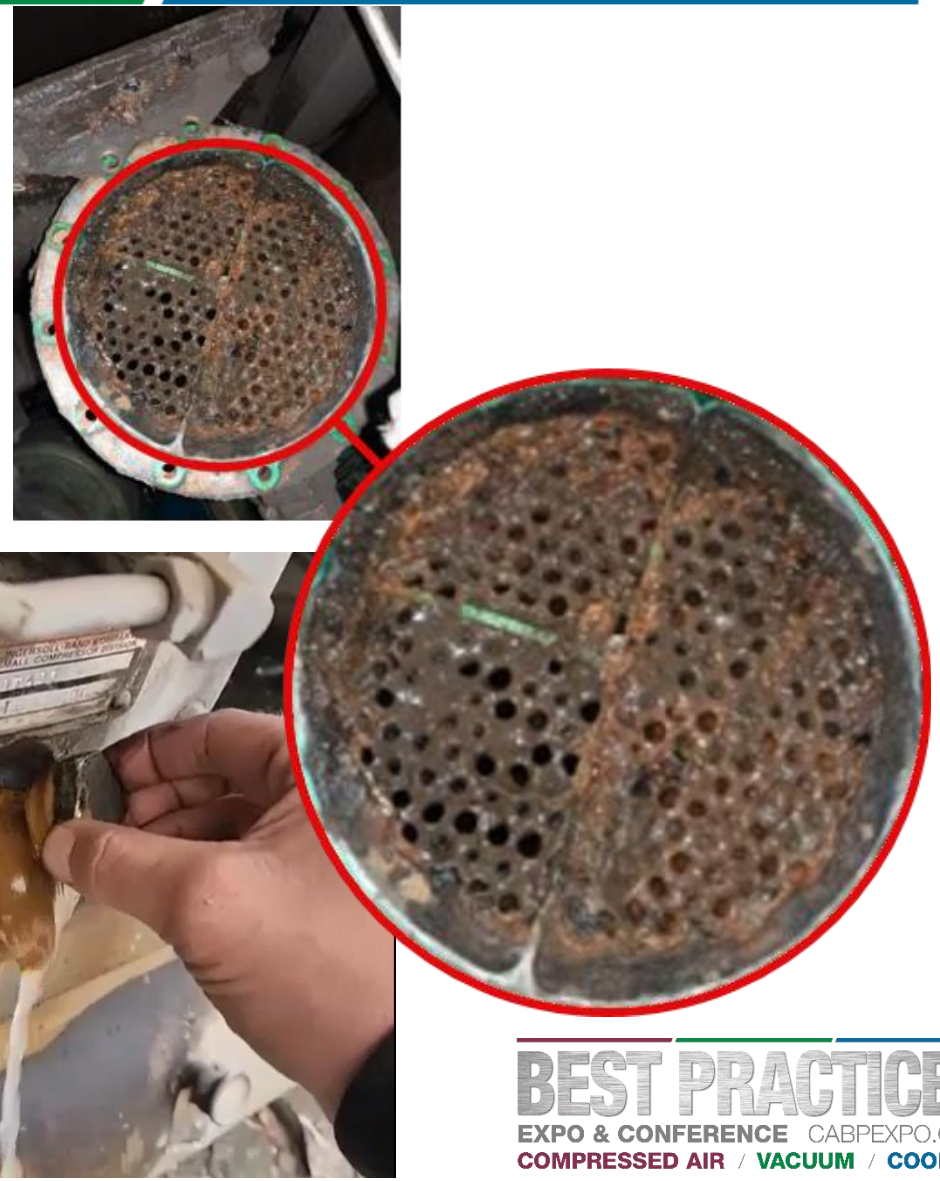
Assessing a system for maintenance issues

- Establish a consistent maintenance routine
- Check pressures and pressure differentials - coordination
- Check operating temperatures/room temperatures
- Look for water or oil in the air/condensate drains
- Lubricant leaks
- Any warnings or maintenance reminders
- Check loaded/running hours
- Follow manufacturers maintenance guidelines
- Resources: CAGI or CAC Best Practices Manual



Six important maintenance items

1. Leak management
2. Filter maintenance, end-use filters and lubricators
3. Air dryer and condensate trap maintenance
4. Proper ventilation, cooling filtering, water quality
5. Monitor and track temperatures
6. Lubricant maintenance/analysis

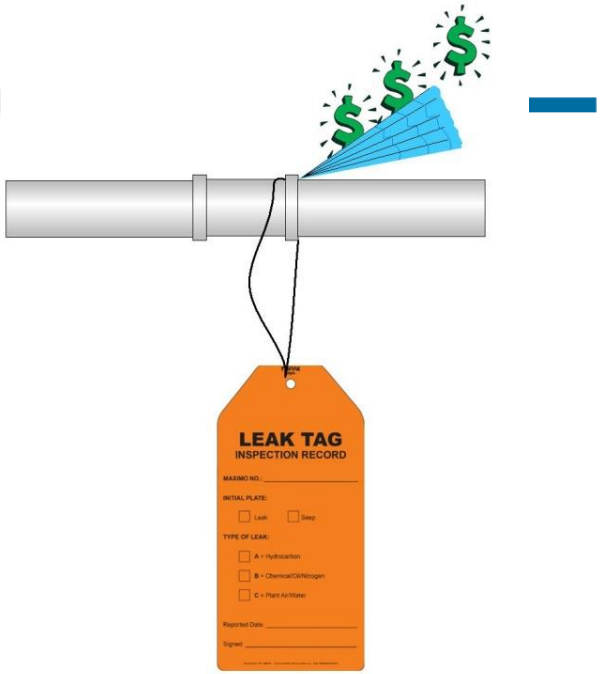


Leak management

- Leaks can make up 20% to 30% of total system demand
- Proactive leak maintenance programs target 5%
- In addition to wasting energy leaks also:
  - Cause a drop in pressure causing end uses to function less effectively, adversely affecting production
  - Leaks shorten the effective life of all system equipment
  - Leaks can lead to adding unnecessary compressor capacity

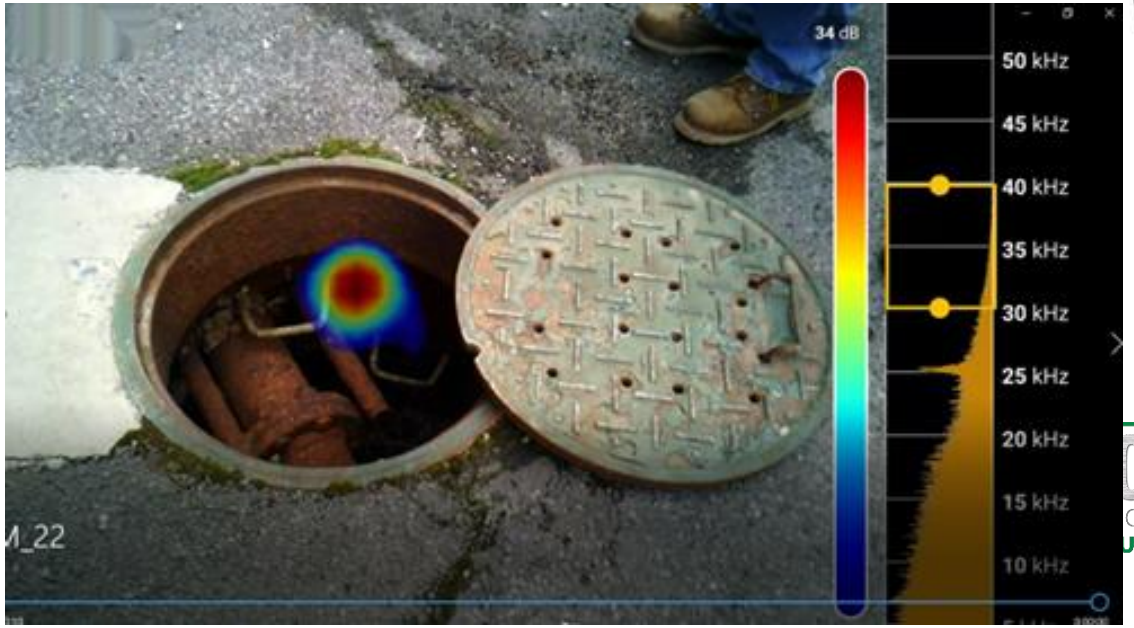
Leak detection

- Leak Tag Program
- Leak is identified with a tag and logged for repair later
- Tag is often a two-part tag
  - One-part stays on leak
  - Other part is turned into maintenance, indentifying the location, size and description of the leak to be repaired.
- Most important – fix the leak!



How acoustic camera leak detection works

- Ultrasonic guns widely used
- New acoustic imagers use microphones and sophisticated signal processing to identify leaks.
- Allows the user to pinpoint sound leaks in walls, doors and floors and target the leak.

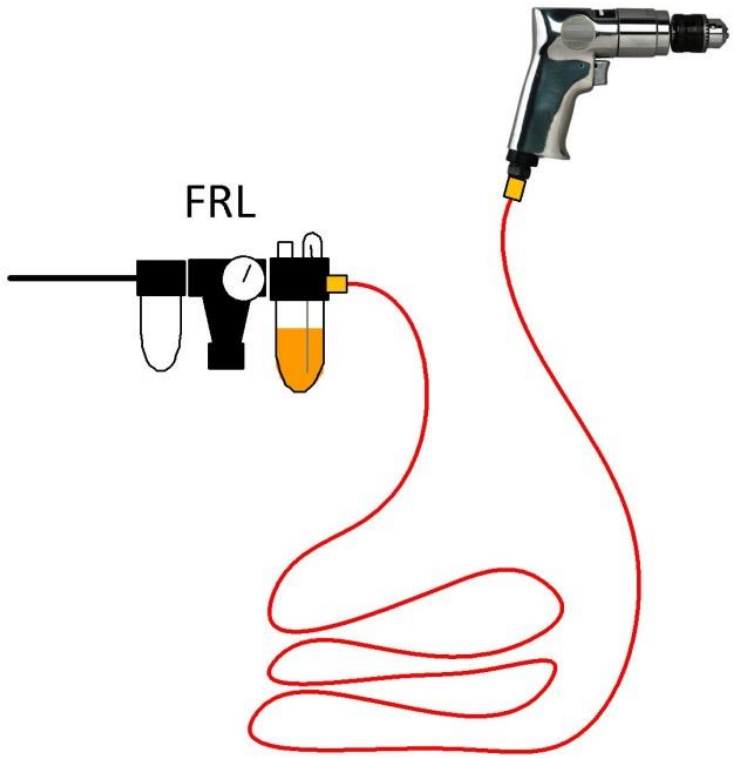


Filter maintenance, end-use filters and lubricators

- Main filter pressure loss can cause rapid compressor cycling and inefficiency
- Use good quality pressure differential gauges – change when indicated or every year
- End use components often represent most of the pressure loss in the system
- Size for peak flow not average
- Maintain lubricator levels, running empty allows wear in connected tools and components

Pressure drop

- Highest pressure drops usually are found at the points of use including undersized or leaking hoses, plastic tubing, disconnects, filters, regulators and lubricators.
- Design then maintain for minimal loss.
- Saves money at the compressors if compressors are correctly controlled.
- Savings depends on compressor control modes



Refrigerated air dryer maintenance

- Over-heat overload is the most common problem – often caused by poor compressor cooling.
- Every 20°F doubles the water content.
- Keep ambient cool, ventilate dryer too.
- Use wet tanks to cool inlet air and catch water.
- Use secondary cooling where needed
- When time to replace go with thermal mass cycling dryer to save energy.

Desiccant air dryer maintenance

- Desiccant that is too hot will not dry, maintain compressor cooling.
- Filter maintenance important on desiccant dryers, desiccant likes to absorb oil but reduces the capacity.
- Ensure purge flow is correct.
- Test and maintain desiccant, it ages.
- Dryer dewpoint control must operate correctly – test – if missing retrofit.

Proper ventilation, cooling, water quality

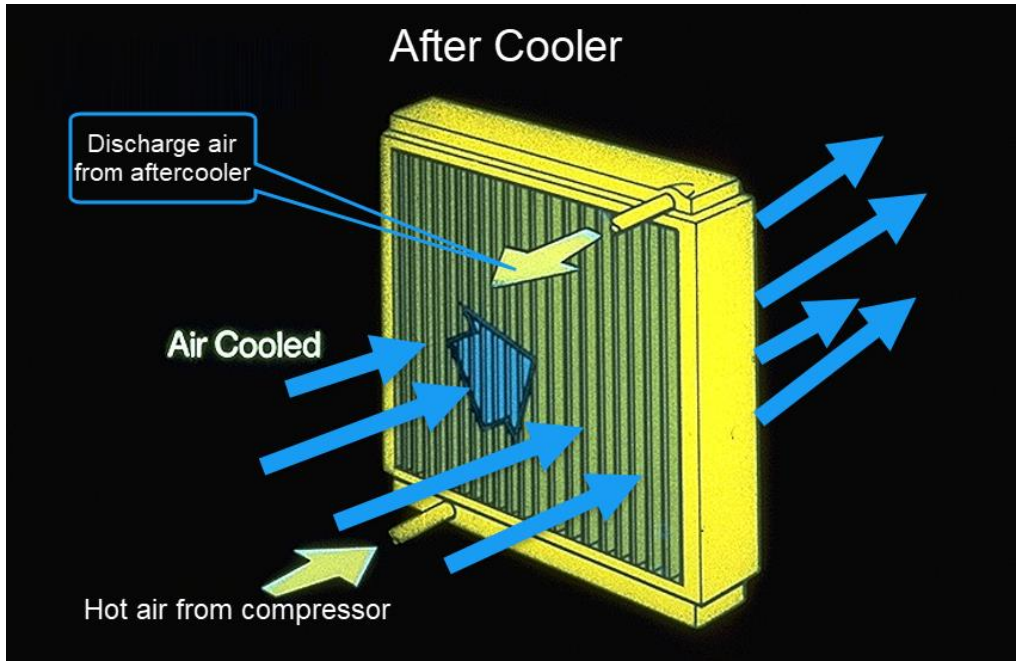
- Filter the cooling air in dusty environments
- Cross ventilation is required – remove radiated heat
- Uninsulated ducts heat up cooling air
- Maintain evaporative cooling systems and ensure proper blowdown
- Test cooling water to ensure quality
- Recover heat for savings

Monitor and track temperatures

- Temperature is an indicator of how systems are performing
- The following measurements are important:
  - Air Intake Temperature
  - Ambient Air Temperature (cooling air)
  - Intercooler Approach Temperature (multi-stage compressors)
  - Lubricant Injected Rotary Screw Oil Temperature
  - Compressor Discharge Temperature
  - Thermo-mixing Valve Temperature (Oil in, Oil out and to sump cooler)

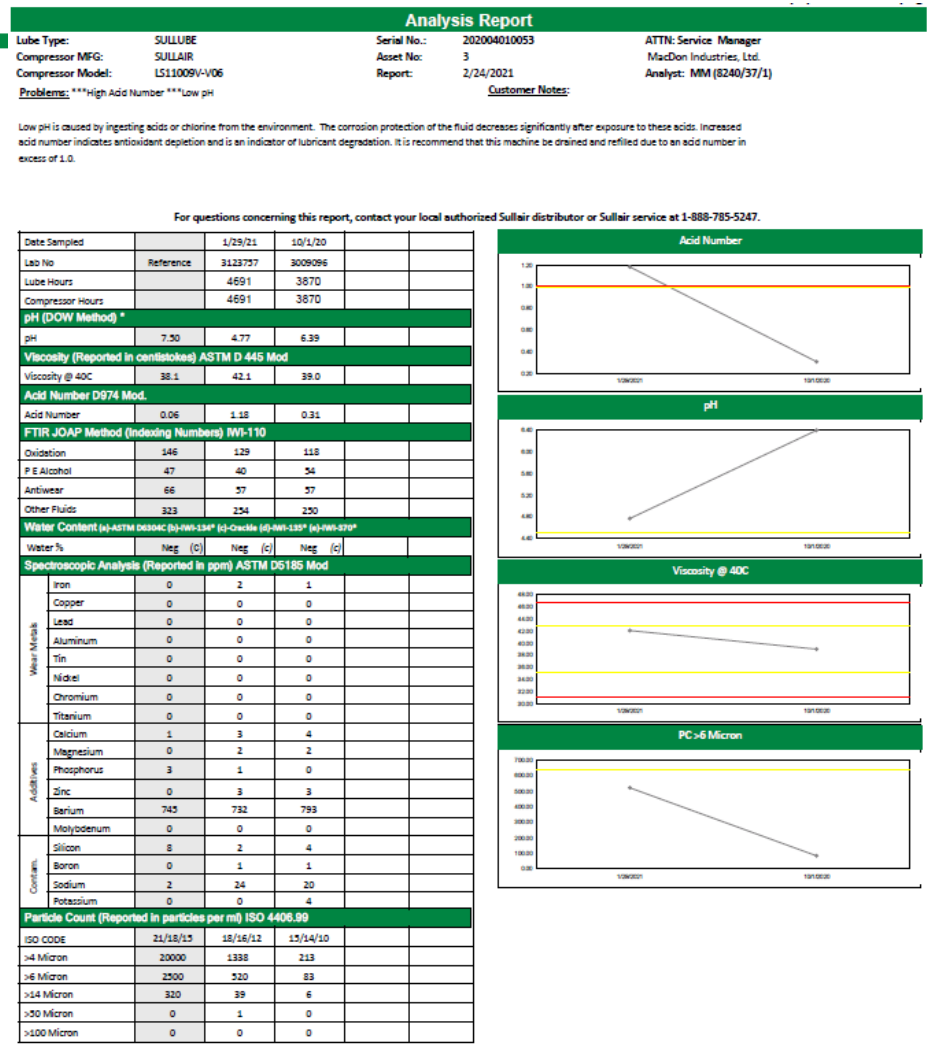
Monitor and track temperatures

- The following other measurements are important:
  - Aftercooler Outlet Temperatures
  - Dryer Inlet Temperatures
  - Dryer (Condenser) Ambient Temperature (air-cooled)
  - Dryer (Condenser) Water Inlet and Outlet Temperatures (water-cooled)
  - Motor Temperatures
  - Bearing Temperatures



Lubricant analysis

- Lubricant analysis results are an indicator of compressor condition
- Key variables to watch in lubricant analysis include:
  - Particle count (ISO code)
  - Total acid number (TAN)
  - Anti-oxidant level
  - Lubricant life remaining
  - Viscosity
  - Contamination … other lubricants
  - Water ppm



Analysis Report

Lube Type:	SULLUBE	Serial No.:	202004010053	ATTN: Service Manager	
Compressor MFG:	SULLAIR	Asset No:	3	MacDon Industries, Ltd.	
Compressor Model:	LS11009V-V06	Report:	2/24/2021	Analyst: MM (8240/37/1)	

Problems: ***High Acid Number ***Low pH

Customer Notes:

Low pH is caused by ingesting acids or chlorine from the environment. The corrosion protection of the fluid decreases significantly after exposure to these acids. Increased acid number indicates antioxidant depletion and is an indicator of lubricant degradation. It is recommend that this machine be drained and refilled due to an acid number in excess of 1.0.

For questions concerning this report, contact your local authorized Sullair distributor or Sullair service at 1-888-785-5247.

Date Sampled		1/29/21	10/1/20			
Lab No	Reference	3123757	3009096			
Lube Hours		4691	3870			
Compressor Hours		4691	3870			
pH (DOW Method) *						
pH	7.50	4.77	6.39			
Viscosity (Reported in centistokes) ASTM D 445 Mod						
Viscosity @ 40C	38.1	42.1	39.0			
Acid Number D974 Mod.						
Acid Number	0.06	1.18	0.31			
FTIR JOAP Method (Indexing Numbers) IWI-110						
Oxidation	146	129	118			
P E Alcohol	47	40	54			
Antiwear	66	57	57			
Other Fluids	323	254	250			
Water Content (a)-ASTM D6304C (b)-IWI-134* (c)-Crackle (d)-IWI-135* (e)-IWI-370*						
Water %	Neg (c)	Neg (c)	Neg (c)			
Spectroscopic Analysis (Reported in ppm) ASTM D5185 Mod						
Wear Metals	Iron	0	2	1		
	Copper	0	0	0		
	Lead	0	0	0		
	Aluminum	0	0	0		
	Tin	0	0	0		
	Nickel	0	0	0		
	Chromium	0	0	0		
	Titanium	0	0	0		
Additives	Calcium	1	3	4		
	Magnesium	0	2	2		
	Phosphorus	3	1	0		
	Zinc	0	3	3		
	Barium	745	732	793		
	Molybdenum	0	0	0		
Contam.	Silicon	8	2	4		
	Boron	0	1	1		
	Sodium	2	24	20		
	Potassium	0	0	4		
Particle Count (Reported in particles per ml) ISO 4406.99						
ISO CODE	21/18/15	18/16/12	15/14/10			
>4 Micron	20000	1338	213			
>6 Micron	2500	520	83			
>14 Micron	320	39	6			
>50 Micron	0	1	0			
>100 Micron	0	0	0			

Summary

- Maintenance is important as the compressed air system is the heart of the plant
- Need to maintain for reliability, efficiency, pressure stability and air quality.
- Six important maintenance areas:
  1. Leaks
  2. Filters and lubricators
  3. Dryers and traps
  4. Ventilation and cooling
  5. Operating temperatures
  6. Lubricant maintenance/analysis

About the Speaker

John Wilkerson
Kaishan

- Training & Support Leader, Kaishan
- 21 years of compressor service & installation experience
- Certified in oil-free, centrifugal, oil-flooded, scroll, and refrigeration compressor maintenance

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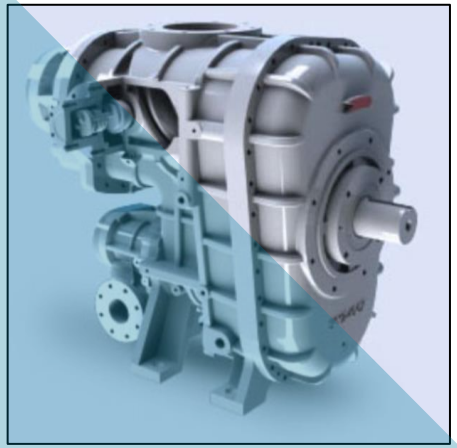

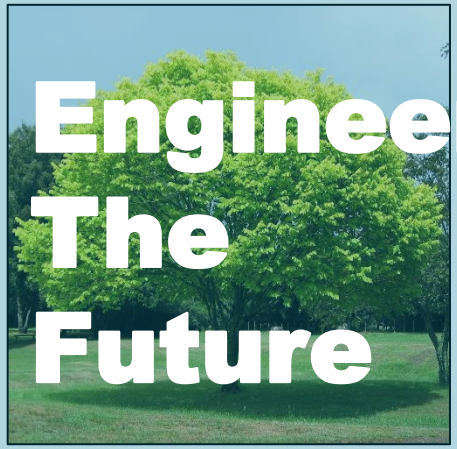

KAISHAN

Rotary Screw Compressor System Setup & Maintenance

June 2024

John Wilkerson
Technical Support Manager
Kaishan USA

Rotary Screw Compressor Systems

- Building an effective maintenance plan
- Check your compressor's vitals
- Oil Sampling

Rotary Screw Compressor Systems

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Building an Effective Maintenance Plan

- Choose a business partner
- Create daily check list
- Forget tolerances, look for changes

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Choose a Business Partner

- Certified Technicians
- Invests in training
- Offers maintenance agreements
- Qualified to perform warranty repair
- Use OEM filters, separators and fluids!

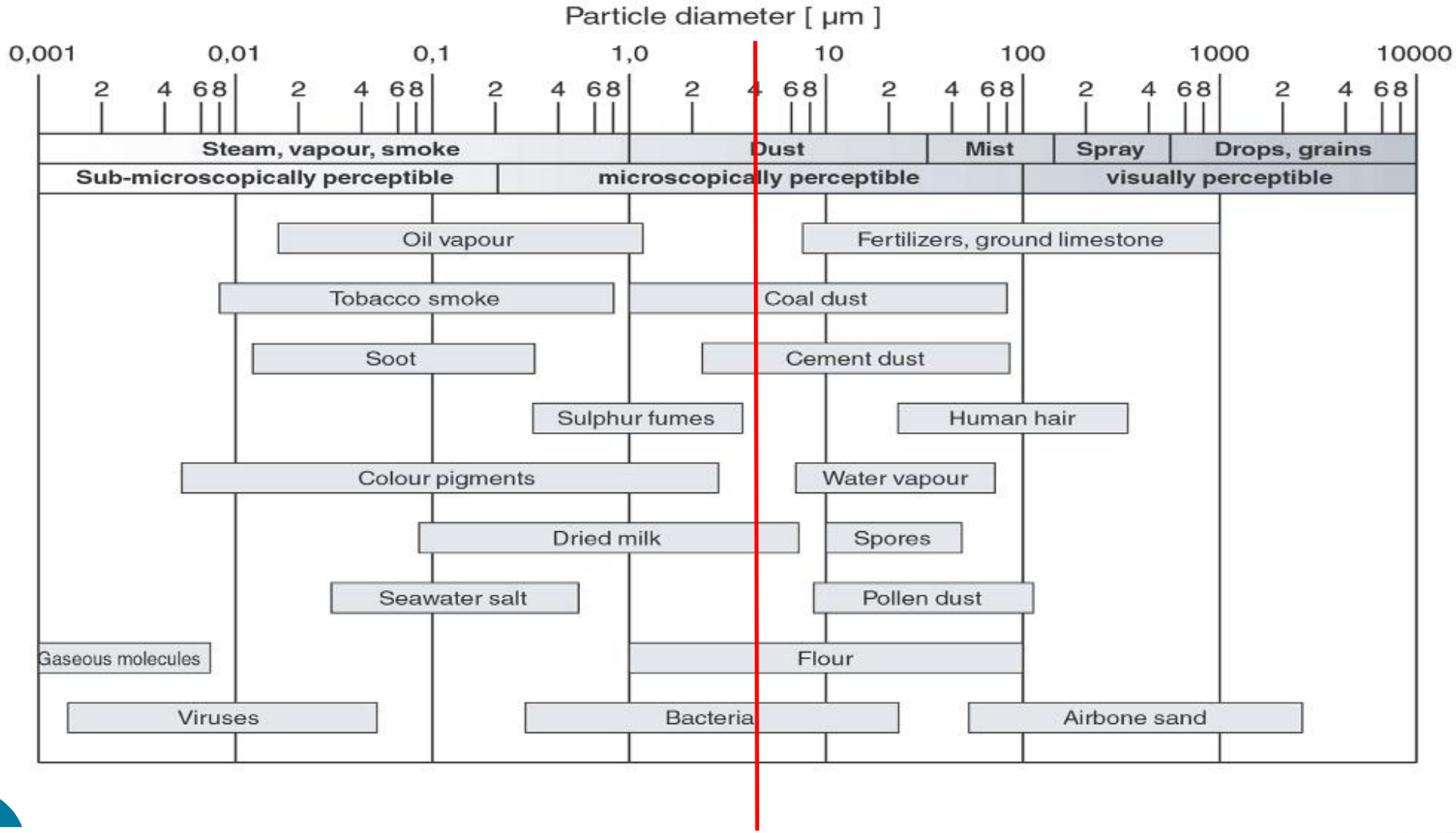
Rotary Screw Compressor Systems

- Building an effective maintenance plan
- Check your compressor's vitals
- Oil Sampling

Check Your Vitals

- Reduce load cycles
- Reduce motor starts
- Remove/prevent condensation
- Control temperatures
- Adapt to your ambient conditions

Adapt to Ambient Conditions



Corrosion Coupon

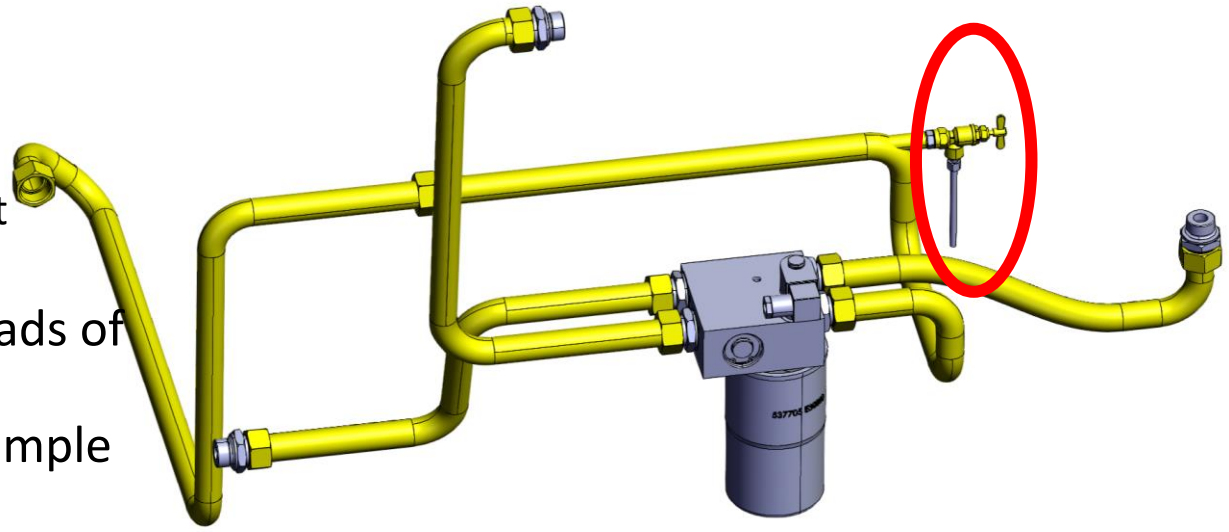
https://corrosionmonitor.com/products/corrosion-classification-coupon-plus

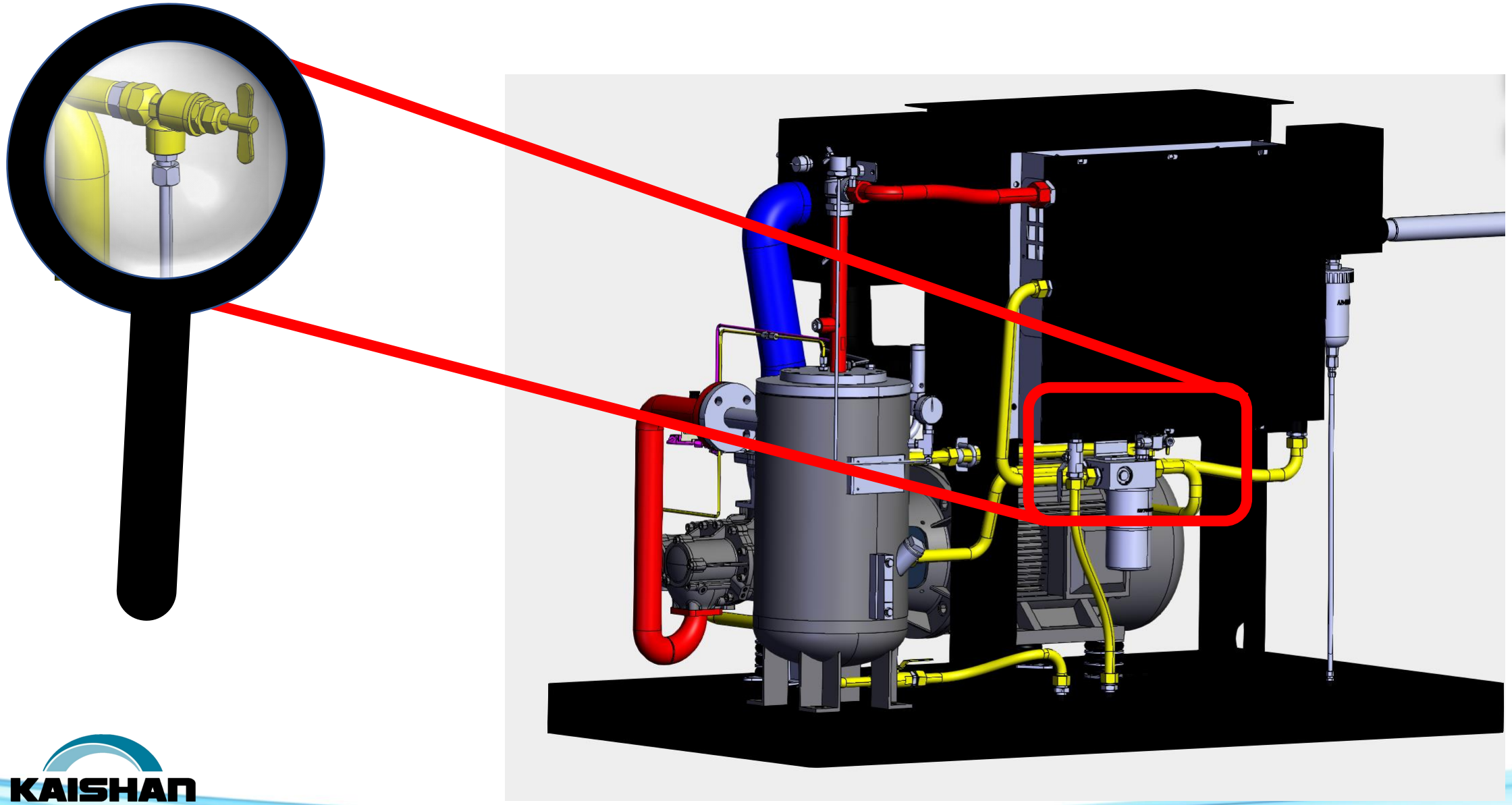
Rotary Screw Compressor Systems

- Building an effective maintenance plan
- Check your compressor's vitals
- Oil Sampling

Sample Procedure

- Locate oil sample valve (photo on next slide)
  - Needle type valve on clean side of filter
  - Reduces “nuisance” bad reports for high water/particle count
- Fill sample bottle up to above 80% but below the threads of the bottle.
- Seal the bottle tightly, wipe clean. Pre-label or label sample bottle immediately after filling to avoid mix-ups.
- Make sure bottles are labelled with full sample details
- Oil Samples are taken to determine if the oil is failing
- Do not rely on the oil samples to protect the airend from debris or water





Lubricant Analysis Report

North America: +1-251-202-0577

0	1	2	3	4
NORMAL		ABNORMAL		CRITICAL

Comments	Check for source of water contamination (SEALS, BREATHERS, FILL PORTS). Water is at a SEVERE LEVEL. Particle Count is at a MINOR LEVEL. Barium is an additive in many transmission, gear and compressor oils; Please provide COMPONENT MODEL number to compare data to the correct standards for this component. Lubricant and filter change acknowledged.

Sample Approver Comments	16-Mar-2023	no changes

	Wear Metals (ppm)										Contaminant Metals (ppm)			Multi-Source Metals (ppm)						Additive Metals (ppm)				
Sample #	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
BL	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	20	0
1	1	0	0	1	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	6	25	34	7

	Sample Information							Contaminants			Fluid Properties					
Sample #	Date Sampled	Date Received	Lube Time	Unit Time	Lube Change	Lube Added	Filter Change	Fuel Dilution	Soot	Water	Viscosity 40°C	Viscosity 100 °C	Acid Number	Base No. D4739	Oxidation	Nitration
			h	h		gal		%	%	%	cSt	cSt	mg KOH / g	mg KOH / g	abs / cm	abs / 0.1mm
BL	N/A	15-Jan-2021	0	0	Unk	0	Unk				46.9	8.3	0.02			
1	08-Mar-2023	15-Mar-2023	504	11869	Yes	0	Yes				47.7		0.45			

	Particle Count (particles/mL)										Additional Testing
Sample #	ISO Code	> 4	> 6	> 10	> 14	> 21	> 38	> 70	> 100	Test Method	Water by Karl Fischer - mod. 6304C
	Based On 4/6/14	particles / mL	particles / mL	particles / mL	particles / mL	particles / mL	particles / mL	particles / mL	particles / mL		ppm
BL	19 / 16 / 11	2948	496	62	18	4	1	0	0	ASTM D7647	53
1	23 / 21 / 17	53202	16803	3641	1135	215	8	0	0	ASTM D7647	**797**

Lubricant Analysis Report

North America: +1-251-202-0577

0	1	2	3	4
NORMAL		ABNORMAL		CRITICAL

Overall report severity based on comments.

The severity will have a corresponding highlighted section and comments

Account Information		Component Information		Sample Information	
Account Number:		Serial #:	K371805806U	Tracking Number:	23132R65984
Company Name:		Model Number:	KRSP-50	Lab Number:	I-561622
Contact:		Component Type:	ROTARY SCREW COMPRESSOR	Lab Location:	Indianapolis
Address:		Manufacturer:	KAISHAN	Data Analyst:	RNM
Phone Number:		Model:	Information Requested	Sampled:	12-Jul-2023
		Application:	UNKNOWN	Received:	21-Aug-2023
		Sump Capacity:	5 gal	Completed:	23-Aug-2023

Filter Information		Miscellaneous Information	Product Information	
Filter Type:	Information Requested		Product Manufacturer:	KAISHAN
Micron Rating:	0		Product Name:	KTL 4000 FG
			Viscosity Grade:	ISO 46

Comments	Suggest monitoring the drain interval and equipment operating temperature. Acid Number is SEVERELY HIGH, which may be due to oxidation, contamination with an acidic product, or lubricant mixing. Elevated acid levels lead to corrosive component wear. Viscosity is MODERATELY HIGH. Causes include contamination, oxidation, incorrectly identified viscosity grade, or adding a different viscosity grade to the component. Zinc is slightly high for this lubricant. Please provide COMPONENT MODEL number to compare data to the correct standards for this component. While unit is hot drain as much of the compressor fluid as possible.Drain all low-lying areas. Refill with COMPRESSOR FLUSH. After 250-300 hrs resample the COMPRESSOR FLUSH.

Sample Approver Comments	24-Aug-2023	no changes

"BL" is the baseline based on what a new oil looks like

The most recent sample is at the bottom

	Wear Metals (ppm)										Contaminant Metals (ppm)			Multi-Source Metals (ppm)						Additive Metals (ppm)				
Sample #	Iron	Chromium	Nickel	Aluminum	Copper	Lead	Tin	Cadmium	Silver	Vanadium	Silicon	Sodium	Potassium	Titanium	Molybdenum	Antimony	Manganese	Lithium	Boron	Magnesium	Calcium	Barium	Phosphorus	Zinc
BL	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	9	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	1	9	1
3	1	0	0	0	2	0	1	0	0	0	1	2	0	0	0	1	0	0	1	0	0	0	7	60
4	1	0	0	1	5	0	0	0	0	0	1	3	0	0	0	0	0	0	1	0	1	0	5	56
5	2	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	2	9	40

If anything is out of tolerance, It will be highlighted and a comment will be provided

	Sample Information							Contaminants			Fluid Properties					
Sample #	Date Sampled	Date Received	Lube Time h	Unit Time h	Lube Change	Lube Added gal	Filter Change	Fuel Dilution %	Soot %	Water %	Viscosity 40°C cSt	Viscosity 100 °C cSt	Acid Number mg KOH / g	Base No. D4739 mg KOH / g	Oxidation abs / cm	Nitration abs / 0.1mm
BL	N/A	15-Jan-2021	0	0	Unk	0	Unk				45.0	7.7	0.01			
1	28-Feb-2022	22-Mar-2022	879	5469	No	0	Yes				46.5		0.02			
2	31-Aug-2022	21-Sep-2022	4	0	Yes	0	Yes				48.3		**2.12**			
3	24-Feb-2023	16-Mar-2023	0	0	No	0	Yes				50.0		**1.21**			
4	08-Jun-2023	07-Jul-2023	1961	8902	No	0	Yes				53.9		**2.40**			
5	12-Jul-2023	21-Aug-2023	2314	9255	No	0	Yes				56.7		**3.94**			

	Particle Count (particles/mL)										Additional Testing
Sample #	ISO Code Based On 4/6/14	> 4 particles / mL	> 6 particles / mL	> 10 particles / mL	> 14 particles / mL	> 21 particles / mL	> 38 particles / mL	> 70 particles / mL	> 100 particles / mL	Test Method	Water by Karl Fischer - mod. 6304C ppm
BL	17 / 15 / 12	1285	310	60	20	4	0	0	0	ASTM D7647	1
1	21 / 20 / 16	17301	5867	1394	476	94	3	0	0	ASTM D7647	17
2	19 / 17 / 14	3255	986	275	110	30	2	0	0	ASTM D7647	75
3	18 / 17 / 13	2197	748	184	60	13	0	0	0	ASTM D7647	38
4	19 / 18 / 16	4892	2009	679	344	141	12	0	0	ASTM D7647	106
5	16 / 14 / 11	493	99	23	12	4	1	0	0	ASTM D7647	182

Comments are advisory only and are based on the assumption that the sample and data submitted are valid. Results [illegible] items tested. Missing fluid or component information limits the evaluation. No warranty is expressed or implied. Measurement uncertainty available upon request.

Pay close attention to water content

Air Filter

Oil filter

	Particle Count (particles/mL)										Additional Testing
Sample #	ISO Code Based On 4/6/14	> 4 particles / mL	> 6 particles / mL	> 10 particles / mL	> 14 particles / mL	> 21 particles / mL	> 38 particles / mL	> 70 particles / mL	> 100 particles / mL	Test Method	Water by Karl Fischer - mod. 6304C ppm
1	24 / 23 / 20	155110	70629	18653	7074	**1987**	117	2	1	ASTM D7647	122

Comments are advisory only and are based on the assumption that the sample and data submitted are valid. Results relate only to the items tested. Missing fluid or component information limits the evaluation. No warranty is expressed or implied. Measurement uncertainty available upon request.

Conclusions:

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

John Wilkerson– Kaishan USA
251-257-0773
jwilkerson@kaishanusa.com
www.kaishanusa.com

Best Practices EXPO Contest

Play for a chance to win a **FREE Full Conference Pass** to the Best Practices 2024 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 main function of a filter in a compressed air system?

A	• Heat Reduction
B	• Moisture Removal
C	• Contaminant Elimination

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

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Optimize your Compressed Air System with Proper Maintenance

Q&A

Please submit any questions through the Question Window on your GoToWebinar interface, directing them to Compressed Air 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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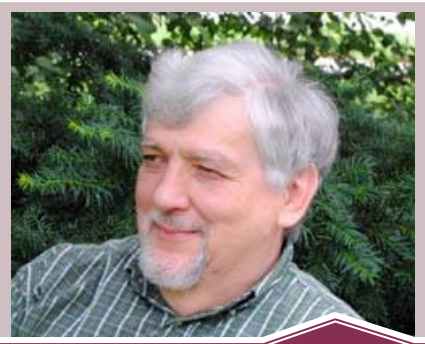
The recording and slides of this webinar will be made available to attendees via email later today.

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

June 2024 Webinar

Advanced Aeration Control for Blowers



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