Best practices guide to air quality

Many applications require high-quality compressed air to protect downstream equipment and end products alike. Here is what you need to know.

Why is air quality important?

The quality of compressed air always matters. Keeping it free from contaminants such as oil, moisture and particulates, not only protects the compressed air system itself but also any downstream equipment and, perhaps most importantly, your end products.

For some applications, high-quality air is a “nice to have.” For many others, however, some degree of air quality is mandated. The requirements are most stringent for products that are ingested by consumers, for example those of the food & beverage sector or the pharmaceutical industry. However, there are also air purity standards for many other applications, including in the medical and electronics sectors.

The failure to meet them can have many expensive consequences. The contamination of a compressed air system can lead to the standstill of production lines, the loss of products, cleaning costs and the recall of contaminated goods (as well as the associated loss of reputation).

It is important to note that the application or process owners of compressed air systems are responsible for defining the required air quality for their applications. That also means that they have to be aware of any applicable standards and ensure that the necessary air treatment equipment is installed to comply with them.

The following guideline will make this job easier and provide answers to some of the most important questions.

What is the **international standard** *for defining* **compressed air quality?**

The international standard that defines air quality is ISO 8573-1:2010. It is divided into seven purity classes each for three types of contaminants (A for particles; B for humidity; C for volatile organic compounds, which includes oil).

Essentially, it tells the operators of compressed air systems how many of these contaminants their compressed air may contain. As you will see in the chart below, the lower the class, the purer the air has to be.

Class	Solid Particle Maximum number of particles per m²			Water Pressure Dew point (°C)	Oil (incl. Capor mg/m³)
	0.1 - 0.5 micron	0.5 - 1.0 micron	1.0 - 5 micron		
0	As specified by the equipment user or supplier and more stringent than class 1				
1	$20,000	$400	$10	≤-70 (-94 F)	≤0.01
2	$400,000	$6,000	$100	≤-40 (-40 F)	≤0.1
3	Not Specified	$90,000	$1,000	≤-20 (-4 F)	≤1
4	Not Specified	Not Specified	$10,000	≤+3 (38 F)	≤5
5	Not Specified	Not Specified	$100,000	≤+7 (45 F)	NA
6	Not Specified	Not Specified	Not Specified	≤+10 (50 F)	NA

Compressed air purity classes for particles

Class[a]	Maximum number of particles per cubic metre as a function of particle size, *d*[b]		
	0,1 µm < *d* ≤ 0,5 µm	0,5 µm < *d* ≤ 1,0 µm	1,0 µm < *d* ≤ 5,0 µm
0	As specified by the equipment user or supplier and more stringent than class 1		
1	≤ 20,000	≤ 400	≤ 10
2	≤ 400 000	≤ 6,000	≤ 100
3	Not Specified	≤ 90,000	≤ 1,000
4	Not Specified	Not Specified	≤ 10,000
5	Not Specified	Not Specified	≤ 100,000
6	Not Specified	Not Specified	Not Specified

Class	Mass concentration[b] C_p mg/m³
6[c]	$0 < C_p \leq 5$
7[c]	$5 < C_p \leq 10$
X	$C_p > 10$

- To qualify for a class designation, each size range and particle number within a class shall be met.
- At reference conditions; see Clause 4.
- See A.3.2.2

Compressed air purity classes for humidity and liquid water

Class[a]	Pressure dewpoint °C
0	As specified by the equipment user or supplier and more stringent than class 1
1	≤ -70
2	≤ -40
3	≤ -20
4	≤ +3
5	≤ +7
6	≤ +10

Class[a]	Concentration of liquid water[a] C_w g/m³
0	As specified by the equipment user or supplier and more stringent than class 1
1	$C_w \leq 0,5$
2	$0,5 < C_w \leq 5$
3	$5 < C_w \leq 10$
4	$C_w > 10$

- At reference conditions; see Clause 4.

Compressed air purity classes for total oil

Class	Concentration of total oil[a] (liquid, aerosol and vapour) mg/m³
0	As specified by the equipment user or supplier and more stringent than class 1
1	≤ 0,01
2	≤ 0,1
3	≤ 1
4	≤ 5
X	> 5

- At reference conditions; see Clause 4.

Class 0 is the most important class. It is the only class in which no limits are defined because they may vary by application. However, it is important to remember that these limits are always more stringent than those of Class 1 air.

It is also possible that the air that is used has to meet different purity classes for particles, humidity and volatile organic compounds. For example, it might have to meet Class 2 purity regarding particles and Class 3 purity regarding humidity and Class 2 regarding volatile organic compounds. In this case, the air would have to meet class [2 : 3 : 2].

Are there any **standards** *or* **guidelines** *that define* **air quality classes** *for specific applications?*

Yes, there are, but not many.

One of them is the UK's BCAS: Food and Beverage Grade Compressed Air Best Practice, Guideline 102. It recommends class [2 : 2 : 1] for direct contact and class [2 : 4 : 2] for indirect contact.

Another is the German VDMA15390, which details the typical purity classes for applications in the food & beverage and pharma sectors. It states that, if the compressed air comes into contact with the end product, then the ISO class [2 : 4 : 1] is recommended if the ambient temperature is above 10°C, and class [2 : 2 : 1] if the ambient temperature is equal to or lower than 10°C.

In addition, there are some other guidelines, such as the ISO22000 standard for food safety. It contains this useful guide for defining and controlling the quality of compressed air:

1 **Analyze Hazards**

Potential hazards to the foods safety are recognized; in addition measures to regulate and control the hazards are identified.

2 **Identification of CCP's**

Critical Control Points throughout the production process of the product are established.

3 **CCP Prevention Measures**

A prevention measure is established at all CCP's for example, minimal cooking time or temperature at a certain point in the product line.

4 **Monitoring of CCP Prevention Measures**

A system is established to monitor prevention measures at a CCP: for example, a computer system would monitor and log the temperature.

5 **CCP Not Met**

Establish a precaution when the CCP hasn't been met, for example, if the temperature is too low, the computer will alarm the batch to be destroyed.

6 **HACCP & CCP Log**

Maintain a log system of all the CCP's; also, this would include records of CCP control methods and action taken to correct potential problems.

This is a Management Standard: it doesn't prescribe in detail what air quality you need for which application, but describes how you have to set up a management system for assessing and safeguarding the correct quality of compressed air and the actions that need to be taken when the requirements are not met. In that respect, it is very much like ISO9001 (for quality), ISO14001 (for environment), ISO45001 (for occupational health and safety),…

What types of **tests** *are available for* **measuring the air quality?**

There are different testing methods available for the different contaminants.
ISO8573-2/9 define the approved test methods in accordance with this standard.
To find out which is the optimal solution for different applications, it might make sense to consult an expert.

What kind of **air treatment equipment** *should I* **use?**

Air treatment is the key to meeting the stringent ISO 8573-1:2010 purity classes. There are different solutions to choose from, such as dryers to reduce the moisture contained in compressed air or filters that remove particles and oil.

In case of oil injected compressors, the oil that is injected in the compressor element to cool, lubricate, and seal during the compression phase, will have to be extracted again. This can be done with a combination of coalescence filters and active carbon filters.

With oil free compressors, there is no oil added to the compressed air at any time, so this is the only way to guarantee that there will never be any oil contamination from the compressors.

While their initial cost is higher, that investment can in time be recovered through lower operating expenses (less maintenance than a lubricated compressor with filters).
And, of course, because there is no threat of oil contamination from the compressor, there is no risk of production stand still, scrap cost of contaminated products or even a costly product recall.

Don't take risks, **consult with experts**

Due to the potentially very costly consequences of allowing your compressed air system to become contaminated, you should always reach out to our experts if you are unsure which standards apply to you or if you have questions about air quality requirements and your air treatment equipment options.

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