Refrigerated vs. Desiccant Dryers - Choosing the Right One

Don Van Ormer
APenergy
Keynote Speaker

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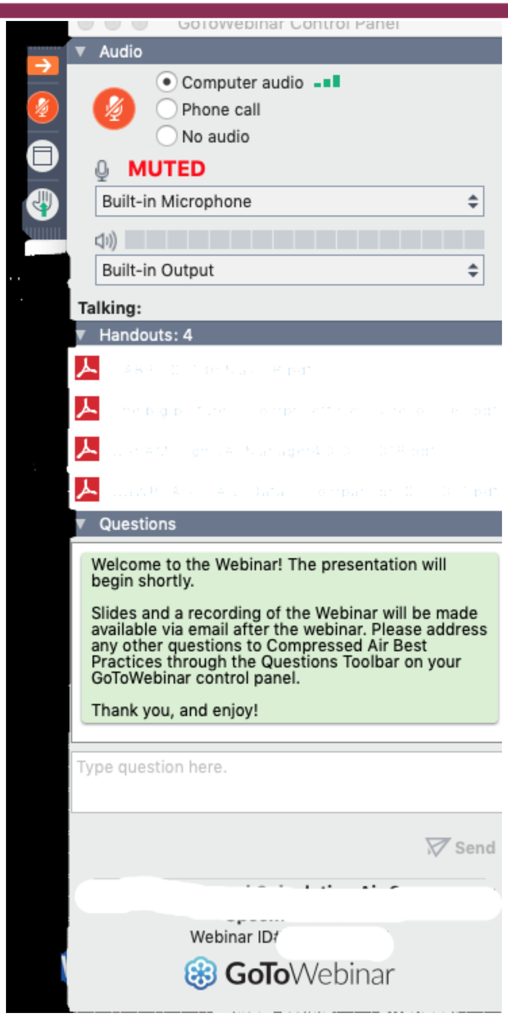

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Desiccant Drying
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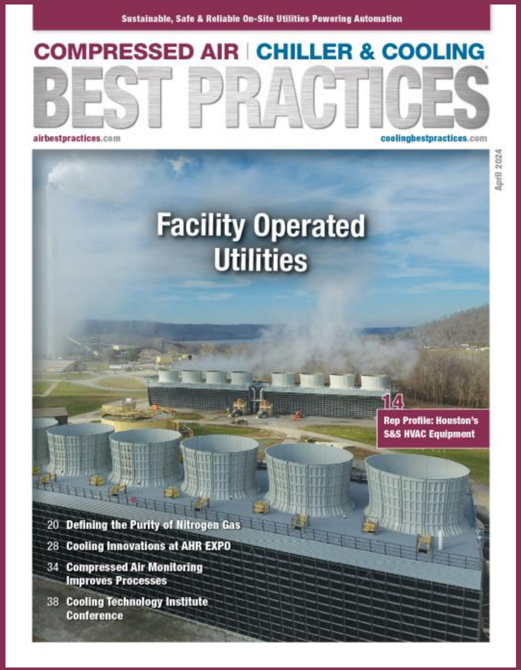

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All materials presented are educational. Each system is unique and must be evaluated on its own merits.

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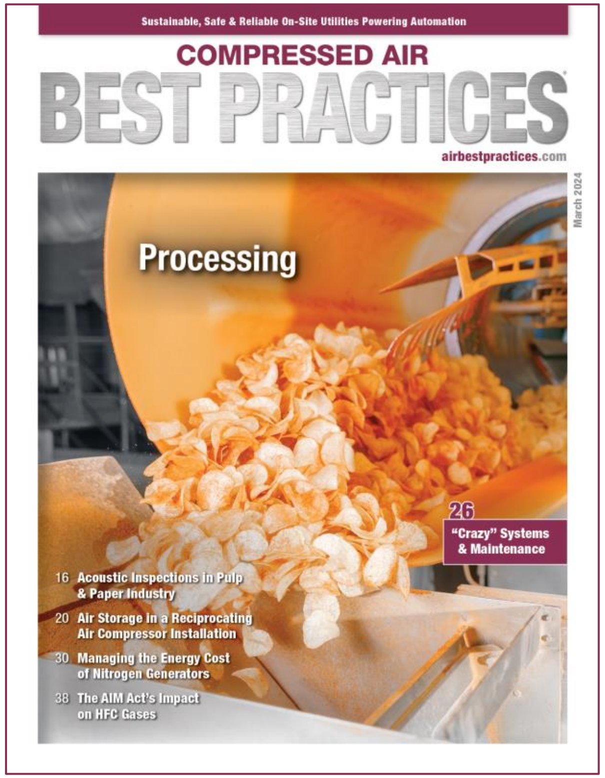
Refrigerated vs. Desiccant Dryers - Choosing the Right One

Introduction by

Compressed Air Best Practices® Magazine



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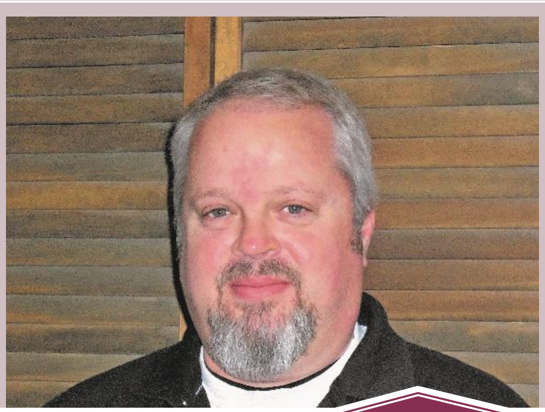
About the Speaker



Don Van Ormer
APenergy

- Auditor, APenergy
- 24+ years of experience in the compressed air consulting industry
- DOE CAC AIRMaster + Specialist
- Performed hundreds of system audits and air system training seminars

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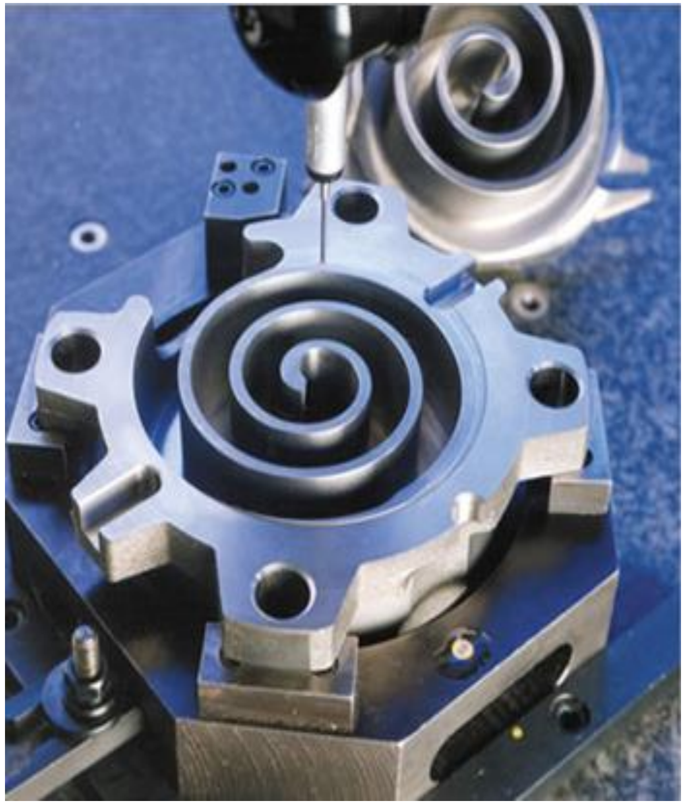
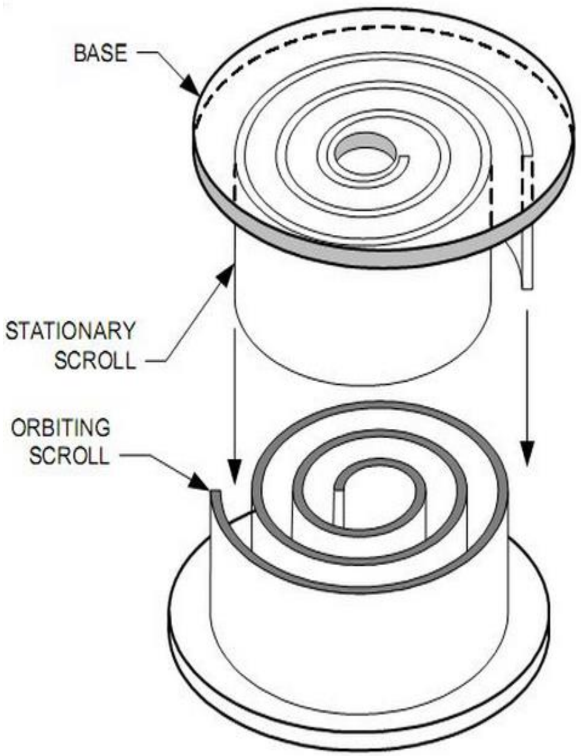
Dryers: Refrigerated and Desiccant

Cycling Refrigerated Dryers – How They Work

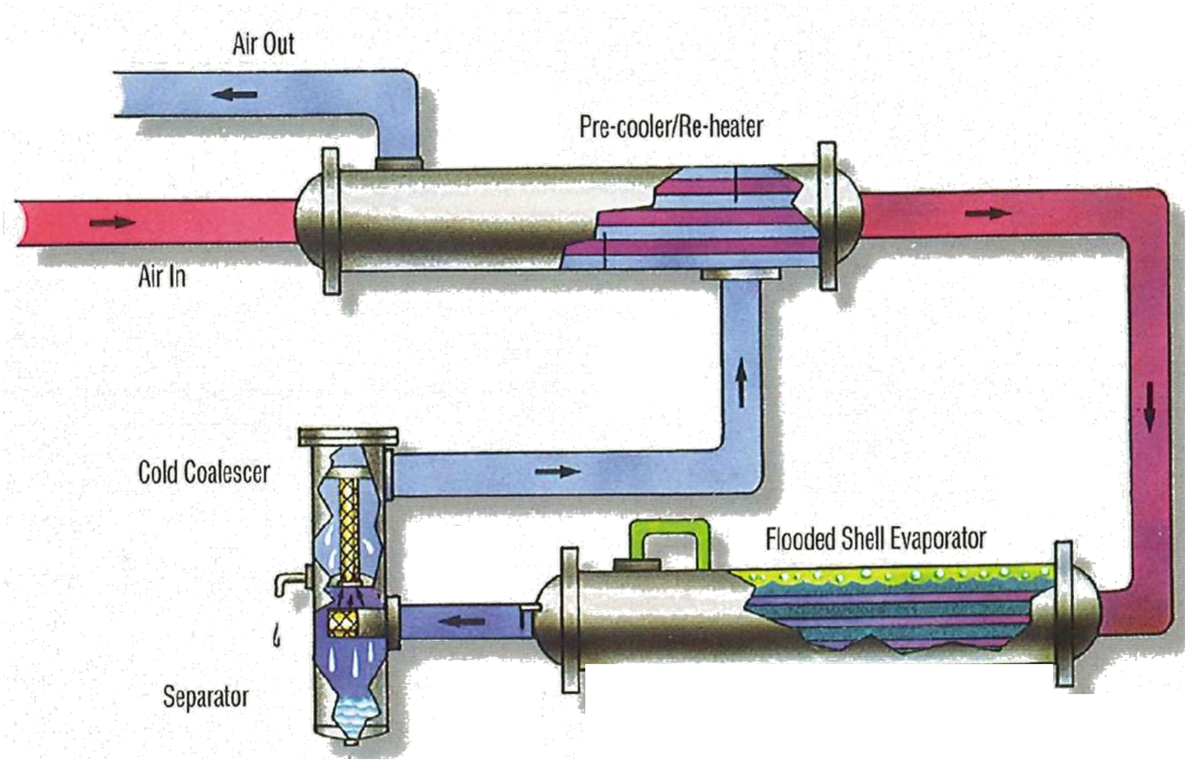
Scroll





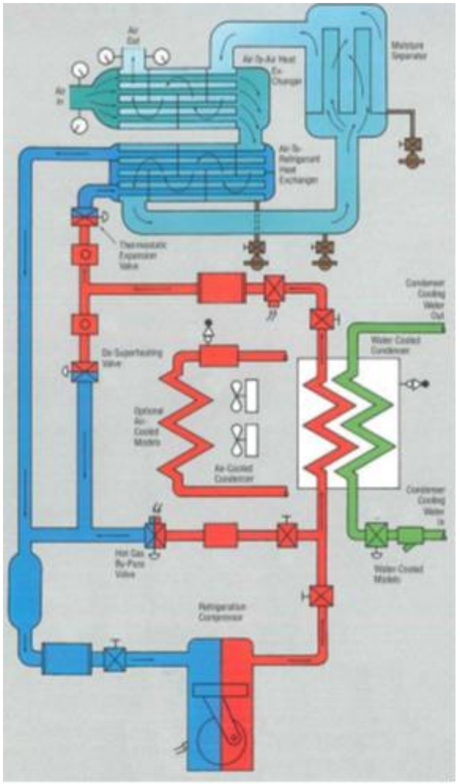
Heat Sink

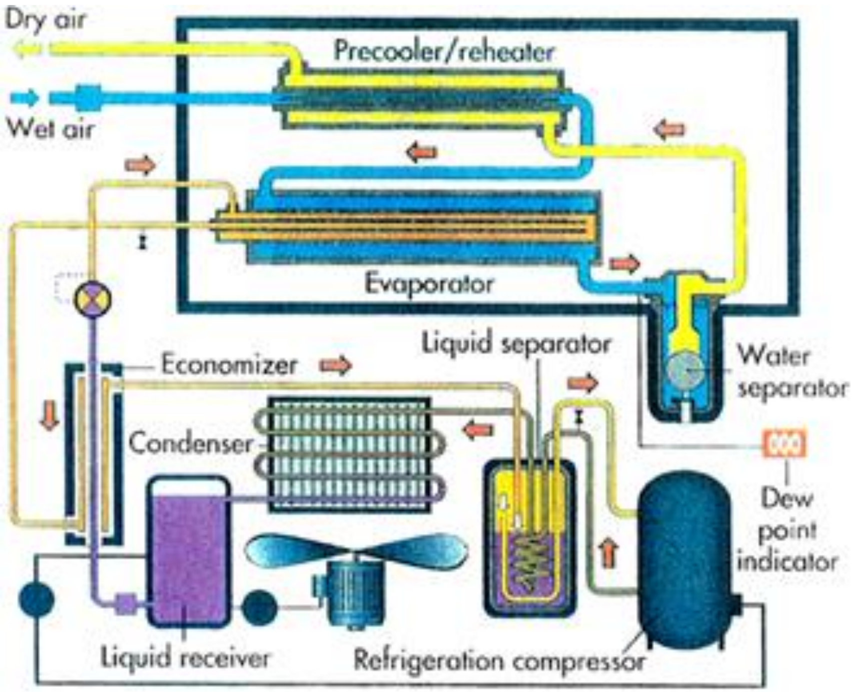
Freon Flooded / Flooded Evap



Non-Cycling Refrigerated Dryers

Direct Expansion



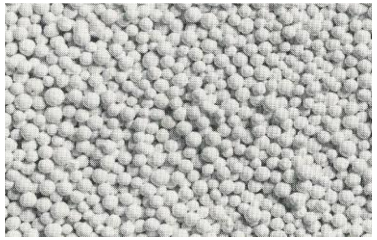


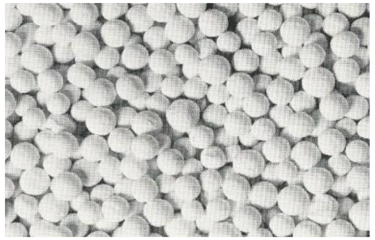
Desiccant Dryers -40˚F PDP Class

• Heatless	15-20% Purge
• Heatless w/Purge Economizer	7-8% Purge
• External Heat	7-9% Purge
• Blower Purge	0% Purge
• Heat of Compression	0% Purge

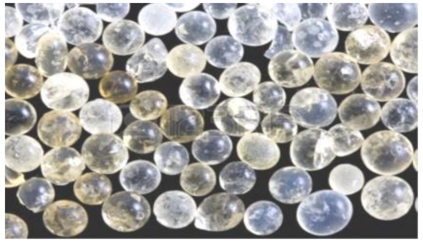
With dew point demand controls the purge air demands can be reduce to approximately half of the normal demand.

Desiccant



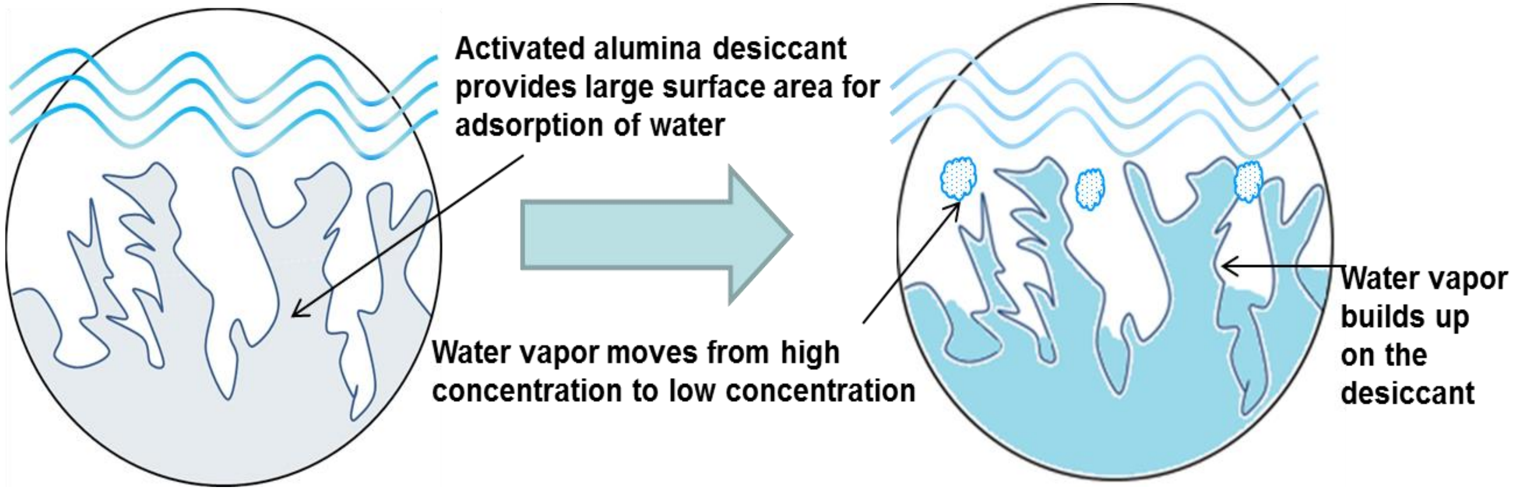


Activated Alumina



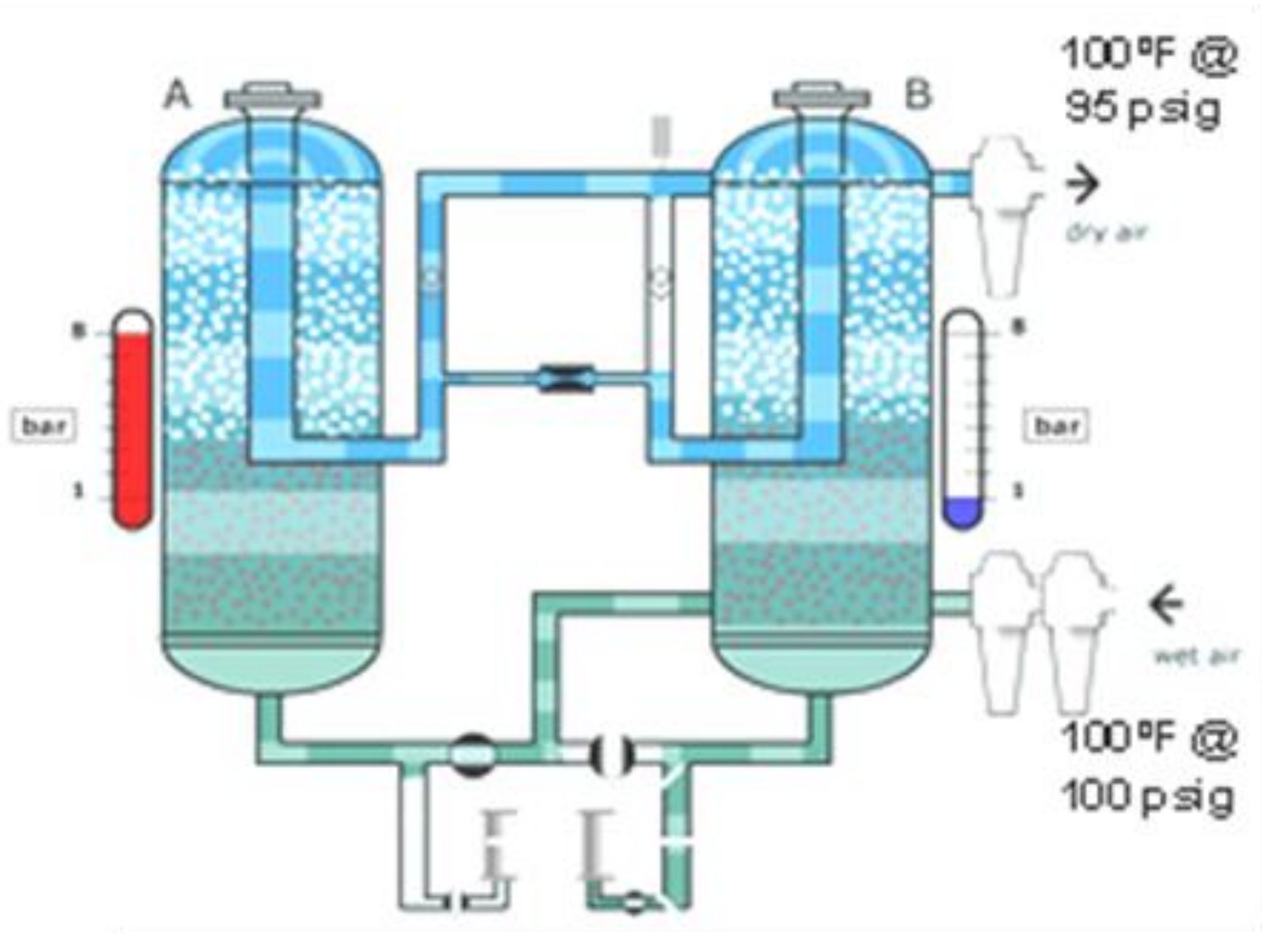
Silica Gel

Molecular Sieve

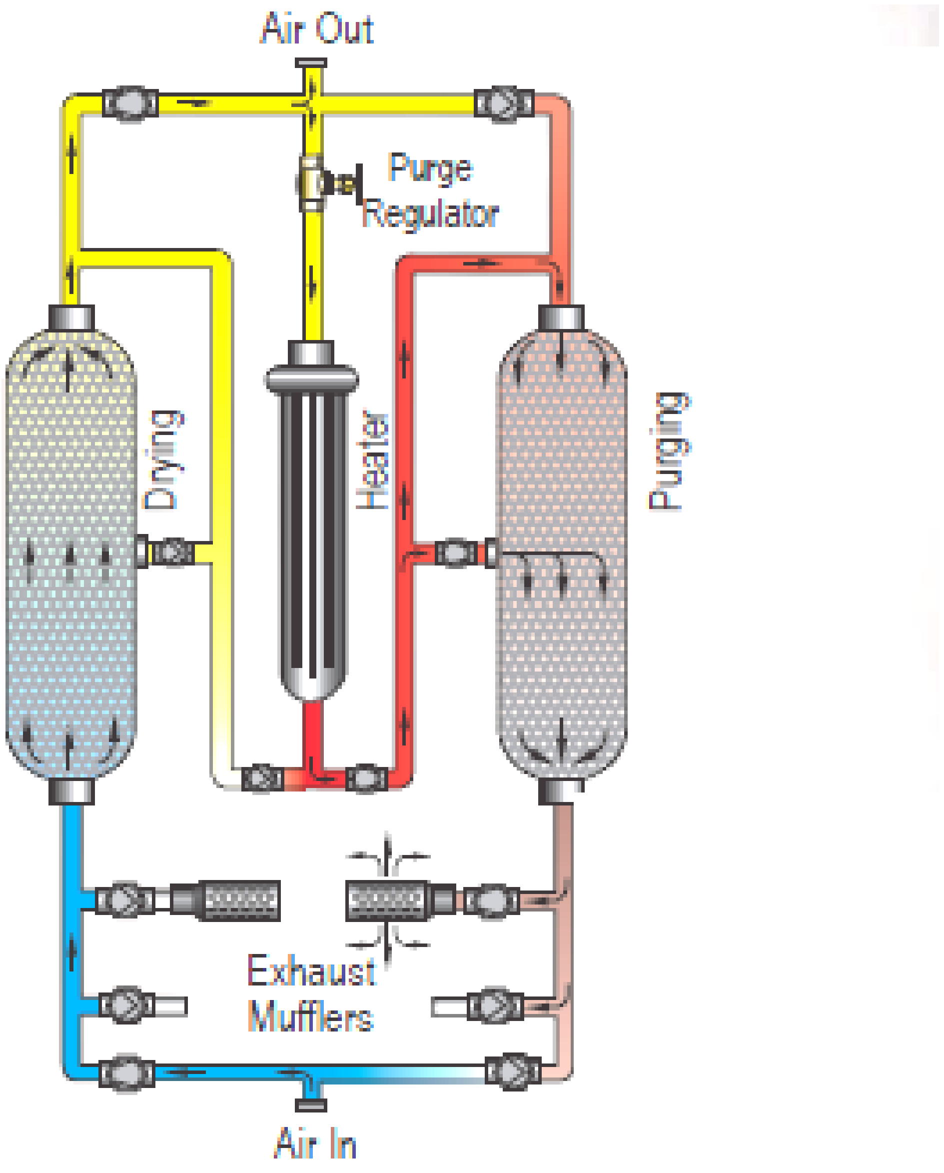


Action as shown from a desiccant dryer: 100 ° F to -40 ° F with 40 ° F pressure dewpoint.
Air exists in the dryer at about 100 ° F. Note: Will not dry at all over 130 ° F

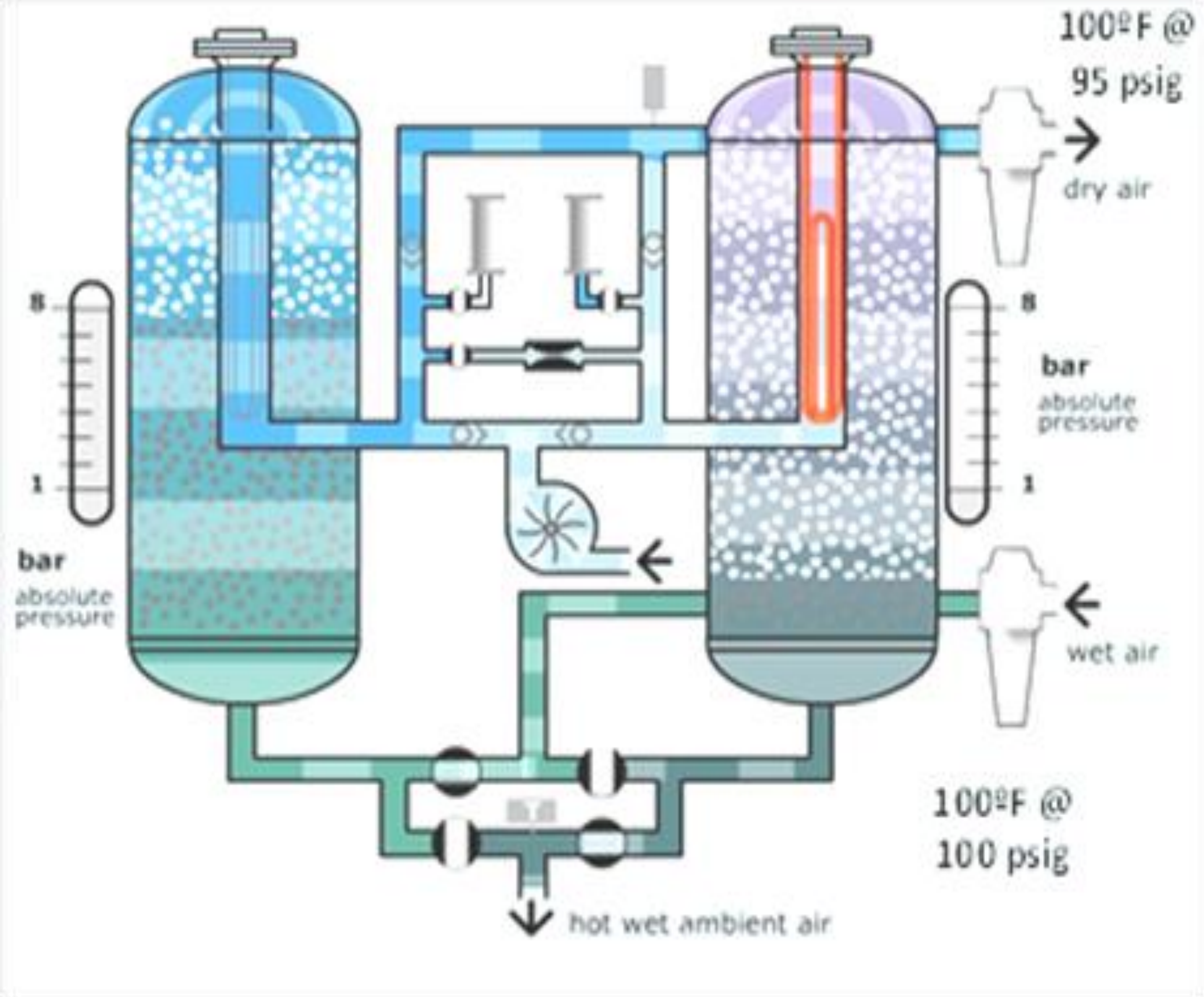
Heatless Desiccant



External Heat Desiccant

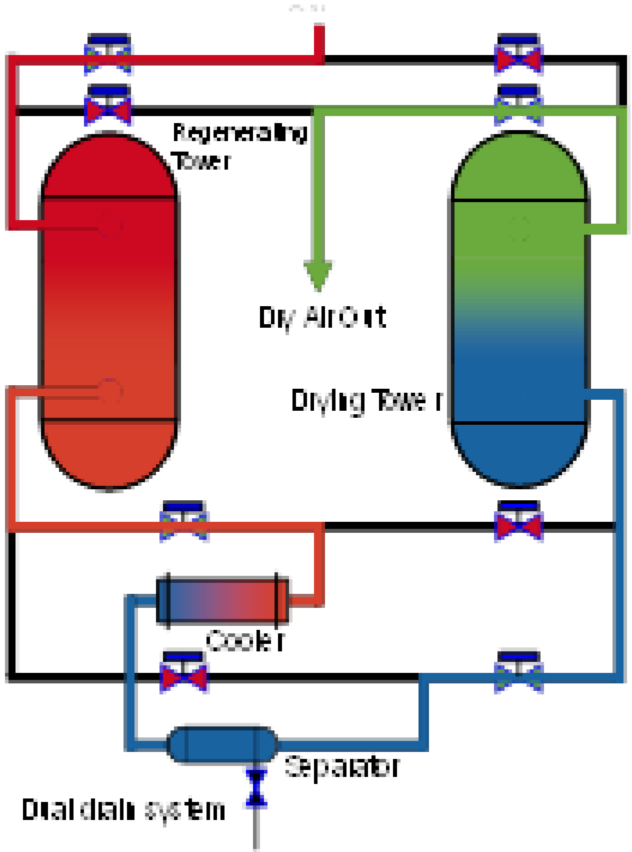


Blower Purge Desiccant

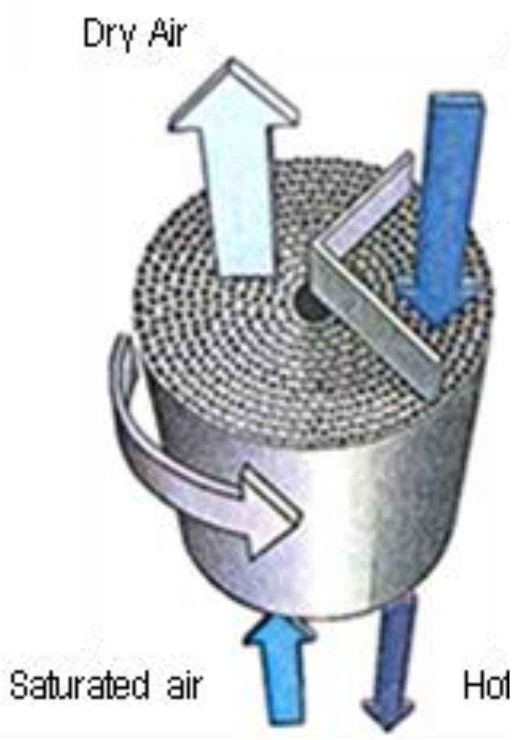


Heat of Compression

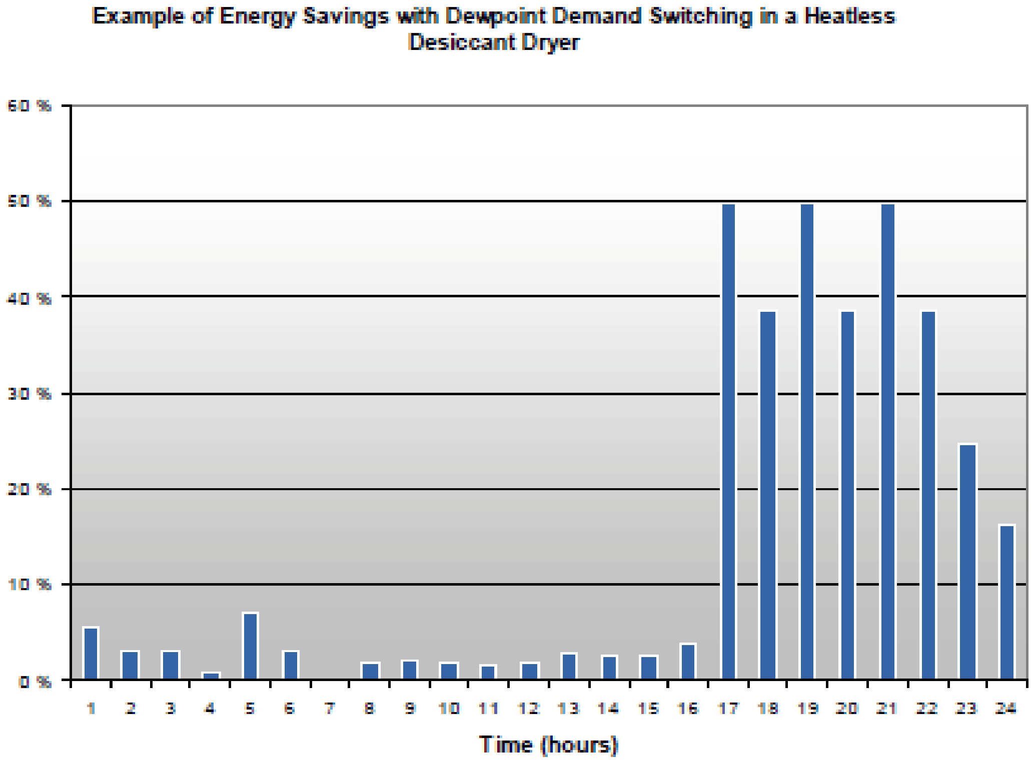
Twin Tower



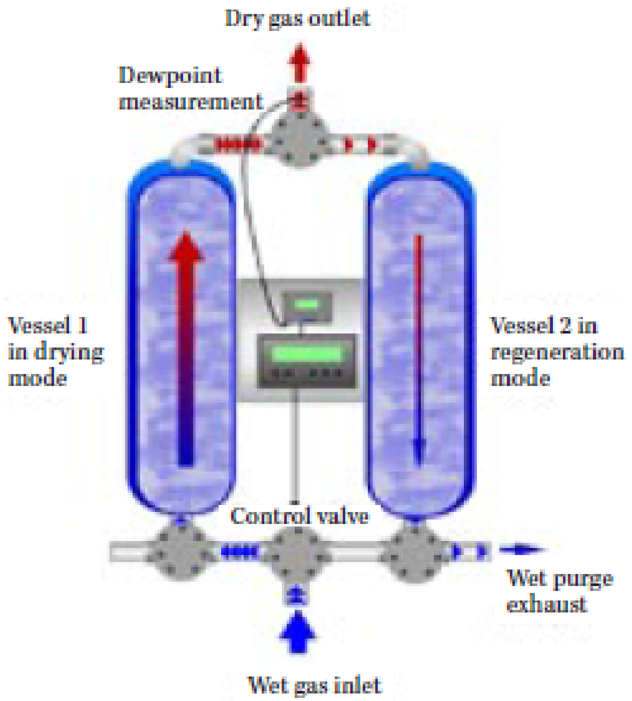
Rotary Drum



Dew Point Demand Controls



An example on savings in a typical 24 hour day at a company where manufacturing occurs in two shifts and the third shift is a cleaning shift. It is evident that the majority of the savings will occur during the off shift. If a plant operates only one shift, the overall savings would increase.



The operation principle of a heatless desiccant dryer equipped with a DDS system. The valve directing the flow to either of the two vessels

Benefits of Decentralized Dryer with -40˚F Dew Point

	Cycling Refrigerated	**Heated Blower Purge with PDP Controls**	**Heated Blower Purge with PDP Controls**
Dryer capacity (scfm)	3,000	500	3,000
Average demand load	2,000	300	2,000
Dewpoint	+38°F PDP	-40°F PDP	-40°F PDP
Dryer cost $	$60,148	$26,686	$131,789
Dryer installation cost $	$30,074	$13,343	$65,895
Total capital cost $	$90,222	$40,030	$197,684
Annual maintenance - filters $	$6,000	$8,000	$15,000
Annual desiccant replacement cost $		$870	$5,222
Total annual maintenance cost $	$6,000	$8,870	$20,222
Heater kW		12	84.9
Heater utilization rate		45%	50%
Blower compressor hp		5	20
Blower utilization rate		60%	66%
Dryer full load kW	16.9		
Cycling dryer utilization	23%		
Total average power use (kW)	3.8	7.8	52.7
Annual energy use $	$2,953	$6,037	$40,644
Total annual cost $	**$19,494**	**$19,584**	**$83,962**

Thank you for attending today's webinar.

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Email: don@apenergy.com
Phone: (740) 862-4112

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Questions?
Please feel free to reach out – we'd be happy to help!

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About the Speaker

Jason Brister
BEKO Technologies

- Product Manager – Desiccant Dryers & Custom Products, BEKO Technologies

- 16 years of experience in the compressed air industry

- BS in Mechanical Engineering

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Drying Solutions for Instrument Air Systems

Jason Brister

Sr. Product Manager

BEKO Technologies, Corp.

Truth In Compressed Air BEKO

Instrument Air – What Is It?

Treated compressed air: higher purity level than typical "plant" (general purpose) compressed air

Globally-recognized standard published by International Society of Automation (ISA) – *previously* known as Instrument Society of America:

› ANSI/ISA-S7.0.01-1996: Quality Standard for Instrument Air

ANSI
American National Standards Institute

ISA International Society of Automation
Setting the Standard for Automation™

Instrument Air – What Is It?

- Instrument air standard defines limits for primary contaminants:
  - Particulate
  - Water
  - Oil

Compressed Air Specifications ANSI/ISA—S7.0.01-1996			
Contaminant:	**Particles**	**Water content**	**Oil content**
Limit:	< 40 µm particle diameter	PDP < +39°F	≤ 1 ppm (w/w or v/v)

"Pressure dew point at the dryer outlet shall be at least 10°C (18°F) *below the minimum temperature to which any part of the instrument air system is exposed*. It shall not exceed 4°C (39°F) at line pressure."

Instrument Air – What Is It?

BEKO

What ISO class for instrument air?

Air quality classes in accordance with ISO 8573-1:2010

Class	Solid particles, max. number of particles per m³ 0.1 µm < d ≤ 0.5 µm	0.5 µm < d ≤ 1.0 µm	1.0 µm < d ≤ 5.0 µm	Pressure dew point °F	Oil content (liquid, aerosol, oil vapor) mg/m³
0	In accordance with the unit operator's or supplier's specifications, stricter requirements than class 1				
1	≤20,000	≤400	≤10	≤–94	≤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	-

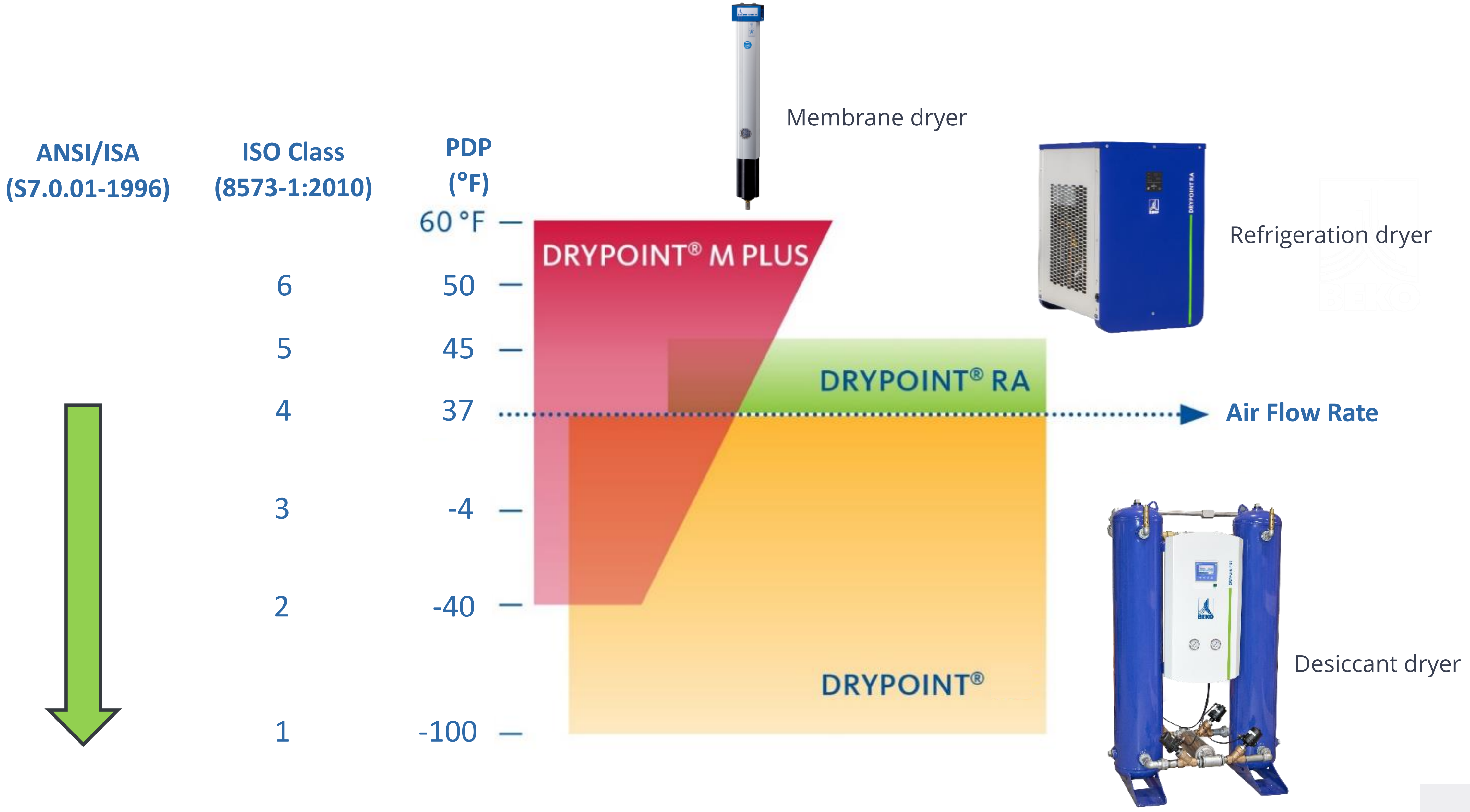
- Measured in accordance with ISO 8573-4, ref. conditions 14.5 psi [a] absolute, 68 °F, 0% RH
- Measured in accordance with ISO 8573-3
- Measured in accordance with ISO 8573-2 and ISO 8573-5, ref. conditions 14.5 psi [a] absolute, 68 °F, 0% RH

Instrument Air – Drying Requirements

Compressed Air Drying Specifications ANSI/ISA—S7.0.01-1996		
ANSI/ISA limit:	*PDP ≤ +39°F	
Recommended ISO class:	[–:*4:–]	**Min. *Ambient* Temp. by ISO class (PDP +18°F)**
ISO Class (8573-1:2010)	**Pressure Dew Point (°F)**	
1	≤ -100	≥ -82
2	≤ -40	≥ -22
3	≤ -4	≥ 14
4	≤ 37	≥ 55
5	≤ 45	≥ 63

**Minimum* – may be lower!

Instrument Air – What Level of Drying?



Variable Drying Requirements

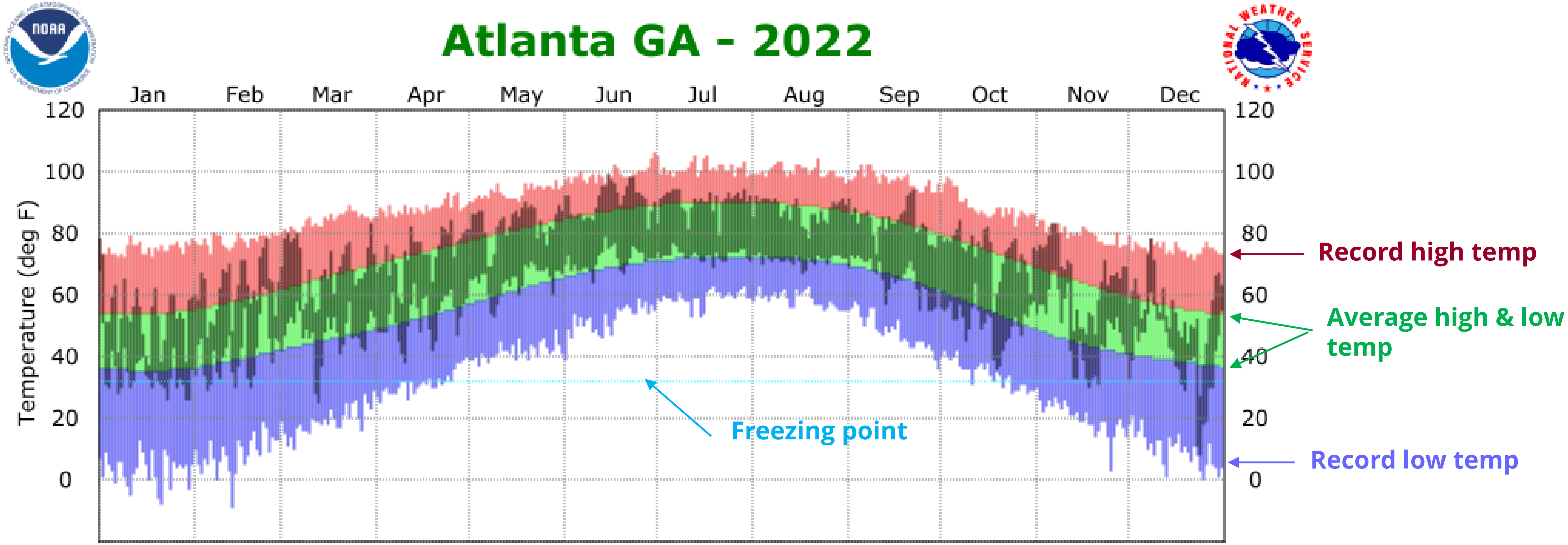
Large industrial manufacturing complexes often have compressed air lines/consumers exposed to outdoor conditions

- From ANSI/ISA, PDP should always be maintained 18°F *below the minimum temperature to which any part of the instrument air system is exposed*

Variable Drying Requirements

Many processes require a fixed or stable pressure dew point – but this is not always the case!

› Compressed air systems are often exposed to ambient temperatures that can fluctuate over a wide range (freezing possible)



Variable Drying Example – Outdoor Process

Common usage case: air pollution control application

- Fabric filter dust collectors, i.e. “baghouses” used throughout all industries to capture particulate matter emissions
  - Dust collection is required in most food processing plants, particularly in grain handling/milling operations
  - Fugitive dust emissions must be controlled for environmental and safety reasons

Variable Drying Example – Outdoor Process

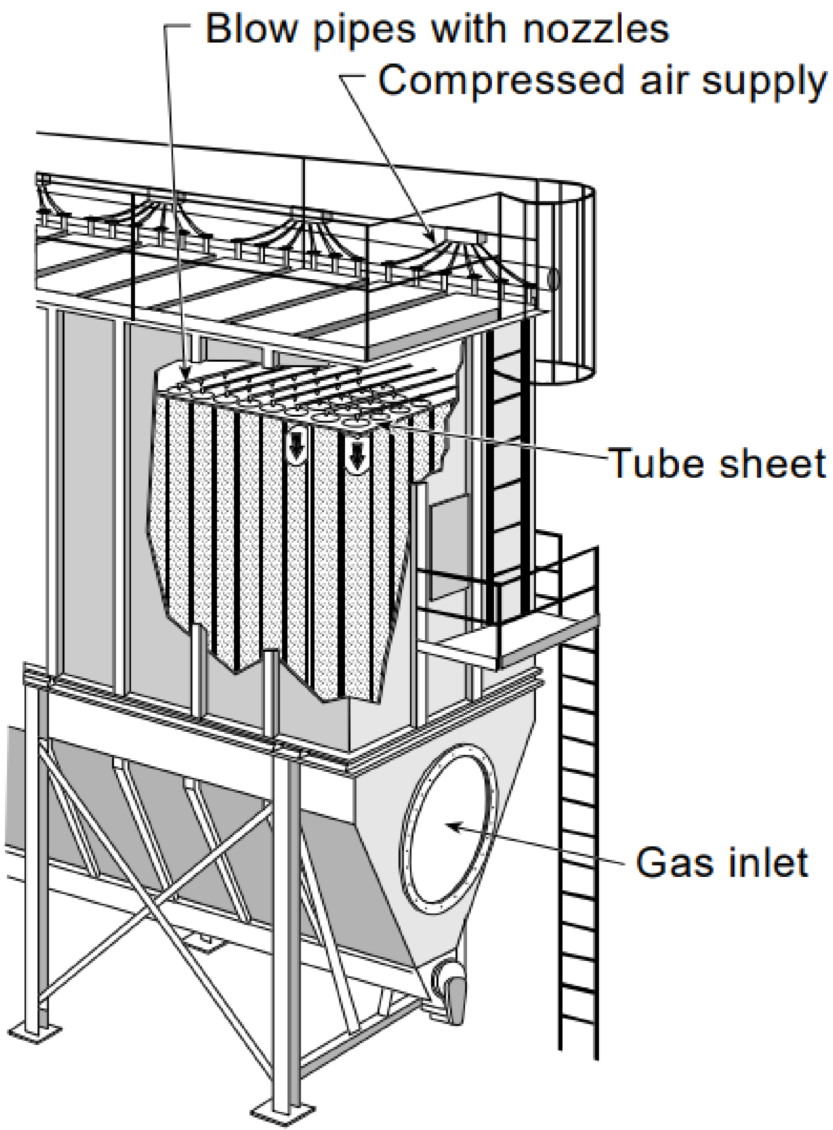


Image courtesy NC State University

Dust collectors and baghouses for air pollution control:

- Pulse-jet type systems use compressed air for automatic filter cleaning
- Large dust collectors are often located outdoors, hence exposed to wide range of ambient conditions
- For outdoor installations, drying requirements may vary by season:
  - ISO class 4-5 (PDP 37-45°F – refrigerant dryer) required at minimum during warm weather periods
  - *ISO class 2-3 (PDP -40 to -4°F – desiccant dryer) may be needed during winter

*the only practical alternative to drying is protecting exposed compressed air equipment from freezing is to insulate and heat *all* exposed surfaces

Variable Drying Example – Outdoor Process

Image courtesy Compressed Air Best Practices

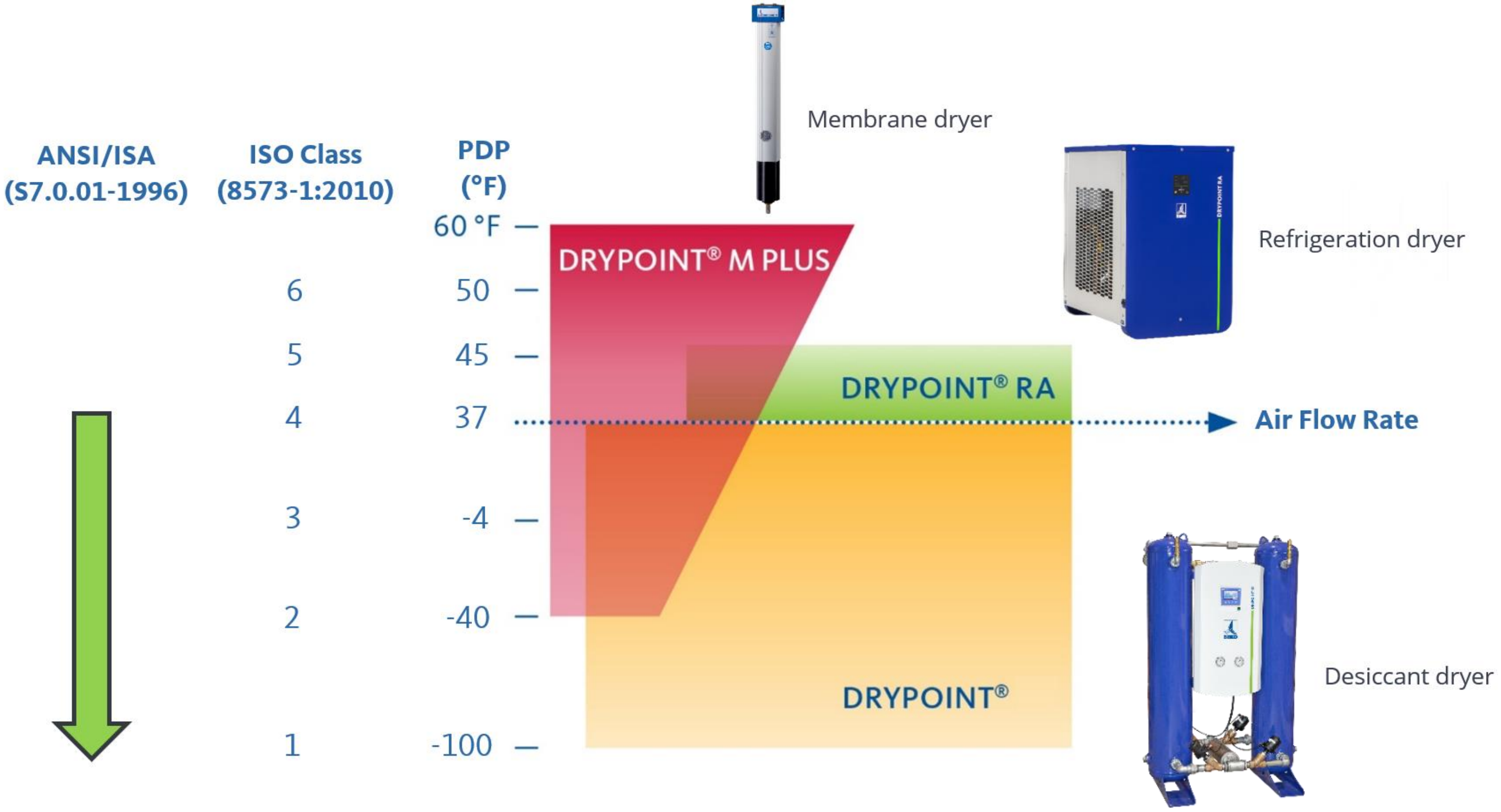
Outdoor compressed air systems exposed to sub-freezing temperatures:

- Why not use desiccant dryers year-round?
  - Potentially over-drying air during warm weather = inefficient use of energy
  - Refrigeration dryers are typically the most efficient method of drying compressed air, therefore preferred when application only requires ISO class 4-5 (general/plant air is sufficient)
- Recommendation: implement a *seasonal* drying plan:
  - Warm weather – refrigeration dryer

  - Cold weather – desiccant dryer

Variable Drying Requirements

General rule: for optimal process efficiency, *only treat the air to the extent required* for the process

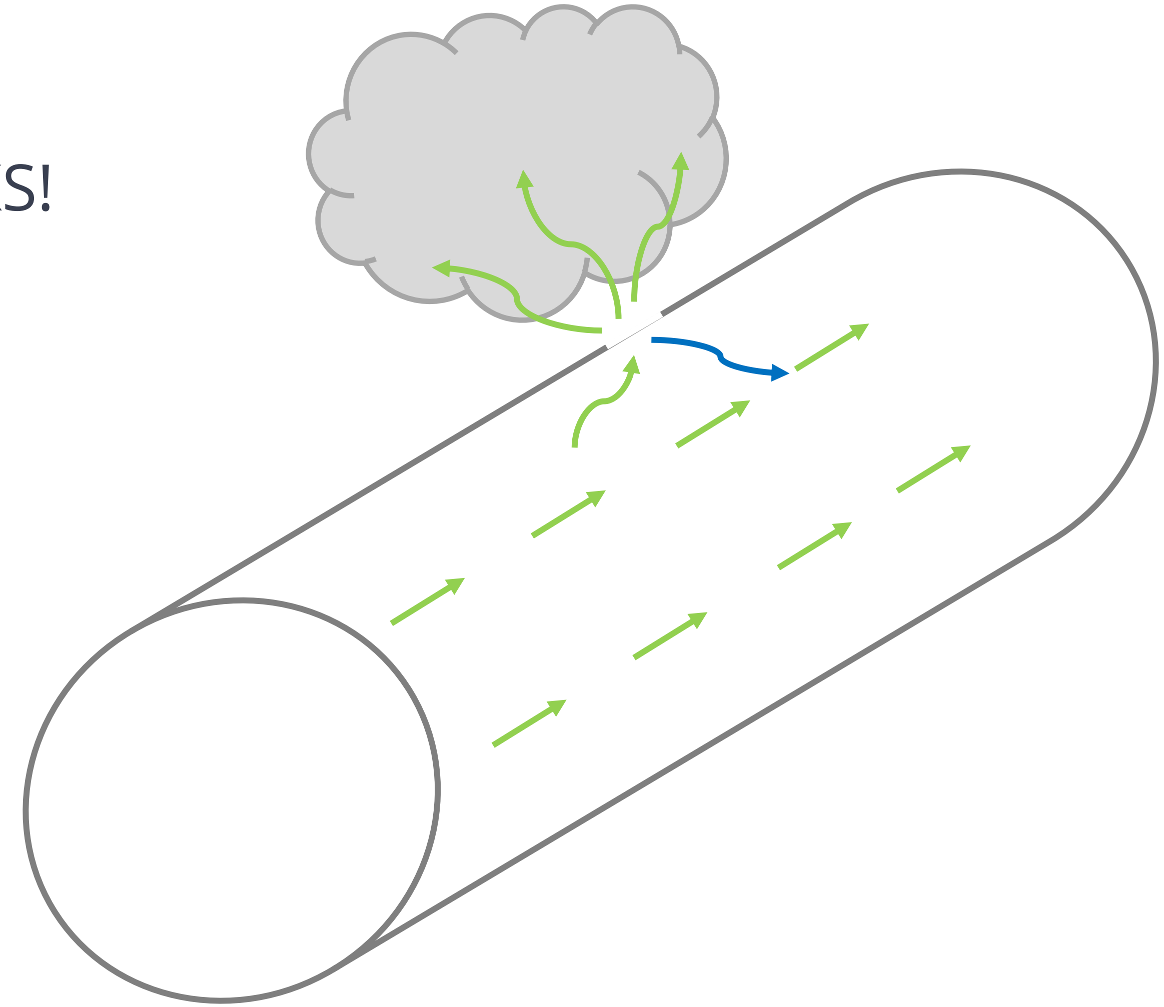


Instrument Air – Keep it Dry

Usage case: instrument air system with dryers for ISO class 3 or better (i.e. PDP of -4°F of lower)

- Dryer are working correctly - what could go wrong resulting in dry air <u>not</u> reaching the process/consumer?

AIR LEAKS!



Instrument Air – Keep it Dry

If compressed air is *escaping* the system via a leak, how can water *enter* the system?

- Physical systems always move toward a more balanced state (equilibrium):
- Reason the compressed air escapes to environment via air leaks (moving from high to low pressure)
- Extremely dry air is an unstable gas – it aggressively seeks to attract water (i.e. equalize saturation pressure)
  - Escaping air drops in temperature – if cooled/leaked air temperature drops below ambient dew point, ambient water vapor will condense on surfaces near the air leak
  - Accumulated condensation will then migrate *into* the compressed air system
  - A very small amount of moisture will quicky degrade pressure dew point!

About the Speaker

Brett Greenlee
Trace Analytics

- Key Accounts and Sales Manager at Trace Analytics
- Promoted high purity compressed air for breathing air end users' health and wellness
- 3 years as a high-pressure breathing air distributor
- 2 years at Trace Analytics managing sales and key accounts

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Air Quality Testing

Risks of Excess Water Vapor

Brett Greenlee with Trace Analytics

TESTING YOUR AIR QUALITY

Brett Greenlee

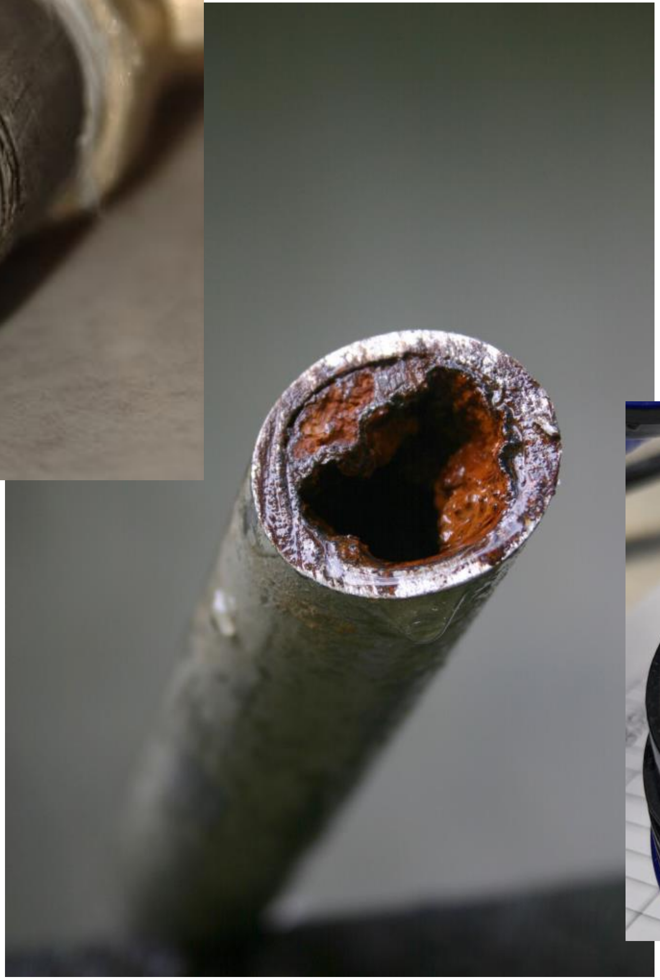
Sales Manager
& Key Accounts

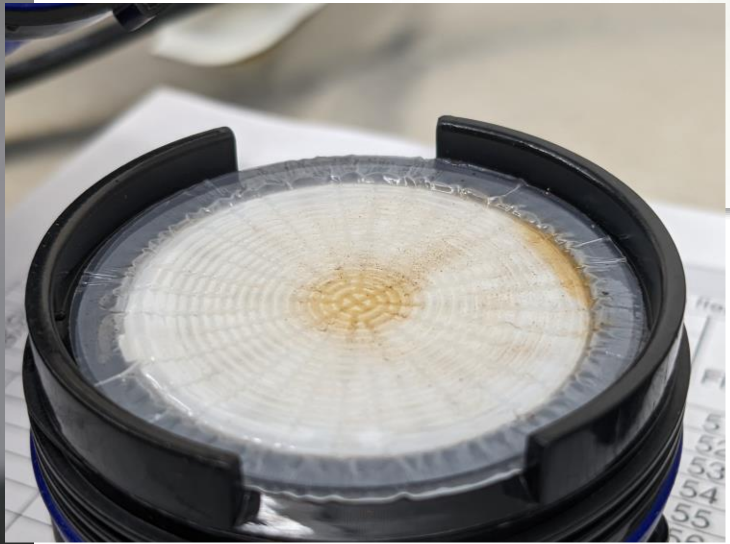
Trace Analytics

Industrial worker, Firefighter, and distributor

- What could be in my air?
- How can I check for moisture in my air?
- Which ISO classes would be common for me?

What’s In Compressed Air?





Risk of Excess Water Vapor

What could it mean?

- rust, corrosion
- microorganisms

How to check for it?

- Colorimetric Tubes
- Dew Point Hygrometer
- Third Party Accredited Laboratory

HOW TO TEST

- Test at the point-of-use
- Test on a regular schedule
- Meet ISO 8573 Requirements

ISO 8573 AND LEVELS OF RISK

HIGH RISK | MEDIUM-LOW RISK | NO RISK

ISO 8573 CLASSES

Risk	PARTICLES	WATER	OIL
HIGH RISK	1–2	1–3	1–2
MEDIUM-LOW RISK	3–5	4–6	3–4
NO RISK	6+	7+	X

THIS CHART SOLELY EXPRESSES THE OPINIONS OF TRACE ANALYTICS, LLC.

ISO 8573 Purity Classes, Common specs

Purity Class Applications

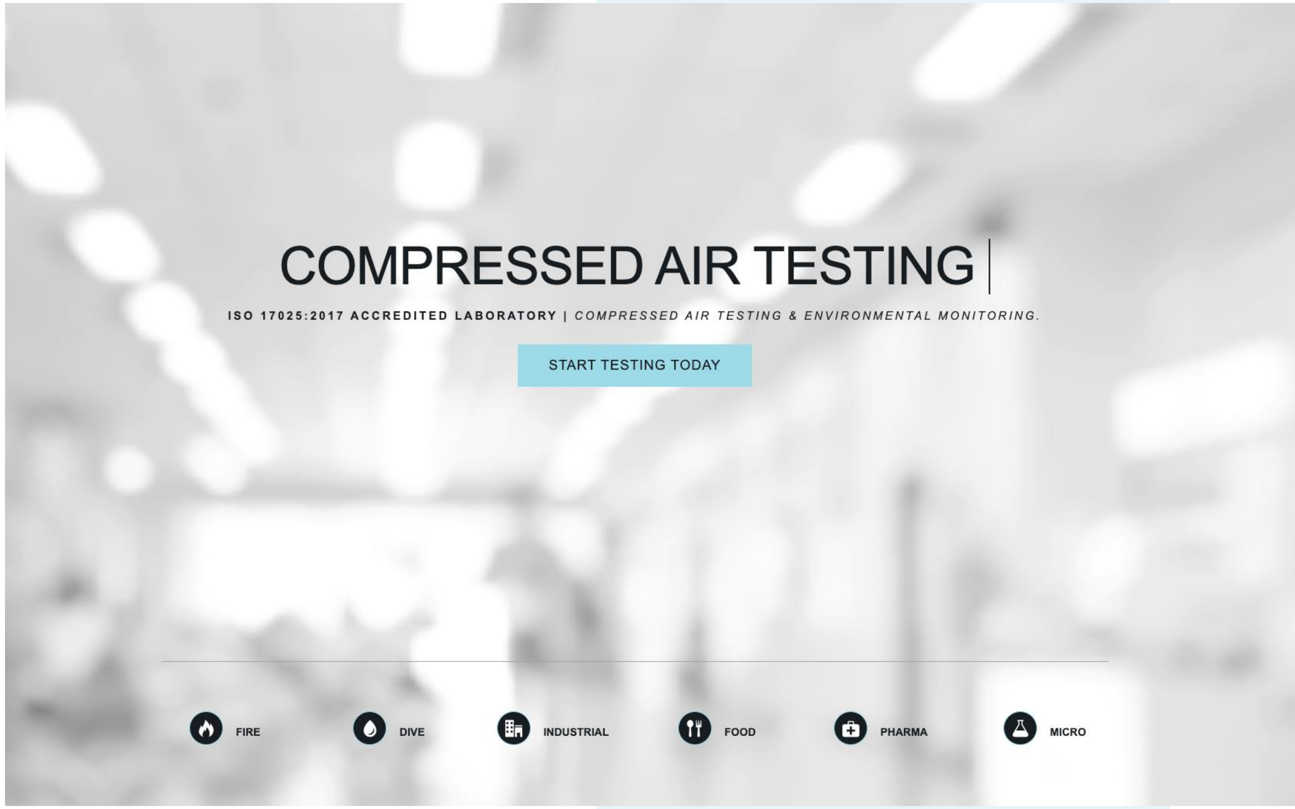
PACKAGING	2	4	2	SOFT DRINK	2	2	2
BAKERY	2	4	2	PHARMACEUTICAL	1	1	1
MEAT	6	4	2	COFFEE	1	4	1
PRODUCE	B	B	B*	PET FOOD	3	4	2
BEER	B	B	B*	BABY FOOD	1	3	2

Above specifications represent the opinicns of individual customers, not published standards

*B:B:B - Baseline analysis for particles, water, and oil - no limits, purity classes met are reported

FDA SQF BRC GLOBAL STANDARDS

Trace Analytics, LLC



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- ISO 17025 Accredited
- **Tests to ISO 8573,** ISO 14644, ISO 14698, and more!
- Has members and contributors on
  - NFPA 1989
  - ISO 8573 committee
  - ISPE Good Practice Guide
- State-of-the-art equipment that allows us to analyze hundreds of samples a day
- Work with clients around the world

TRACE Analytics

the compressed air testing experts

HAVE QUESTION WE DIDN’T COVER?

Reach out to our team of experts.

Refrigerated vs. Desiccant Dryers - Choosing the Right One

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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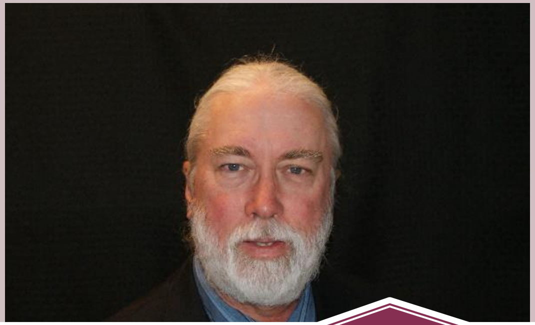
April 2024 Webinar

CTI STD-201RS Thermal Certification for Cooling System Heat Rejection Equipment, Part 2



Mike Womack
Cooling Technology Institute
Keynote Speaker

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