VAISALA / APPLICATION NOTE

Improving Refrigerant Dryer Systems Through More Accurate Dew Point Measurement

Compressed air is vital for virtually any manufacturing industry, from operating pneumatic tools to spray painting, blow molding, and chemical mixing. Whatever the application, the compressed air needs to be dry to avoid risk of corrosion, malfunctions, and poor end-product quality, all of which can result in unnecessary costs. Today, roughly 80 percent of compressed air systems use refrigerant dryers to maintain dryness. Unfortunately, many of them lack accurate dew point measurement, leading to unnecessary operating costs and lower end-product quality.

Depending on the desired pressure dewpoint, the choice in dryer selection will vary. Generally speaking, the two most common types of industrial dryers used in compressed air systems are desiccant and refrigerant.

Desiccant dryers use adsorbing materials such as silica gel or activated alumina to remove moisture from the air, where as refrigeration dryers remove moisture by cooling it in a heat exchanger and purging the condensed water. A separate refrigerant compressor and heat exchanger are used to handle this cooling function. Refrigeration dryers can produce the dew point levels required for compressed air of class 4 quality or above, whereas desiccant dryers are needed for class 3 and below (based on ISO Standard 8570.1, see table 1)

Why Measuring Temperature at The Air Cooler Is Not Enough

Traditionally, refrigeration dryers have been equipped with only a temperature sensor – which are often times considered to be equivalent to a dew point measurement. Yet there are several potential reasons why the temperature measurement may not indicate the true dew point of the air:

- Drain valves can fail
- Drain points can become blocked, leading to improper removal of water and consequent contamination of the air with micro droplets
- The condensate can overload the drain system, meaning that even a steady condensate flow is no guarantee of normal operation.
- Temperature measurement can also be misleading in cases of high flowrates, as the whole air mass is not cooled to the heat exchanger temperature.

As these factors indicate, the only way to accurately measure moisture and monitor correct dryer operation is to use a dew point sensor installed at the dryer outlet.

Not Only Usability and Reliability But Also Energy Efficiency

Refrigerant dryer control systems have developed considerably in recent years with modern controls utilizing accurate dew point data.

For example, variable speed drives can now be used to adjust the refrigeration cycle thereby optimizing dryer performance. Especially in the case of varying load conditions, the savings in energy consumption can be significant – up to 50 percent.

Correct Placement of The Dew Point Sensor

Since dew point is pressure dependent it is important to know where in the system dew point is being measured and what the conditions are at each location in order to draw correct conclusions about dryer performance. Figure 1 demonstrates how dew point changes as a function of decreasing pressure from its initial value of +4°C, a typical pressure dewpoint for refrigeration dryer. To provide a practical example: the compressed air system is supposed to produce air with pressure of 7 bar and a dew point of +4°C. If dew point is measured downstream at a position where the pressure is 6 bar, a dew point reading of +4°C might give the impression that the system is operating correctly. However, when pressure dependence is taken into account, the actual dew point at the dryer is only +6°C. The lesson learned from this example is that the best dew point measurement location is directly on the dryer outlet.

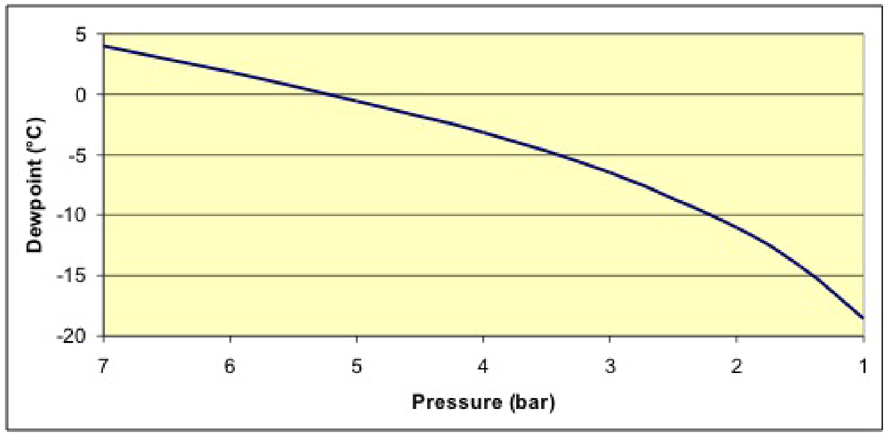

Figure 1. The dew point of air as a function of decreasing pressure – for air with initial state Td 4°C and 7 bar.

Air Quality Class	Pressure Dewpoint (°C)	Vaisala Dewpoint Instruments
1	-70	DMT152
2	-40	DMT142, DMT242, DMT340, DM70
3	-20	
4	3	DMT132, HMT330, DM70
5	7	
6	10	

Table 1. The moisture requirement for the different compressed air quality classes according to the ISO 8753.1 standard and the most typical Vaisala dewpoint instrument choices for each class.

Choosing the ideal dew point instrument for each system

Due to the wide variety of compressed air systems, no single product addresses all measurement needs. Even if factors such as tolerance, impurities, inherent stability, electrical, and mechanical connections are disregarded, the dynamic measurement range required to accurately cover the full scale of compressed air quality classes is vast. For example, a system operating at a pressure of 7 bar and a dew point of -70°C contains only 0.39 parts per million (ppm) of water vapor, whereas a system with the same pressure but a dew point of +10°C contains about 1,800 ppm water vapor, i.e. the concentration difference is more than three orders of magnitude.

To satisfy these extremes, Vaisala has developed a range of specialized dewpoint measurement instruments optimized for various dewpoint levels. Table 1 shows the moisture requirement for the different compressed air quality classes according to the ISO 8753.1 standard. The table also shows the most typical Vaisala dewpoint instrument choices for each compressed air quality class.

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For more information, visit www.vaisala.com or contact us at sales@vaisala.com

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