



Metropolitan Air Compressor Co., Inc.

Compressed Air - Food/Bev

Presented By: Adam Zimmerman



Meeting Summary

Metro Air

Treatment

Compressor Types &
Selection

Measurment

Questions





Metropolitan Air Compressor Co., Inc.



Metropolitan Air Compressor Co., Inc.

Serving the Michigan
Market Since 1975

Certified Auditor on
Staff

Turnkey System Provider

Largest Service
Department In The Area

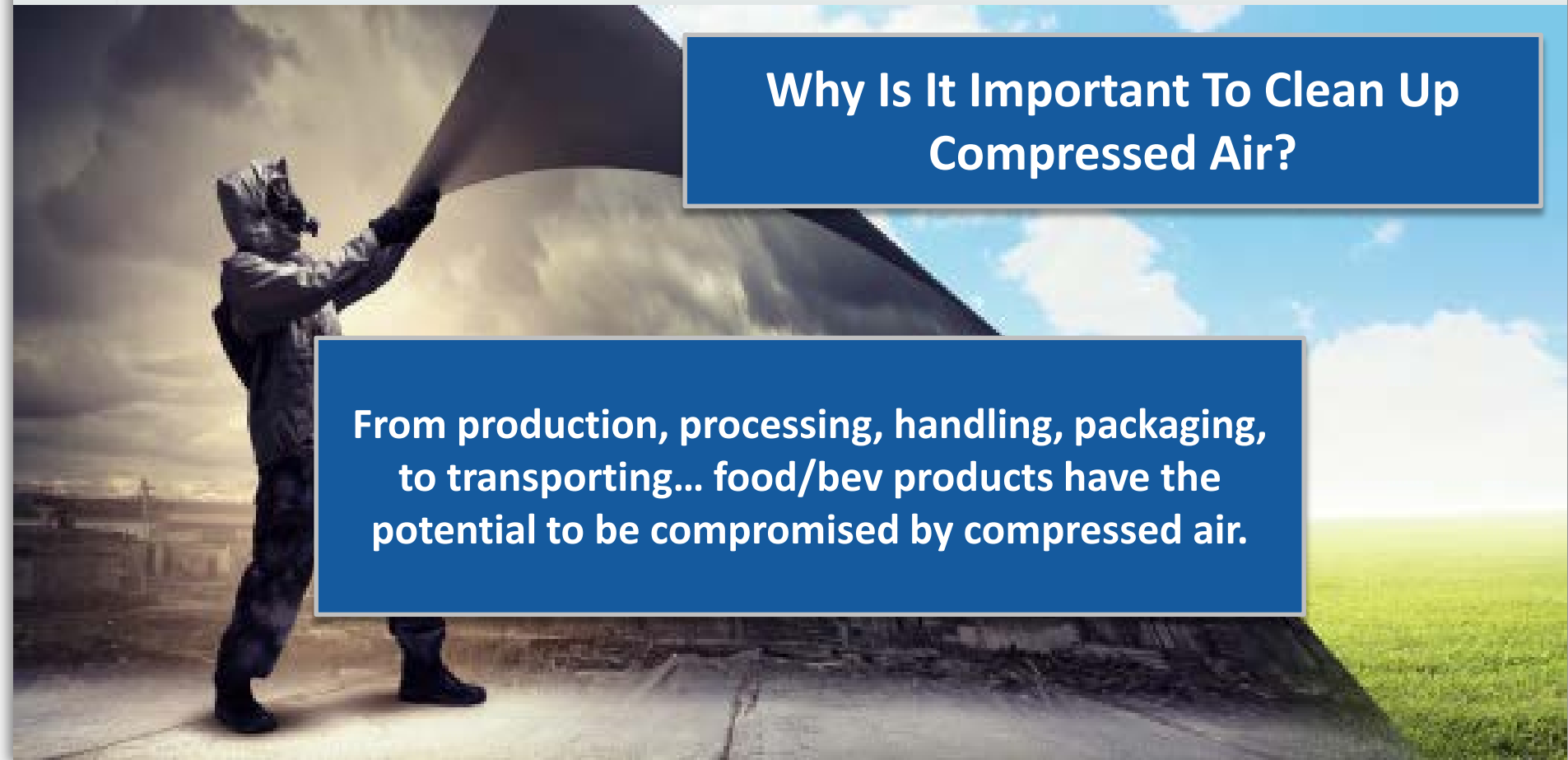
Complete Staff CAGI
Trained

Compressed Air,
Vacuum, and Service

Compressed Air Treatment

**Why Is It Important To Clean Up
Compressed Air?**

**From production, processing, handling, packaging,
to transporting... food/bev products have the
potential to be compromised by compressed air.**



Compressed Air Treatment

Benchmarking of Compressed Air GMPs

Good Manufacturing Practices - Compressed Air in Food Plant	Dew Point	Oil Removal	Particulate Removal (Includes microbiological particles)	Efficiency	Location of Filtration
FDA Code of Federal Regulations Title 21CFR, Part 110.40 (g) ¹		Compressed air or other gases mechanically introduced into food or used to clean food-contact surfaces or equipment shall be treated in such a way that food is not contaminated with unlawful indirect food additives.			
FDA Guidance RTE foods ²			0.3 Micron		Point of use
FDA and the FSMA ¹² (Food Safety Modernization Act)		The FSMA does not introduce any specific regulations related to compressed air. It primarily requires companies under FDA jurisdiction to employ a risk-based (HACCP-like) food safety management scheme.			
3-A Standard 604-05-3A ³ Section: D6.6.1		Point of Use-Contact (sterile air): 99.999% ¹⁰ All other: 99% ¹⁰			
British Compressed Air Society (BCAS) ⁴ Section 6	-40° F/C	< 0.01 mg/m ³	0.1 - 0.5 Micron		
British Retail Consortium (BRC) ⁹		Compressed air used directly in contact with the product shall be filtered.			
Safe Quality Foods (SQF) 7.2 edition ⁵ .		Compressed air that contacts food or food contact surfaces shall be clean and present no risk to food safety. Compressed air systems used in the manufacturing process shall be maintained and regularly monitored for purity.			
SQF Guidance Document for Edition 7.2, July 2014			0.01 Micron	99.999%	Point of use
International Featured Standards (IFS) version 6 ⁶ . Section 4.9.10.2		Compressed air shall not pose a risk of contamination.			
Global Red Meat Standard (GRMS) ⁷		Hazards relevant to food safety shall be controlled in critical control points (CCP) and/or by GMP measures.			
FSSC 22000 ISO 22000:2005 ⁸ + BSI PAS 220:2008 ¹¹	ISO22000:2005 := Prerequisite Programs should be in place to address supplies of air (Section 7.2.3.C) BSI PAS 220:2008 Section 6.5 := (Summarized) Compressed air systems shall be constructed and maintained so as to prevent contamination. Requirements for filtration, microbiology, and humidity (RH%) shall be specified. Filtration of the air should be as close to the point of use as is practicable.				
Most Demanding Purification Levels	-40° F/C	< 0.01 mg/m ³	0.01 Micron	Point of Use-Contact: 99.999%	Point of use



= Not Specified

= Most critical standard

Compressed Air Treatment

Moisture

Oil

Particulates

Air qualities in accordance with ISO 8573-1:2010

Class	Solid particles, max. number of particles per m ³			Pressure dew point	Oil content (liquid, aerosol, oil vapor)
	0.1 µm < d ≤ 0.5 µm	0.5 µm < d ≤ 1.0 µm	1.0 µm < d ≤ 5.0 µm	°F	mg/m ³
0	In accordance with the unit operator's or supplier's specifications, stricter requirements than class 1				
1	≤20,000	≤400	≤10	≤-100	≤0.01
2	≤400,000	≤6,000	≤100	≤-40	≤0.1
3	-	≤90,000	≤1,000	≤-4	≤1
4	-	-	≤10,000	≤37	≤5
5	-	-	≤100,000	≤45	> 5
6	-	-	-	≤50	-

■ Measured in accordance with ISO 8573-4, ref. conditions 14.5 psi [a] absolute, 68 °F, 0% RH

■ Measured in accordance with ISO 8573-3

■ Measured in accordance with ISO 8573-2 and ISO 8573-5, ref. conditions 14.5 psi [a] absolute, 68 °F, 0% RH

Compressed Air Treatment

Product Contact

Definition: Process whereby compressed air is in contact as a part of the production and processing of the product including packaging and transportation.

In-Direct Product Contact

Definition: Process whereby compressed air is exhausted into the local atmosphere of the food preparation, production, processing, packaging and/or storage.



Compressed Air Treatment

Product Contact

Class	Maximum number of particles per m ³ for particle sizes, d (µm) (at reference conditions see 7.3.1)		
	0,1 < d ≤ 0,5	0,5 < d ≤ 1,0	1,0 < d ≤ 5,0
2	≤ 400 000	≤ 6 000	≤ 100
	Pressure Dew-point (°C)		
2	≤ -40		
	Concentration total oil (liquid, aerosol, and vapour) (mg/m ³)(at reference conditions)		
1	≤ 0,01		

In-Direct Product Contact

Class	Maximum number of particles per m ³ for particle sizes, d (µm) (at reference conditions see 7.3.1)		
	0,1 < d ≤ 0,5	0,5 < d ≤ 1,0	1,0 < d ≤ 5,0
2	≤ 400 000	≤ 6 000	≤ 100
Pressure Dew-point (°C)			
4 ¹	≤ +3		
Concentration total oil (liquid, aerosol, and vapour) (mg/m ³)(at reference conditions)			
2	≤ 0,1		

Compressed Air Treatment - Moisture

Air qualities in accordance with ISO 8573-1:2010

Class	Solid particles, max. number of particles per m ³			Pressure dew point	Oil content (liquid, aerosol, oil vapor)
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Compressed Air Treatment - Moisture

Why Is It Important To Remove The Moisture From Compressed Air?

Damage to equipment

Causes rust/scale in pipes

Damage to end product

Breeds Microorganisms

Contamination

Freezing Air Lines



Compressed Air Treatment - Moisture

How do you define dry?

A photograph of a desert landscape with large, orange sand dunes. In the foreground, a camel is walking towards the left, and several other camels are visible in the distance. The sky is clear and blue.

10% RH

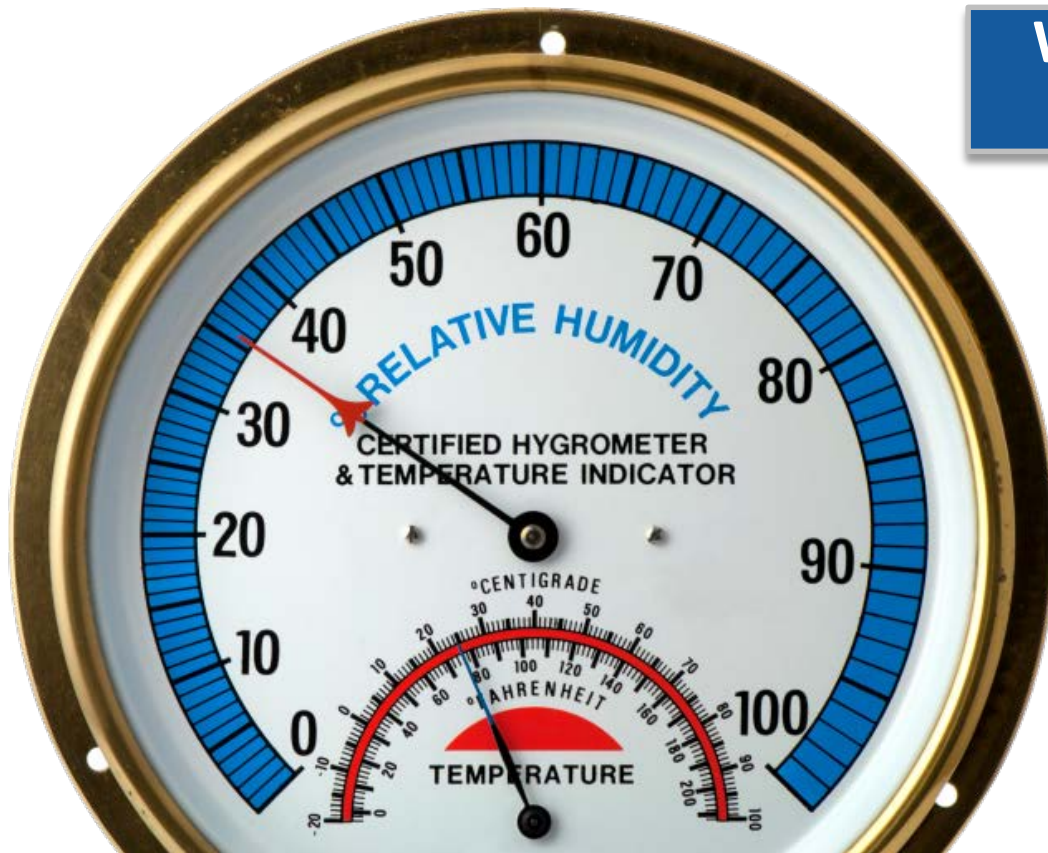
A photograph of a lush green forest with dense foliage and trees. In the background, there are rolling hills and mountains under a blue sky with scattered white clouds.

90% RH

Compressed Air Treatment - Moisture

What Is Relative Humidity?

What is it “Relative” to?



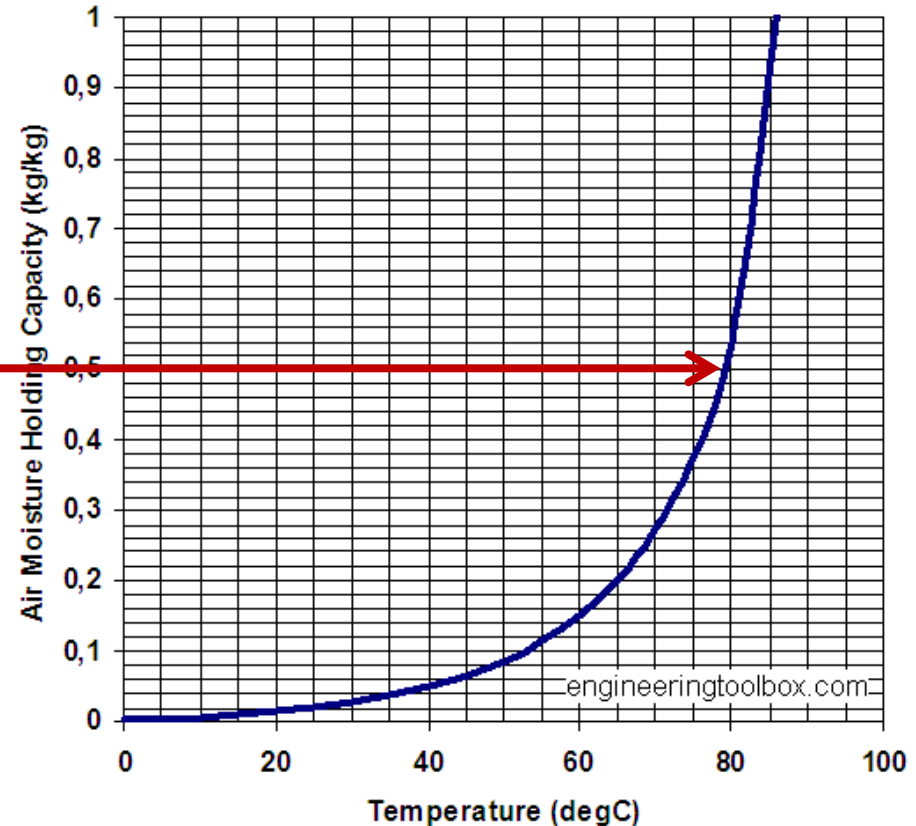
Compressed Air Treatment - Moisture

Rule of Thumb: Every 20 degrees the temperature rises... that air can hold twice as much water.

What does the blue line represent?

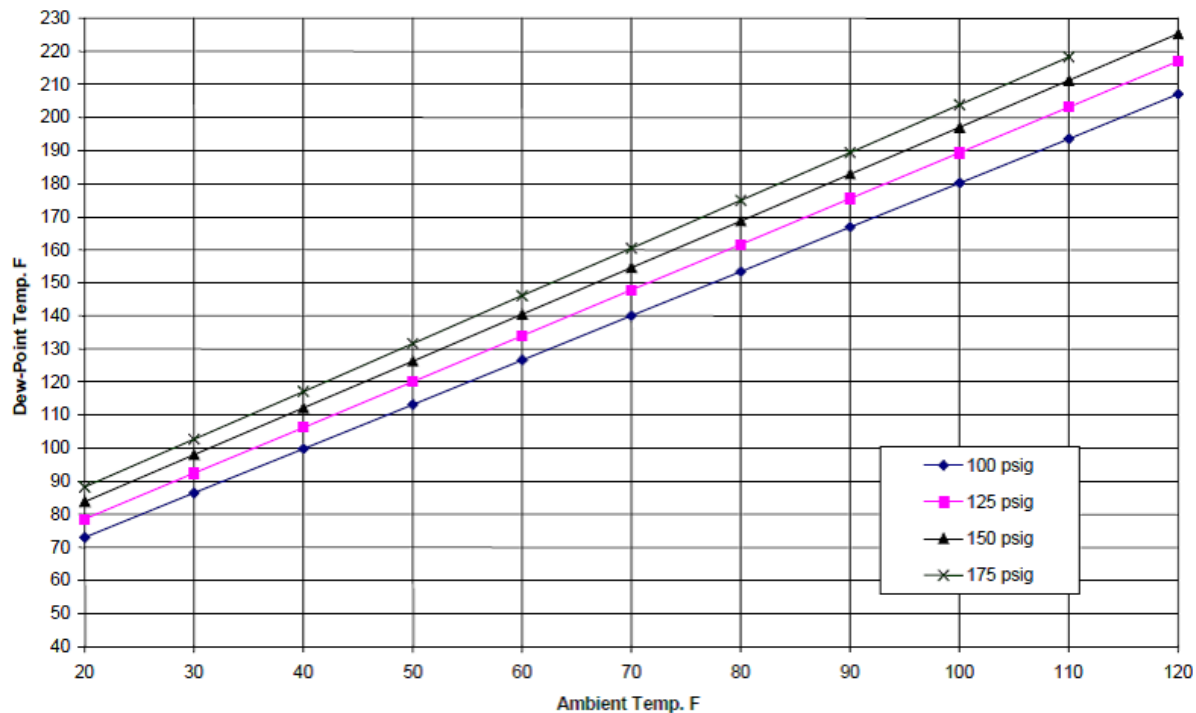
Answer: 100% Relative Humidity

aka Dew Point!



Compressed Air Treatment - Moisture

Dew-Point Temperature vs. Ambient Temperature
(100% Relative Humidity)

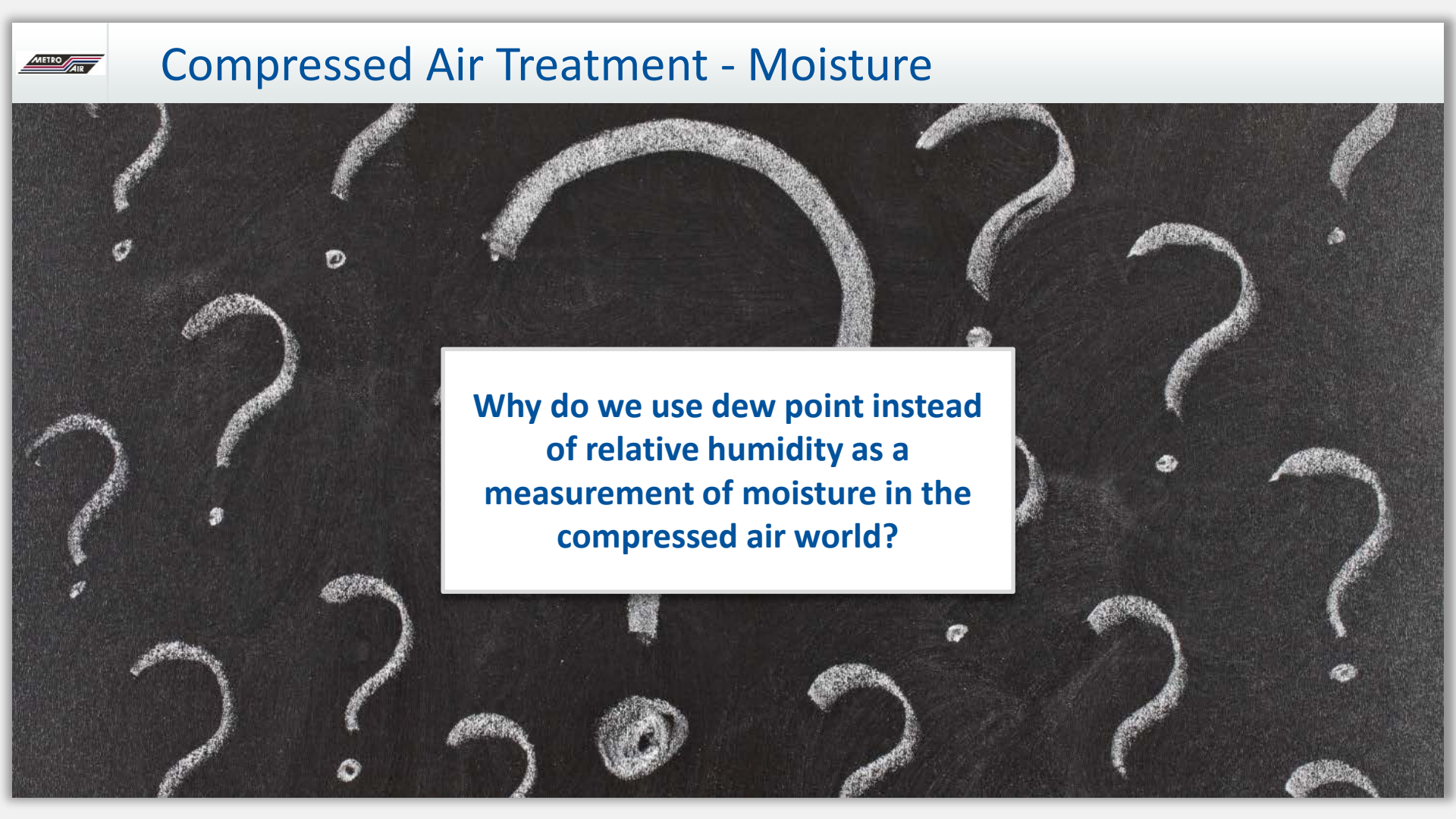


Compressed Air Treatment - Moisture



Examples of Dew Point

Compressed Air Treatment - Moisture

The background of the slide is a dark, textured surface, possibly black or dark grey, covered with numerous white, hand-drawn question marks of various sizes and orientations. The question marks are scattered across the entire background, creating a sense of inquiry or confusion.

**Why do we use dew point instead
of relative humidity as a
measurement of moisture in the
compressed air world?**

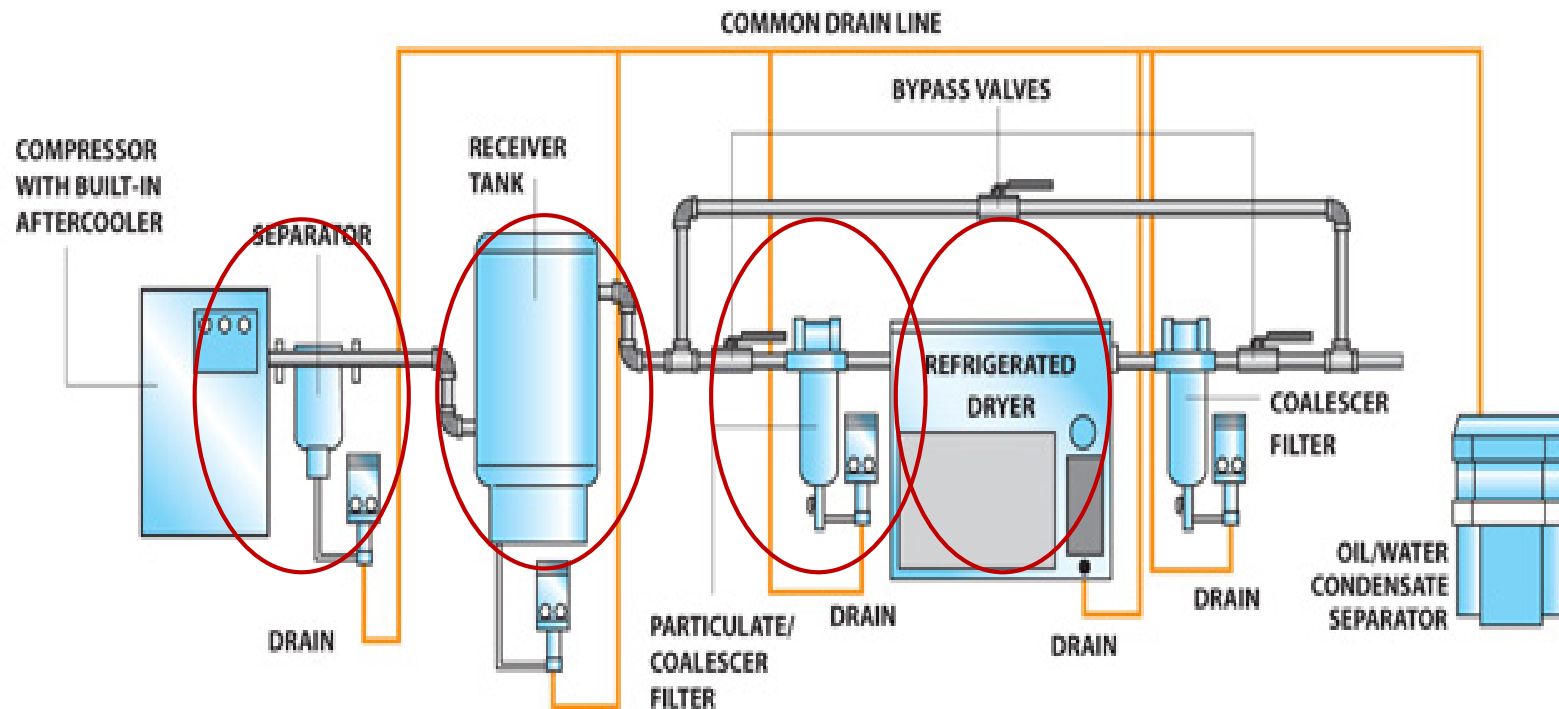
Compressed Air Treatment - Moisture

Gallons of Water Entering Systems Per Day Per 100 SCFM

Ambient Air Temperature	Degrees F	% Humidity								
		20%	30%	40%	50%	60%	70%	80%	90%	100%
	120	18.6	27.9	37.2	46.5	55.8	65.1	74.4	83.7	93.0
	110	14.1	21.0	27.9	35.1	42.0	48.9	55.8	63.0	69.9
	100	10.5	15.6	20.7	26.1	31.2	36.6	41.7	46.8	52.2
	90	7.8	11.4	15.3	19.2	23.1	26.7	30.6	34.5	38.4
	80	5.7	8.4	11.1	13.8	16.8	19.5	22.2	24.9	27.9
	70	3.9	6.0	7.8	9.9	12.0	13.8	15.9	18.0	19.8
	60	2.7	4.2	5.7	6.9	8.4	9.9	11.1	12.6	14.1
	50	2.1	3.0	3.9	4.8	6.0	6.9	7.8	8.7	9.9
	40	1.2	2.1	2.7	3.3	3.9	4.8	5.4	6.0	6.6
	30	0.9	1.2	1.8	2.1	2.7	3.0	3.6	3.9	4.5
	20	0.6	0.9	1.2	1.5	1.7	1.9	2.1	2.4	2.7

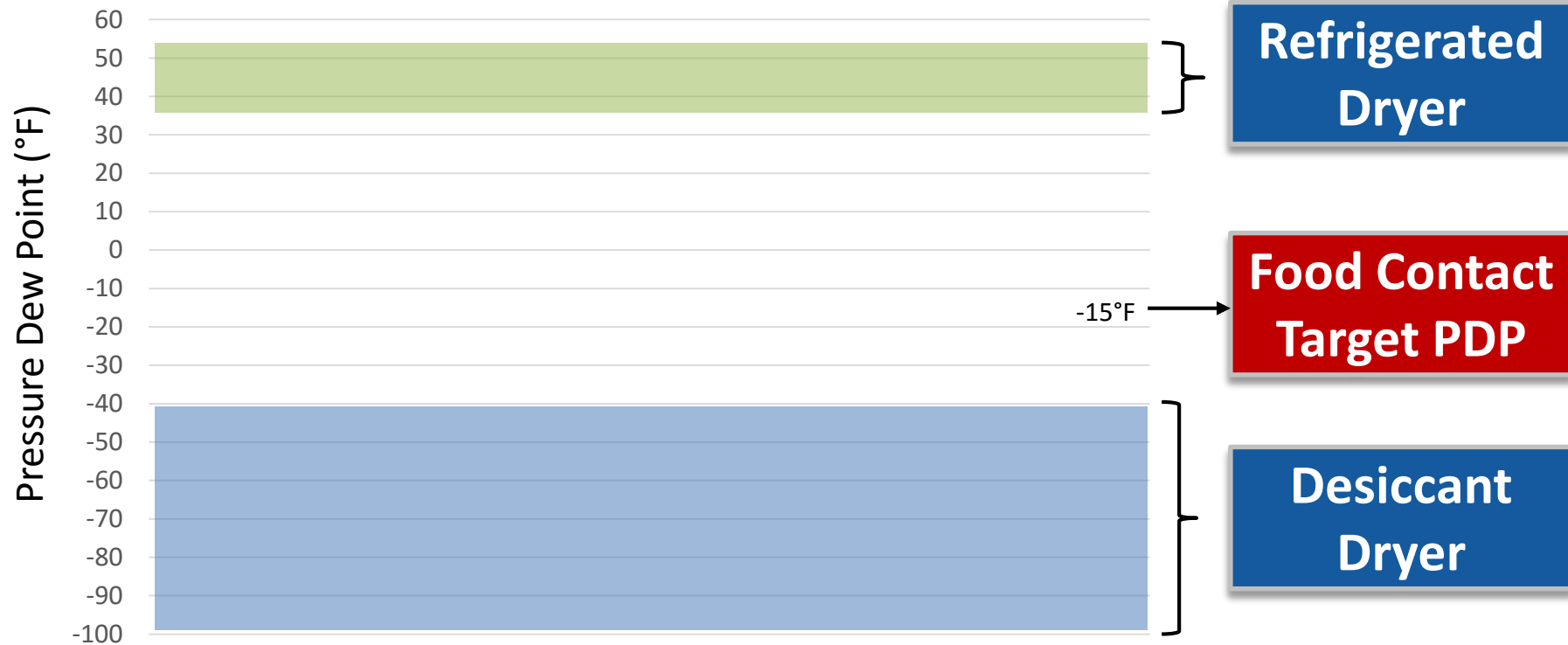
Compressed Air Treatment - Moisture

Where is the water dropping out at?

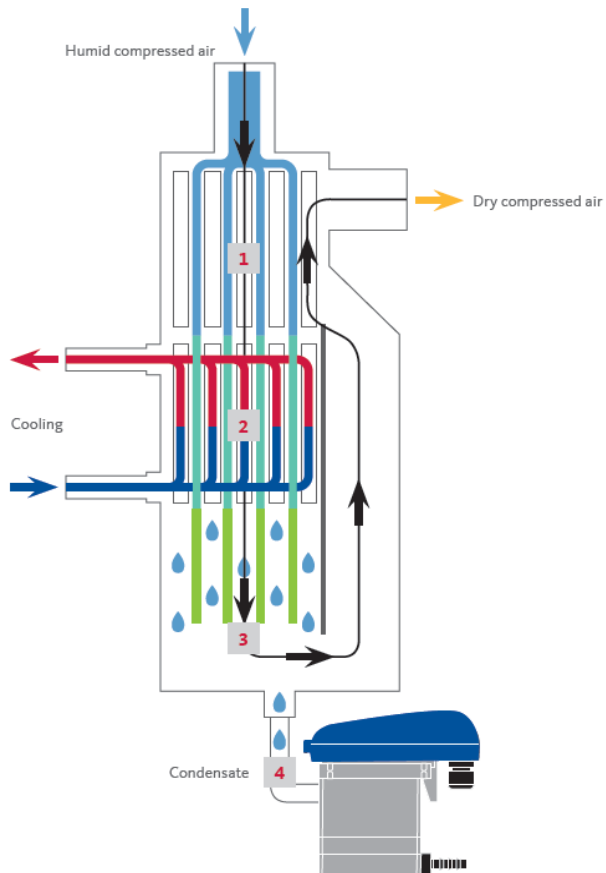


Compressed Air Treatment - Moisture

Typical Dryer Options



Compressed Air Treatment - Moisture



**Refrigerated Dryer
Function**

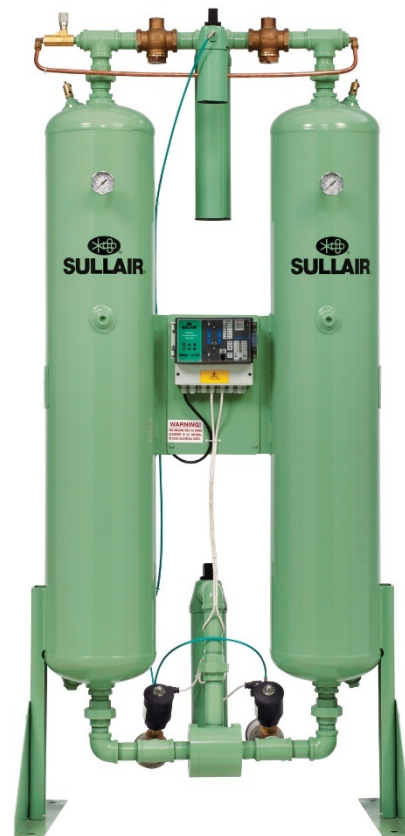
**Why is it important to
reheat the air?**

Compressed Air Treatment - Moisture

What if you need a dew point under 32°F

Desiccant Dryers!

**Dew points down to as low as
-40°F to -100°F**



Compressed Air Treatment - Moisture



Absorption versus Adsorption

Compressed Air Treatment - Moisture

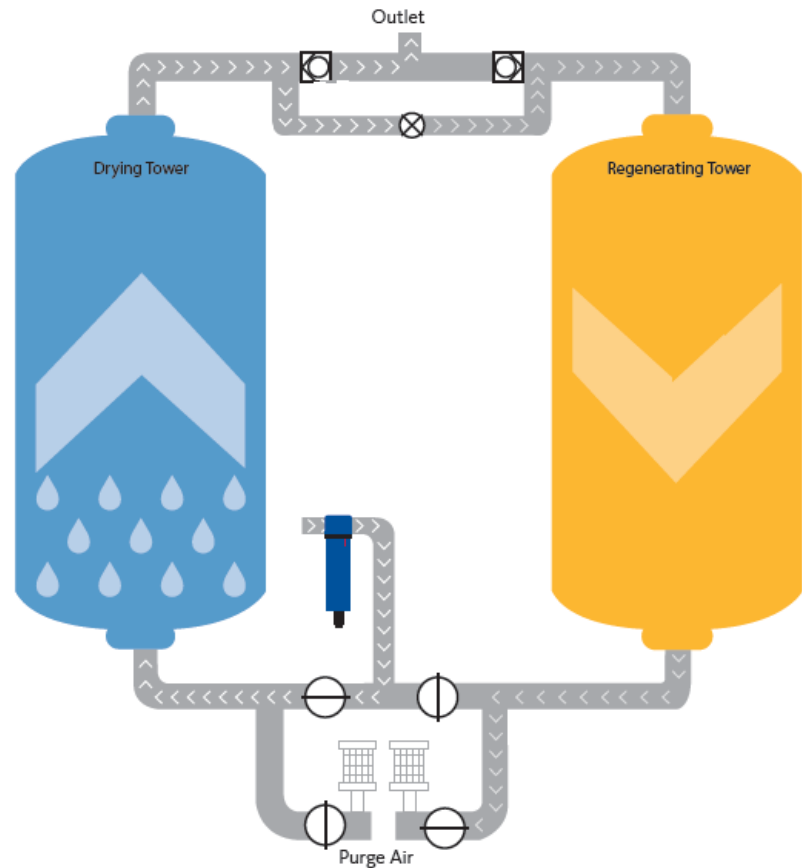
The background of the slide is a dense, close-up photograph of numerous small, white, spherical desiccant beads. The beads are uniform in size and color, creating a textured, repetitive pattern across the entire frame.

How Does a Desiccant Bead Work?

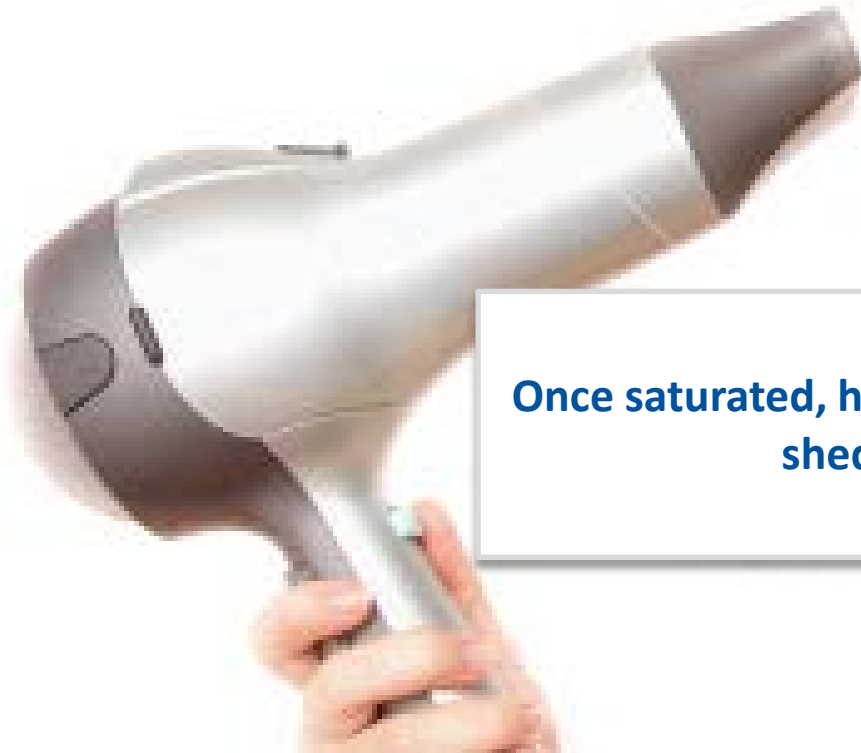
Compressed Air Treatment - Moisture

Heatless

- No Heat to Regenerate
- 15% Purge Air
- 10 Minute NEMA Cycle



Compressed Air Treatment - Moisture

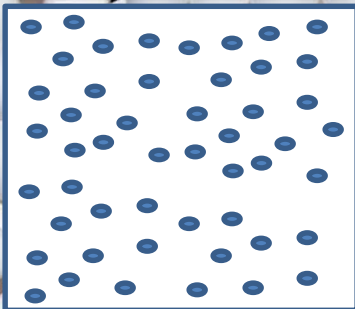


Once saturated, how does a desiccant bead shed the water?

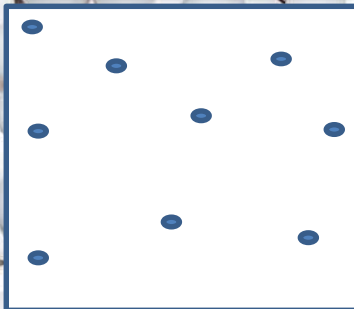
Compressed Air Treatment - Moisture

Once saturated, how does a desiccant bead shed the water?

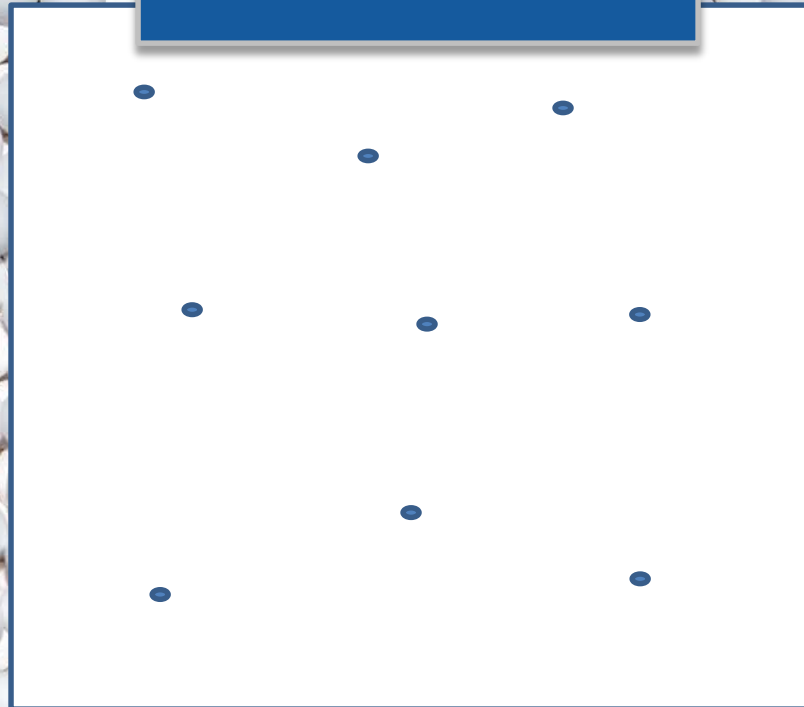
Pre-Treated



Dried



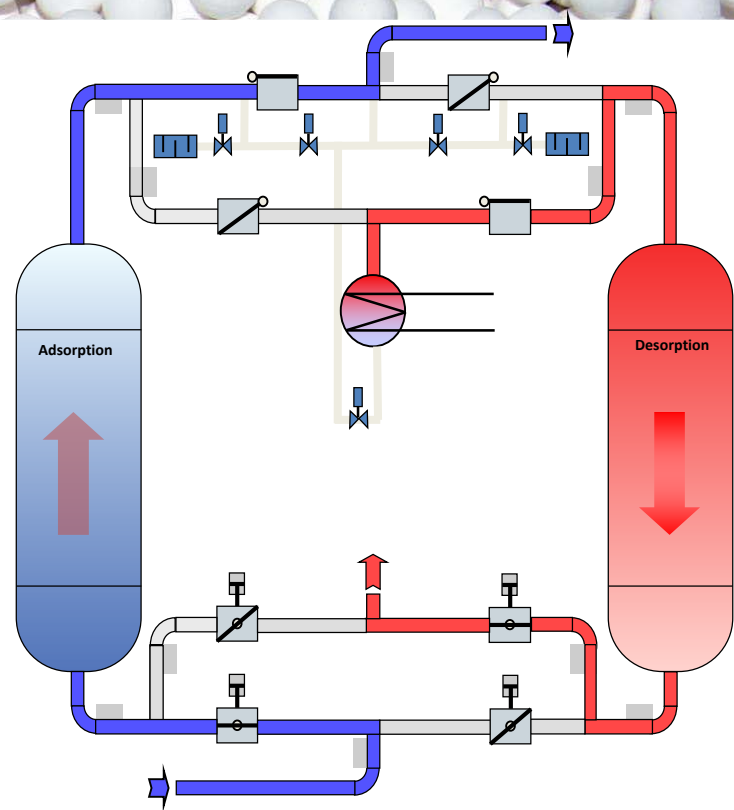
Expanded for Purge Air



Compressed Air Treatment - Moisture

Heated Purge

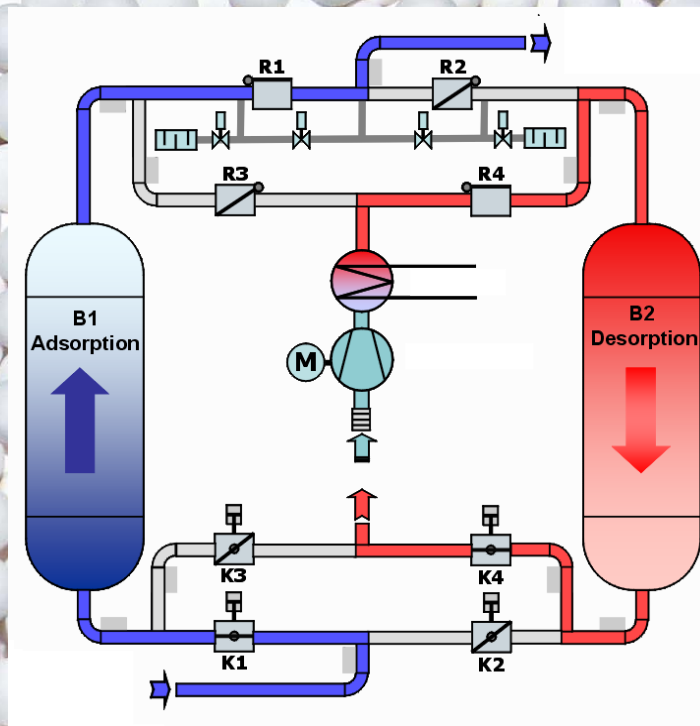
- Heat Needed
- 7% Purge Air to Regenerate and Cool
- 8 Hour NEMA Cycle



Compressed Air Treatment - Moisture

Heated Blower Purge

- Average 2-3% Purge
 - 0% Purge Used to Regenerate
 - 7% Purge used for cooling cycle only
- 0% Purge Option Available
 - Blower used to cool regenerated tower
 - Loads regenerated bed with moisture and can cause dew point spike upon switching
- 8 Hour NEMA Cycle



Compressed Air Treatment - Moisture



Proper Drainage

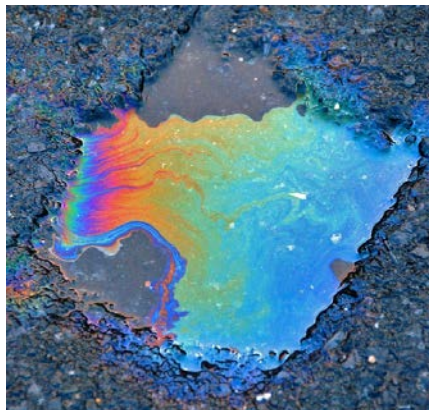


Compressed Air Treatment - Moisture

Where should the condensate
and oil go after it is
discharged from a drain?



or



or



Compressed Air Treatment - Moisture

**On average, how much oil
does a 100 HP compressor
pass each year?**

**Conservatively about 10
gallons per year!**

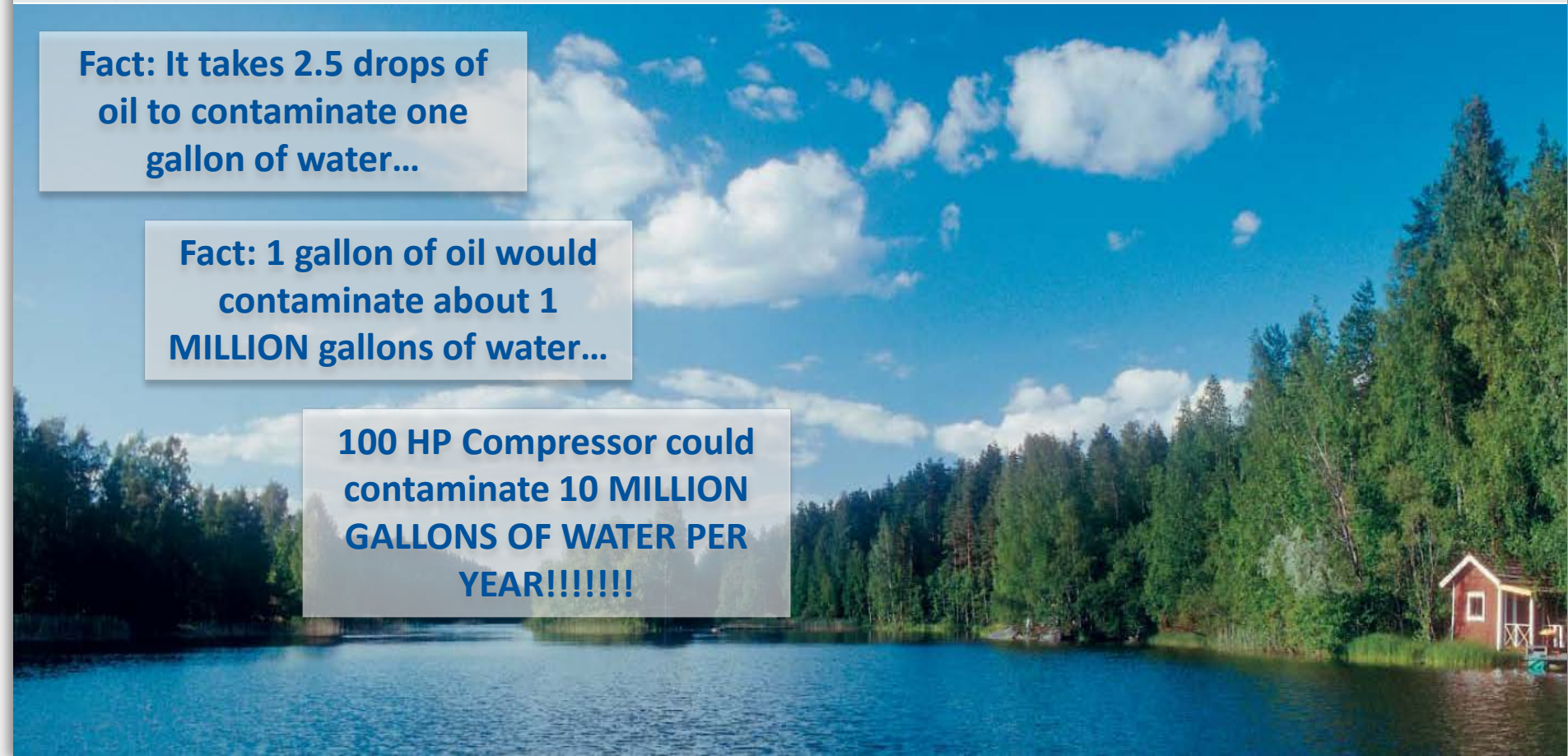


Compressed Air Treatment - Moisture

Fact: It takes 2.5 drops of oil to contaminate one gallon of water...

Fact: 1 gallon of oil would contaminate about 1 MILLION gallons of water...

100 HP Compressor could contaminate 10 MILLION GALLONS OF WATER PER YEAR!!!!!!



Compressed Air Treatment - Oil

Air qualities in accordance with ISO 8573-1:2010

Class	Solid particles, max. number of particles per m ³			Pressure dew point	Oil content (liquid, aerosol, oil vapor)
	0.1 μm < d ≤ 0.5 μm	0.5 μm < d ≤ 1.0 μm	1.0 μm < d ≤ 5.0 μm	°F	mg/m ³
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2	≤400,000	≤6,000	≤100	≤-40	≤0.1
3	-	≤90,000	≤1,000	≤-4	≤1
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■ Measured in accordance with ISO 8573-3

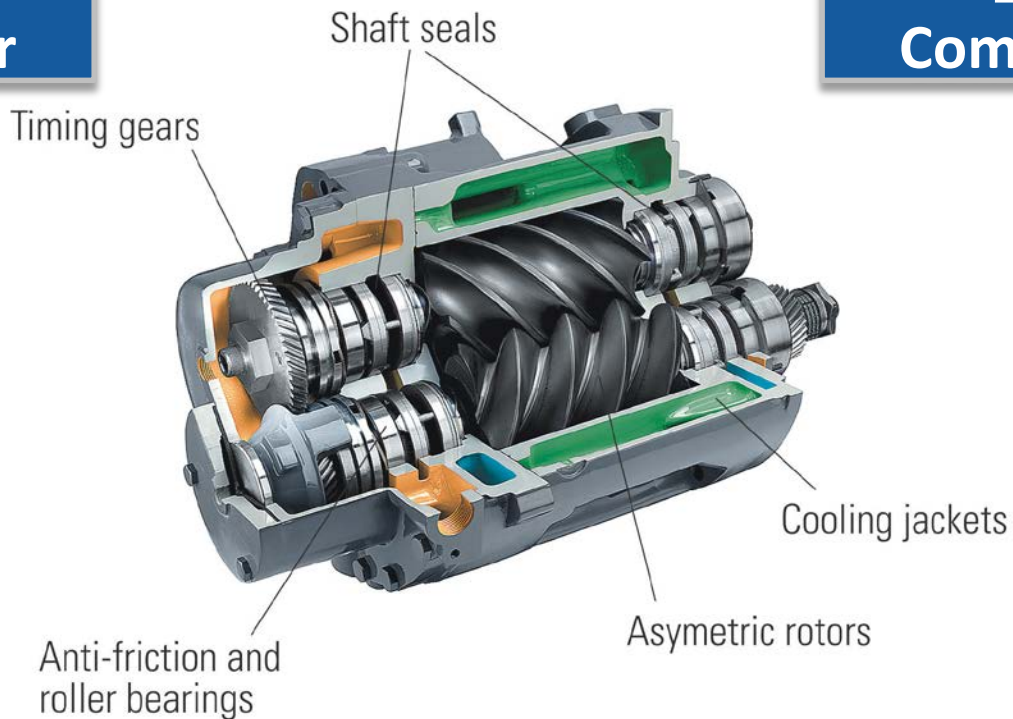
■ Measured in accordance with ISO 8573-2 and ISO 8573-5, ref. conditions 14.5 psi [a] absolute, 68 °F, 0% RH



Compressed Air Treatment - Oil

**Oil Free
Compressor**

**Oil Flooded
Compressor**

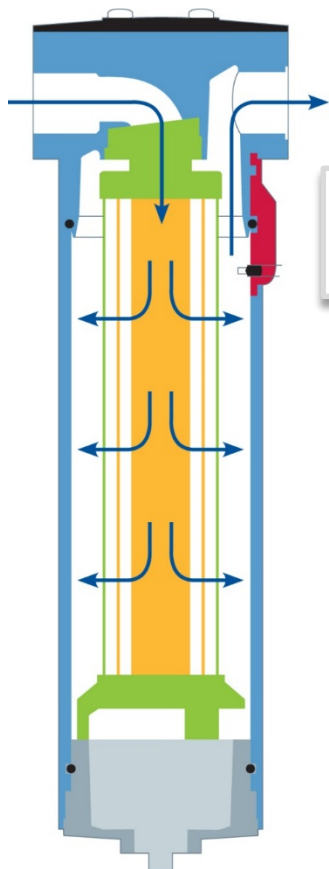


Compressed Air Treatment - Oil

Oil Passing – From Oil Flooded Air Compressor

CONCENTRATION PPM _w	TIME (Hours)	GALLONS PER YEAR			
		25 HP 100 SCFM	50 HP 250 SCFM	100HP 500 SCFM	200HP 1000 SCFM
2	2000	0.2	0.5	1.2	2.4
	4000	0.5	1.0	2.4	4.8
	8000	1.0	1.9	4.8	9.6
4	2000	0.5	1.2	2.4	4.8
	4000	1.0	2.4	4.8	9.6
	8000	1.9	4.8	9.6	19.2
6	2000	0.7	1.8	3.6	7.2
	4000	1.4	3.6	7.2	14.4
	8000	2.9	7.2	14.4	28.8
8	2000	1.0	2.4	4.8	9.6
	4000	1.9	4.8	9.6	19.2
	8000	3.8	9.6	19.2	38.4

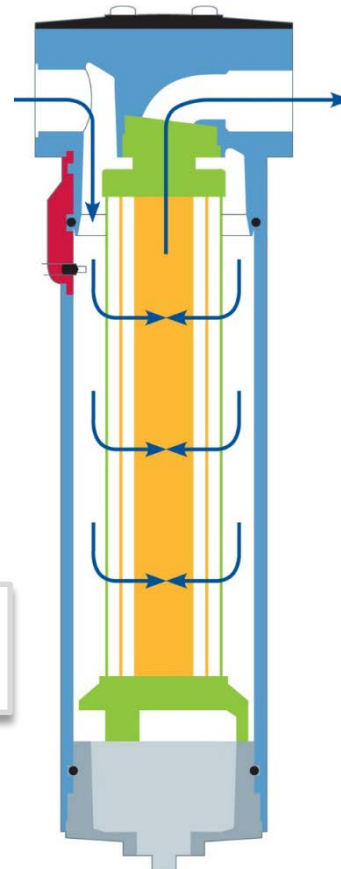
Compressed Air Treatment - Oil



**Coalescing
Filter**

**What's The
Difference?**

**Particulate
Filter**



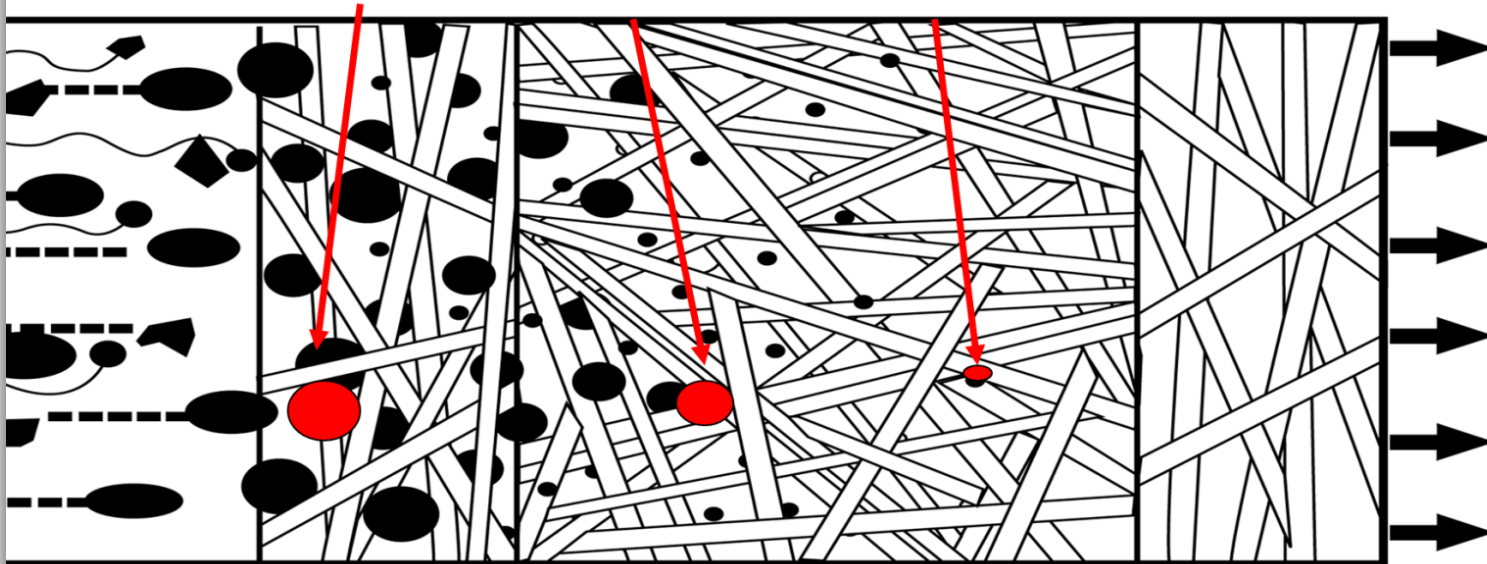
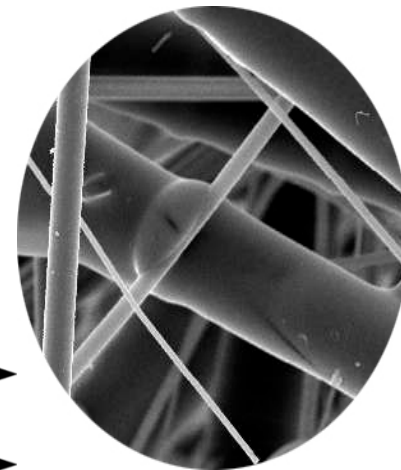
Compressed Air Treatment - Oil

Let's take a
closer look...

Direct
collection

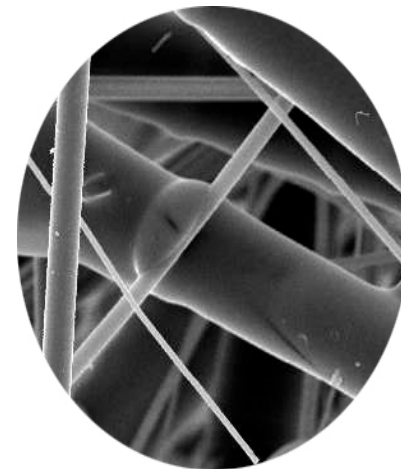
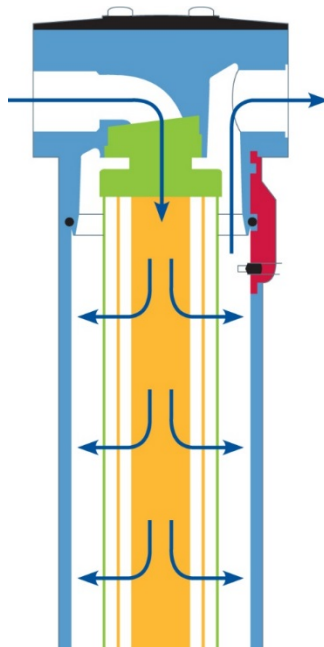
Impingement
separation

Brownian motion



Compressed Air Treatment - Oil

Let's take a closer look...



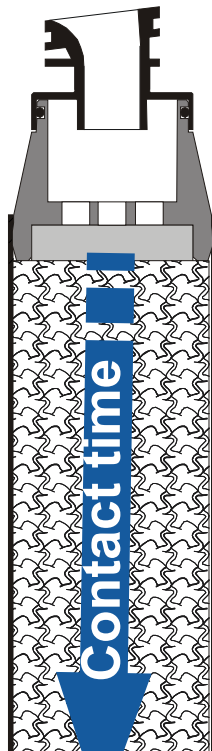
ELEMENT GRADE	ELEMENT TYPE	MICRON RATING	OIL CARRYOVER	DRY Δ PRESSURE (psid)	WET Δ PRESSURE (psid)
Grade C	Coarse	25 μm	5 mg/m ³	.44	.73
Grade G	General	5 μm	1 mg/m ³	.58	1.74
Grade F	Fine	1 μm	.1 mg/m ³	.73	2.17
Grade S	Superfine	.01 μm	.01 mg/m ³	.87	2.9

Compressed Air Treatment - Oil

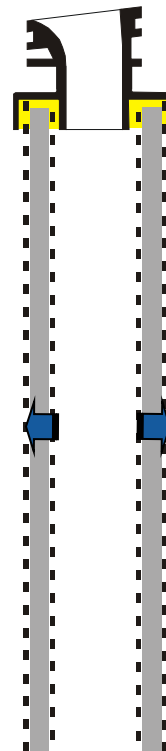
Activated Carbon Cartridge

Removal of Oil Vapor

Activated Carbon is a desiccant... must install dryer up stream to remove moisture!

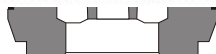


Activate Carbon Filter



Never install downstream of a heated desiccant dryer!

ELEMENT GRADE	ELEMENT TYPE	MICRON RATING	OIL CARRYOVER	Δ PRESSURE (psid)
Grade V	Activated Carbon Cartridge	1 μm	.003 mg/m ³	.54



Compressed Air Treatment - Oil

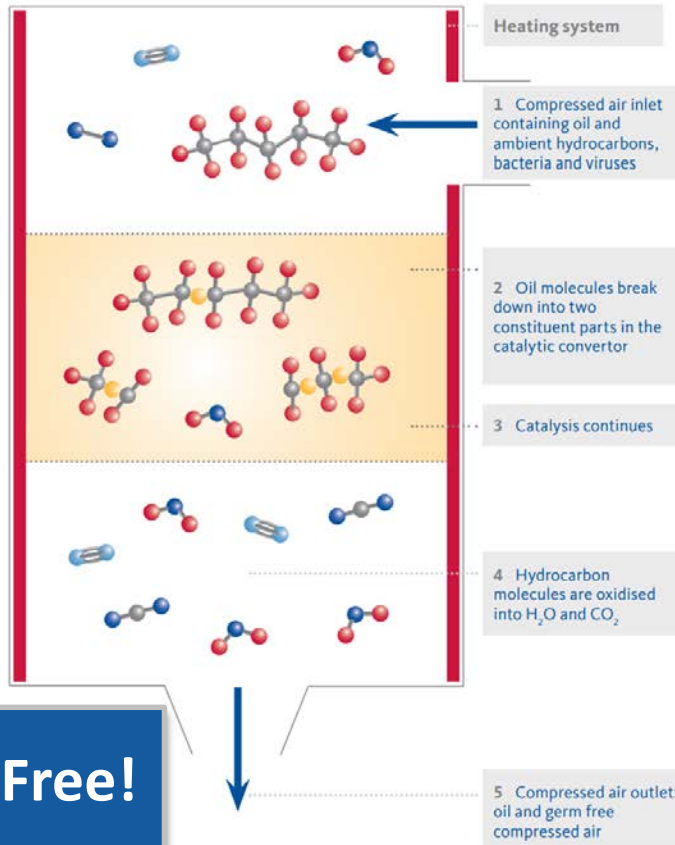
Catalytic Converter

Oil molecule (carbon and hydrogen)
Catalytic converter
N-nitrogen
O ₂ -oxygen
CO ₂ -carbon dioxide
H ₂ O-water

Phase 1

Phase 2

Phase 3



Oil & Microorganism Free!



Compressed Air Treatment - Oil

Food Grade Oil

H1 Lubricants: These lubricants may have incidental contact with food. Formulations may only contain certain base stocks, additives and thickeners as specified by FDA regulations (21 CFR 178.3570). In addition, in the event of incidental contact, contamination of food by an H1 lubricant must not exceed 10 parts per million (i.e., 0.001 percent).

Compressed Air Treatment - Oil

3 Options

**Oil Flooded Air
Compressor with
Filtration**



Compressed Air Treatment - Oil

3 Options

Oil Flooded Air
Compressor with
Food Grade



Compressed Air Treatment - Oil

3 Options

Oil Free Air
Compressor



Compressed Air Treatment - Particulates

Air qualities in accordance with ISO 8573-1:2010

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Compressed Air Treatment - Particulates

Solid particles per ft ³ in typical industrial air	Solid particles per ft ³ @ 100 psig	80% of the solid particles below 10 µm	Efficiency of a compressor intake filter < 5 µm	Potential remaining solids particles per ft ³ @ 100 psig
4,000,000	32,000,000	25,600,000	90%	2,560,000



Compressed Air Treatment - Particulates



**Critical
Application???**



**Point Of Use
Filtration!!!**

Compressed Air Treatment - Microorganisms

Removal of Microorganisms

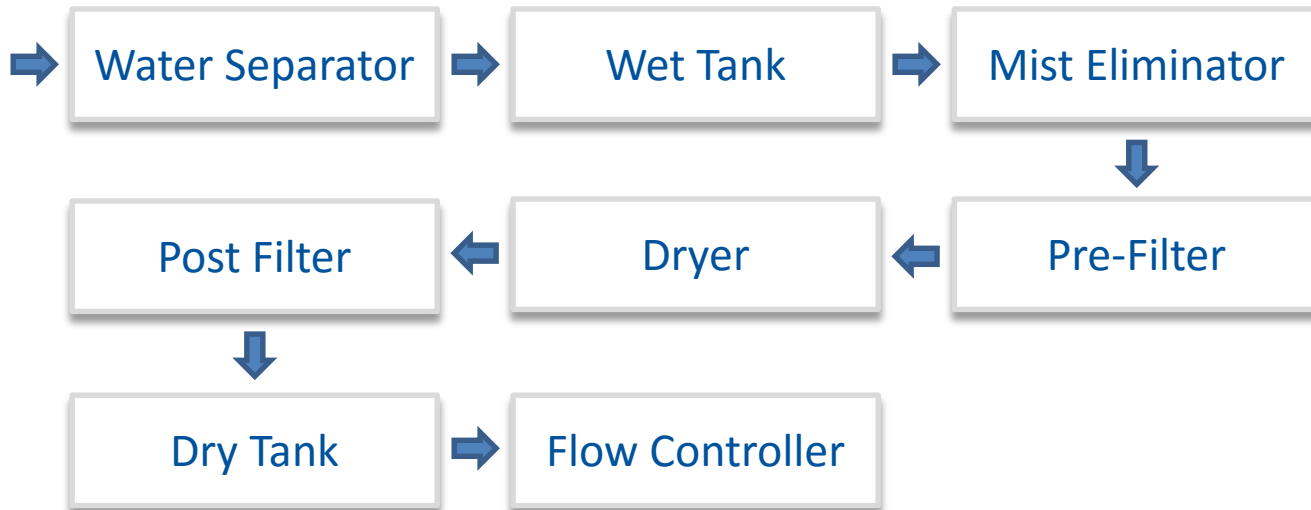
**Appropriate
Filtration**

**Pressure Dew
Points Under -15°F**

**Catalyst
Technology**

Compressed Air Treatment

What's Next?



Compressor Selection

How Do You Choose?

Pressure?

Voltage
Required?

Cost?

Controls?

Storage?

Oil Free vs. Oil
Flooded?

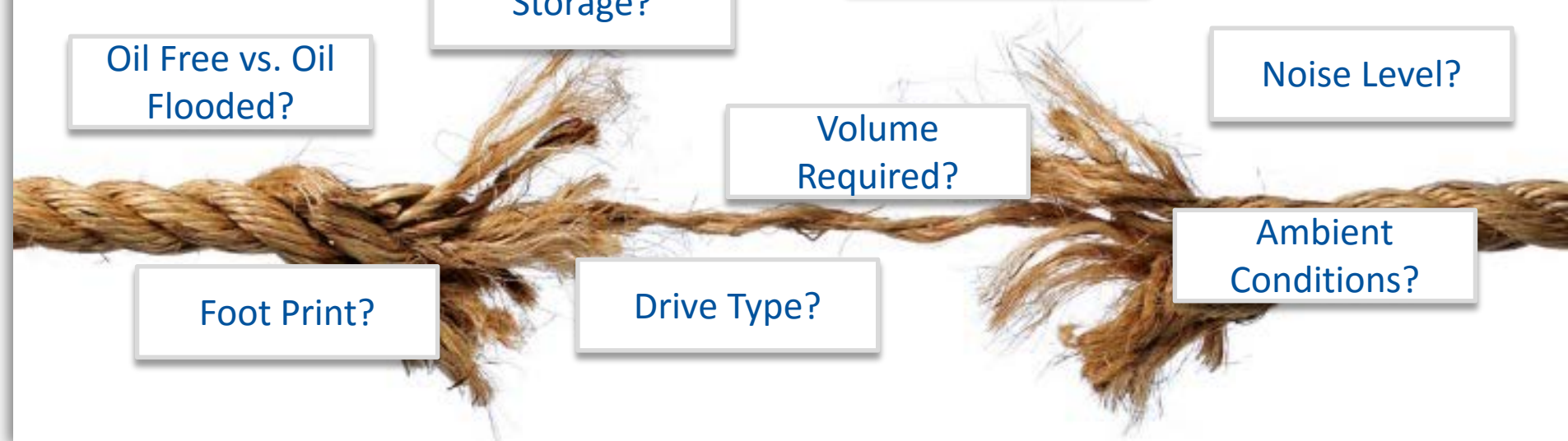
Noise Level?

Volume
Required?

Ambient
Conditions?

Foot Print?

Drive Type?



Compressed Air Treatment - Measurement



Compressed Air Treatment - Measurement



Compressed Air Treatment - Measurement

Flow Meter



Dew Point Meter



Pressure Meter



Ampere Meter



Temperature Meter



Compressed Air Treatment - Measurement

Oil Carbon Vapor Monitor



In Line Constant
Reading Sensor

Compressed Air Treatment – Measurement (Air Sampling)

Oil

Particulates

Moisture

Microorganisms



One World. One Standard.

“SQF Module 11.5.7 Requires Compressed Air To Be Regularly Monitored For Quality And Microbiological Purity.”

The logo for TRACE Analytics LLC features a red checkmark icon to the left of the text "TRACE Analytics LLC" in a blue sans-serif font.

TRACE Analytics LLC

BLANK

Compressed Air Maintenance



Unmaintained systems will pass more oil, remove less water, and allow more particulates into system.

A good maintenance, control, and measurement program are your best defenses!



Questions???