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COMPRESSED AIR BEST PRACTICES®

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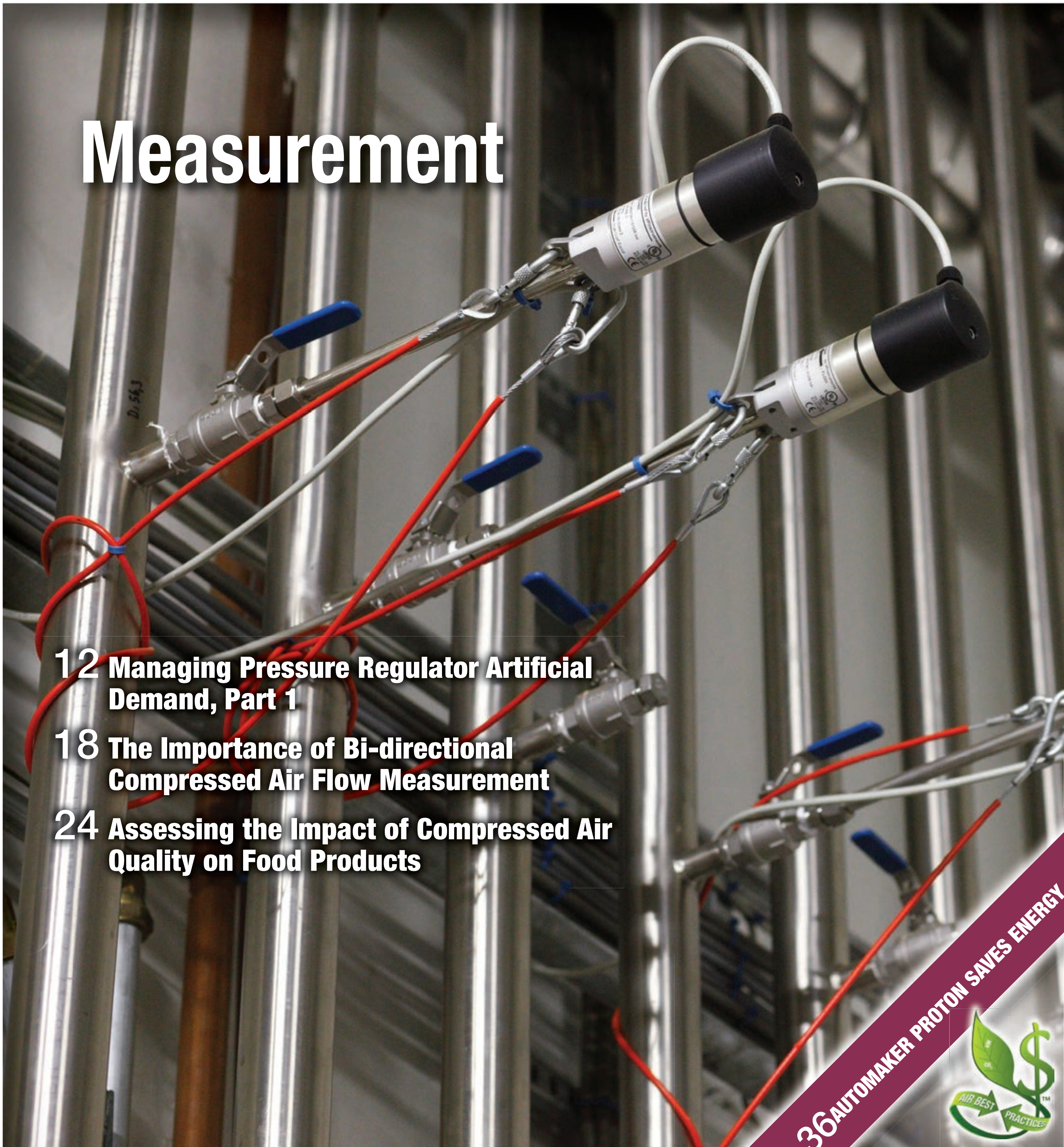


Measurement

12 Managing Pressure Regulator Artificial Demand, Part 1

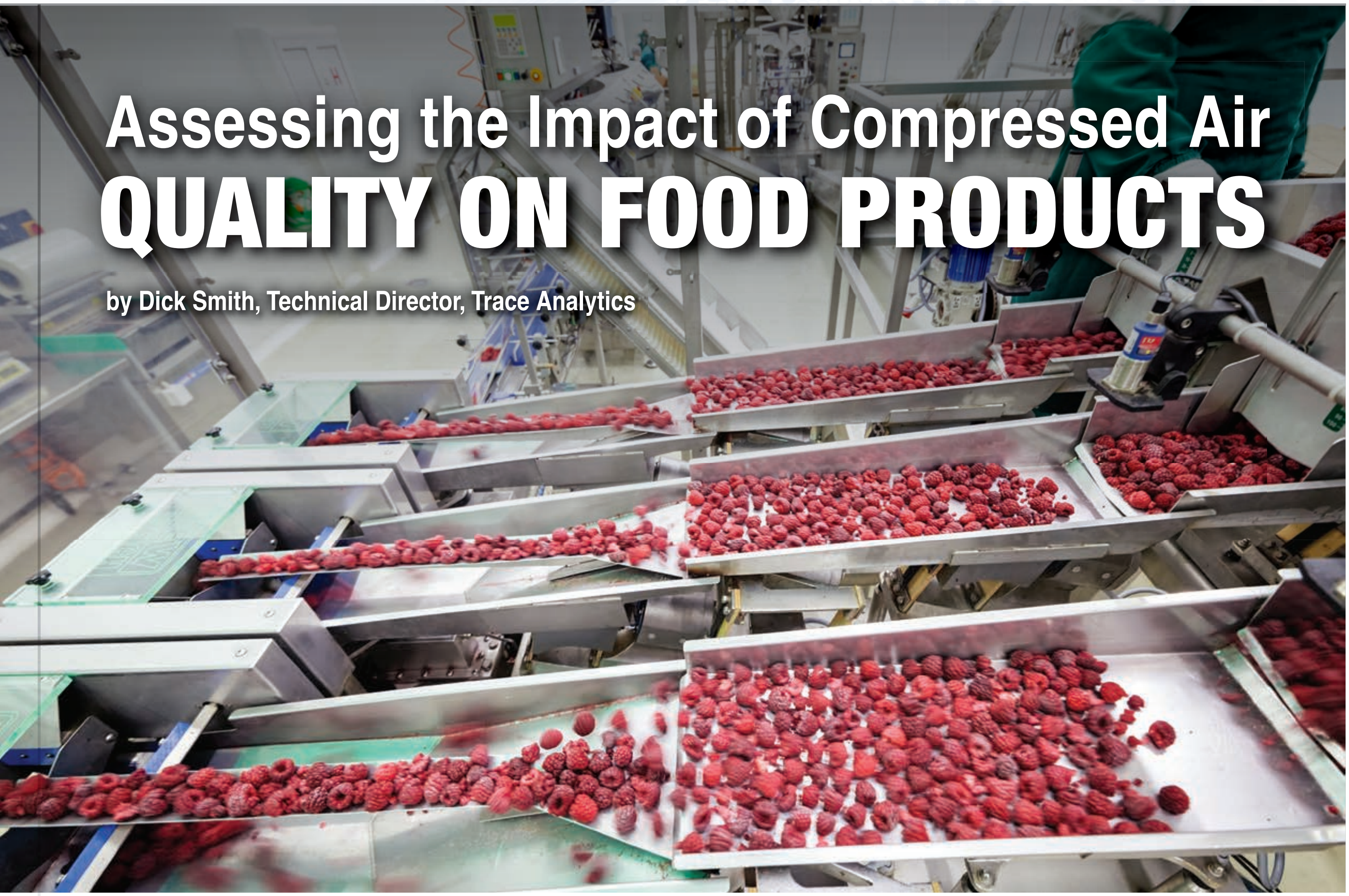
18 The Importance of Bi-directional Compressed Air Flow Measurement

24 Assessing the Impact of Compressed Air Quality on Food Products

36 AUTOMAKER PROTON SAVES ENERGY

Assessing the Impact of Compressed Air QUALITY ON FOOD PRODUCTS

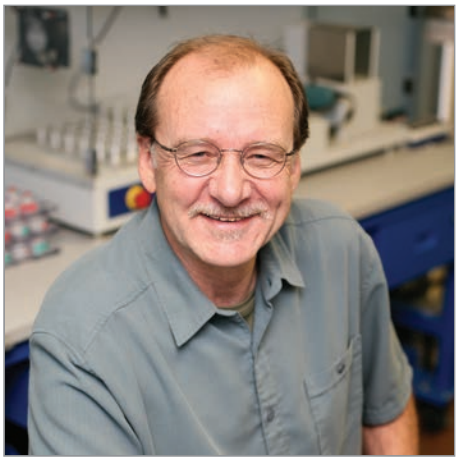
by Dick Smith, Technical Director, Trace Analytics



► Compressed air is a critical utility widely used throughout the food industry. Being aware of the composition of compressed air used in your plant is key to avoiding product contamination. Your task is to assess the activities and operations that can harm a product, the extent to which a product can be harmed, and how likely it is that product harm will occur. Assessing product contamination is a multi-step process in which you must identify the important risks, prioritize them for management, and take reasonable steps to remove or reduce the chance of harm to the product, and, in particular, serious harm to the consumer.

Source of Potential Product Harm

Normal ambient air contains millions of inert particles, 5-25 grams of water, 1-5 micrograms of oil, and tens to hundreds of bacteria per cubic meter. In addition, the system itself can be a source of possible contamination, including pipe scale and rust, polymer shredded particles, rubber gasket pieces, sealing tape, metal shavings from pipe cuts, and even particles from charcoal filters and desiccant canisters. Sometimes condensed water or liquid oil already present in the system forms into an aerosol or vapor, creating yet another source of contamination.



Dick Smith is the Technical Director for Trace Analytics, LLC

Risk Assessment

Generally, the steps of assessing the risks of product contamination are as follows:

1. Identify potential hazards
2. Assess the risk of harm
3. Assess existing control measures for adequacy
4. Assess if extra controls are needed
5. Schedule regular reviews to see if the controls are working

TABLE 1. ISO 8573-1:2010 — PART 1: CONTAMINANTS AND PURITY CLASSES								
	PURITY CLASSES FOR PARTICLES MAXIMUM NUMBER OF PARTICLES PER CUBIC METER (m^3) AS A FUNCTION OF PARTICLE SIZE, d[b]				PURITY CLASSES FOR HUMIDITY AND LIQUID WATER		PURITY CLASSES FOR OIL (LIQUID, AEROSOL, AND VAPOR)	
	MAXIMUM NUMBER OF PARTICLES PER m^3							
CLASS	0.1 < d ≤ 0.5 µm	0.5 < d ≤ 1.0 µm	1.0 < d ≤ 5.0 µm	> 5 µm	CLASS	PRESSURE DEW POINT °C	CLASS	Concentration of Total Oil mg/m^3
0	As specified by the equipment user or supplier and more stringent than class 1							
1	≤20,000	≤400	≤10	None	1	≤-70	1	≤ 0.01
2	<400,000	≤6,000	≤100	None	2	≤-40	2	≤ 0.1
3	not specified	≤90,000	≤1,000	None	3	≤-20	3	≤ 1
4	n/s	n/s	≤10,000	None	4	≤+3	4	≤ 5
5	n/s	n/s	≤100,000	None	5	≤+7	5	> 5
—	Particles by Mass Concentration, CP, mg/m^3				6	≤+10		
6	0 < CP ≤ 5				Class	Concentration of Liquid Water[b] CW g/m^3		
7	5 < CP ≤ 10							
X	CP >10							
					7	CW ≤ 0.5		
[a] To qualify for a class designation					8	0.5 ≤ CW ≤ 5		
[b] At reference conditions: 20°C, 100 kPa; 0 rel. water vapor pressure					9	5 < CW ≤ 10		
[c] See ISO 8573-1:2010 A.3.2.2					X	CW > 10		

Identifying Hazards

A number of the components of ambient air become contaminants once they enter the compressed air stream. For the sake of this discussion, we will omit airborne microbes, as they were thoroughly discussed by Lee Scott in the Jan/Feb 2016 Issue of Compressed Best Practices® Magazine: http://www.airbestpractices.com/standards/food-grade-air/compressed-air-gmps-gfsi-food-safety-compliance.

When a compressed air component has a deleterious effect on the product, it is considered a compressed air contaminant. ISO 8573.1:2010 contains purity classes for components/contaminants in compressed air as shown in Table 1.Further, the British Retail Consortium (BRC) and the British Compressed Air Society (BCAS) have worked together to author a code of practice for the food and beverage industry. This code

TABLE 2. A BRIEF SUMMARY OF FOOD AND BEVERAGE GRADE COMPRESSED AIR BEST PRACTICE GUIDELINE 102 PRODUCED BY THE BRC AND BCAS, JULY 18, 2013

PRODUCT CONTACT	PARTICLES, MAXIMUM NUMBER PER CUBIC METER BY PARTICLE SIZE RANGE				HUMIDITY (WATER VAPOR), PDP °C	TOTAL OIL, mg/m³	ISO 8573-1:2010 EQUIVALENT
	0.1≤0.5 μm	0.5≤1 μm	1-≤5 μm	>5 μm			
Direct	≤400,000	≤6,000	≤100	None	≤-40	≤0.01	2:2:1
Indirect	≤400,000	≤6,000	≤100	None	≤+3	≤0.1	2:4:2

incorporates selections from the ISO 8573-1:2010 purity classes to arrive at recommendations for compressed air that comes into **direct contact** with the product, as well as compressed air that comes into **indirect contact** with the product, as seen in Table 2.

These two specifications encompass most identifiable hazards. According to the Guideline, compressed air quality shall be tested and verified at least twice per year or per the manufacturer's recommendations. Additional testing is also warranted whenever maintenance work or any activity that may affect the air quality is performed on the compressed air system. The Guideline recognizes the importance of compressed air quality and states that compressed air should now be part of the Pre-Requisite Program (PRP) in addition to the Hazard Analysis & Critical Control Points (HACCP) plan. Whenever maintenance is performed a representative selection of the air outlets shall be tested to confirm that the compressed air meets the relevant Purity Classes.

Assessing Risk of Harm

It may be helpful to catalog the elements of the compressed air system using something like the checklist in Table 3 below. The table allows you to assign the level of risk for each element with a numerical value (0 being no risk and 5 being certain risk).

In order to implement a monitoring plan, we must take stock of the compressed air system. Table 3 (pg. 28) shows information that is not atypical of first-time air testing customers, although many of the entries made relating to piping, seals, sealants, and valves are not usually discovered prior to initial sampling. Based on this information, sampling can begin.

Table 4 (pg. 29) lists materials for parts of a compressed air system, in order of what creates the best sampling environment. This table may be useful in assessing a system's current risk of exceeding specifications.

ASSESSING THE IMPACT OF COMPRESSED AIR QUALITY ON FOOD PRODUCTS

TABLE 3. COMPRESSED AIR SYSTEM RISK ASSESSMENT CHECKLIST

AREA	ITEM	DESCRIPTION	PER SOP[A]	OTHER ISSUES	RISK
Compressor Room	Air Compressor		Yes	What about regularly scheduled maintenance or lack of maintenance, food grade oil vs non-food grade oil	2
	Make	PJ's Compressors			
	Model				
	Serial Number	4592222			
	Compressor Hours	22,600			
	Hours Per Week	Unknown			
	Inlet Filtration	Yes	Unknown		2
	System Pressure	130 psig			
	Aftercooler	Yes			
	Air Receiver	Yes			
	Bulk Liquid Separator	Yes			
	Particle Filtration 1	5 micron	Yes		2
	Particle Filtration 2	0.01 Micron			
	Refrigerated Dryer	Yes	Yes		2
	Refrigerated Dryer Pressure Dew Point	38°F			
	Desiccant Dryer	No	N/A		3
	Pressure Dew Point	N/A			
Piping	Air Compressor		Unknown		4
	Piping & Fitting	Cast Iron			
	Fitting Type	Threaded			
	Seal Type	Thread to Thread			
	Sealant Type	Pipe Putty			
	Valving	Ball Valve			
	Pipe Chase/Run		Unknown		4
	Piping & Fitting	Unknown			
	Seal Type	Thread to Thread			
	Sealant Type	Tape & Pipe Putty			
	Valving	Ball Valve			
	Point of Use		Unknown		1
	Piping & Fitting	Stainless Steel			
	Seal Type	SS			
	Sealant Type	SS Ferrules			
	Valving	Ball Valve			
Point of User Application	Point of Use Tubing	Yellow Hose	Unknown		4
	Point of Use Filtration	None			
	Point of Use Desiccant Dryer	No			
	Point of Use Pressure	50 psig			
	Number of Outlets	16			
Sampling Connection	Fittings	Quick Connect	N/A	Sampling not yet performed	1
	Valves	SS Ball Valve			
	Tubing	Particle Free Polymer			
				Total	**25**

[A] Operated and maintained per written SOP
[B] Risk, 0-5; 0 being no risk and 5 being a certainty that the specification will be exceeded

Assessing Existing Controls

Staying current on regulations and publications will ensure knowledge of relevant standards. As for the present state of existing controls, there are two ways to monitor the quality of compressed air, either by testing all critical points of application, or by testing a random representative portion. While it can cost more to test all points, it is the only completely accurate method, since contamination can occur at any specific point without effecting others nearby. It may happen that the one point that isn't tested ends up being the one that is contaminated.

Sampling strategies should be robust to ensure that the air provided to all points of use is of consistent quality. There are several sampling options to consider when assessing your system and its controls:

- Determine the percentage of sampling points to be tested over a given time period, e.g., 100%, 50%, 25%, etc.
- Take three samples: one close to the compressor, one midway through the system, one as far away from the purification as possible
- Sampling immediately before and after filter changes to weigh worst case scenarios against best case scenarios. Data obtained after 3-4 filter changes can be used to establish a trend analysis.

Reviewing Efficacy of Controls

After receiving air sample test results, control efficacy will be made apparent. If the contaminant quantity falls within an acceptable threshold, by industry, then controls are adequate. However, if contaminants meet or exceed set standards, the options are to either

TABLE 4. MATERIAL PREFERENCES FOR BETTER AIR SAMPLES

BASED ON LASER PARTICLE COUNTER AND CUSTOMER EXPERIENCE

ITEM	BEST > BETTER > GOOD > NOT SO GOOD > POOR
Piping & Fittings	Stainless Steel > Conductive Polymer > Nylon > Polyester > Vinyl > Polyethylene > Copper > Glass > PTFE > Aluminum > Black Iron
Seal Type	Welded > SS Compression > Rubber O-Ring Compression > Threaded
Sealant Type	Welded > SS Ferrule > Polymer O-ring > PTFE Tape > Putty
Valving	Particle Free SS > SS Shut-off > Ball Valve w/ Conductive Polymer Seal > Ball Valve w/ Rubber Seal > Valve with Rubber Seal

(Mostly relating to particles, but has some applicability to water and oil.)

reassess if the limits were set inappropriately, or to add additional controls, such as point of use filters.

Assessing Whether Additional Controls Are Needed

If, in the previous step, control efficacy proved inadequate to achieving the desired air purity rating, additional controls are, obviously, called for. Information about options may be available by industry or across industries, but the principle is to either add controls where none are in place, like adding a refrigerant dryer where there is none, or to add controls to existing controls, like adding a desiccant dryer to a refrigerant dryer. If, in the previous step, even the bottommost standards aren't met, then basic controls need to be implemented immediately.

Scheduling Regular Review

This pertains to periodic reviews, the timeframes of which are designated by industry standard setters (BCAS recommends semi-annual). Quarterly testing is a good place to start in industries and geographies where testing is not strictly enforced. This can provide a baseline where no historic data exists, or, in cases where records already exist, can provide an accurate current assessment. Compressed air systems are not static, but dynamic—always changing. Component parts breakdown and malfunction, requiring maintenance or replacement, and there is not always an obvious indication that a device which is plugged in and running is not performing to standard. Regular testing hedges against the possibility of underperformance or non-performance.

Compressed air quality is a critical aspect of sanitation in the food industry. While regulation is still in its infant stages in some places, the core desire to protect consumers is enough to warrant regular air testing, as well as to ensure that equipment and processing environments are operating efficiently. Testing, while it does cost, stands to safeguard against the possibility of greater cost of damage or incident. ■

For more information please contact Trace Analytics at tel: 800-247-1024 x 4, email: TraceAnalytics@AirCheckLab.com or visit www.AirCheckLab.com.

To read similar ***Food Industry*** articles visit http://www.airbestpractices.com/industries/food or to learn about similar ***Food-Grade Air Standards*** visit http://www.airbestpractices.com/standards/food-grade-air

> "Quarterly testing is a good place to start in industries and geographies where testing is not strictly enforced. This can provide a baseline where no historic data exists, or, in cases where records already exist, can provide an accurate current assessment."
>
> — Dick Smith, Technical Director, Trace Analytics

Compressed Air System Risk Assessment Checklist

Area	Item	Description	Per SOP[A]	Other Issues	Risk
Compressor Room	Compressor				
	Make				
	Model				
	Serial Number				
	Compressor Hours				
	Hours Per Week				
	Inlet Filtration	Yes No			
	System Pressure				
	Aftercooler	Yes No			
	Air Receiver	Yes No			
	Bulk Liquid Separator	Yes No			
	Particle Filtration 1 (um size)				
	Particle Filtration 2 (um size)				
	Refrigerated Dryer	Yes No			
	Refrigerated Dryer Pressure Dew Point				
	Desiccant Dryer	Yes No			
	Pressure Dew Point	Yes No			
Piping	Compressor				
	Piping & Fitting				
	Fitting Type				
	Seal Type				
	Sealant Type				
	Valving				
	Pipe Chase/Run				
	Piping & Fitting				
	Seal Type				
	Sealant Type				
	Valving				
	Point of Use				
	Piping & Fitting				
	Seal Type				
	Sealant Type				
	Valving				
Point of User Application	Point of Use Tubing				
	Point of Use Filtration	Yes No			
	Point of Use Desiccant Dryer	Yes No			
	Point of Use Pressure	50 psig			
	Number of Outlets	16			
Sampling Connection	Fittings				
	Valves				
	Tubing				
				Total	

[A] Operated and maintained per written SOP

[B] Risk, 0-5; 0 being no risk and 5 being a certainty that the specification will be exceeded

The table may be useful in assessing a system's current risk of exceeding specifications.

Material Preferences for Better Air Samples	
Based on Laser Particle Counter and Customer Experience	
Item	Best > Better > Good > Not So Good > Poor
Piping & Fittings	Stainless Steel > Conductive Polymer > Nylon > Polyester > Vinyl > Polyethylene > Copper > Glass > PTFE > Aluminum > Black Iron
Seal Type	Welded > SS Compression > Rubber O-Ring Compression > Threaded
Sealant Type	Welded > SS Ferrule > Polymer O-ring > PTFE Tape > Putty
Valving	Particle Free SS > SS Shut-off > Ball Valve w/ Conductive Polymer Seal > Ball Valve w/ Rubber Seal > Valve with Rubber Seal