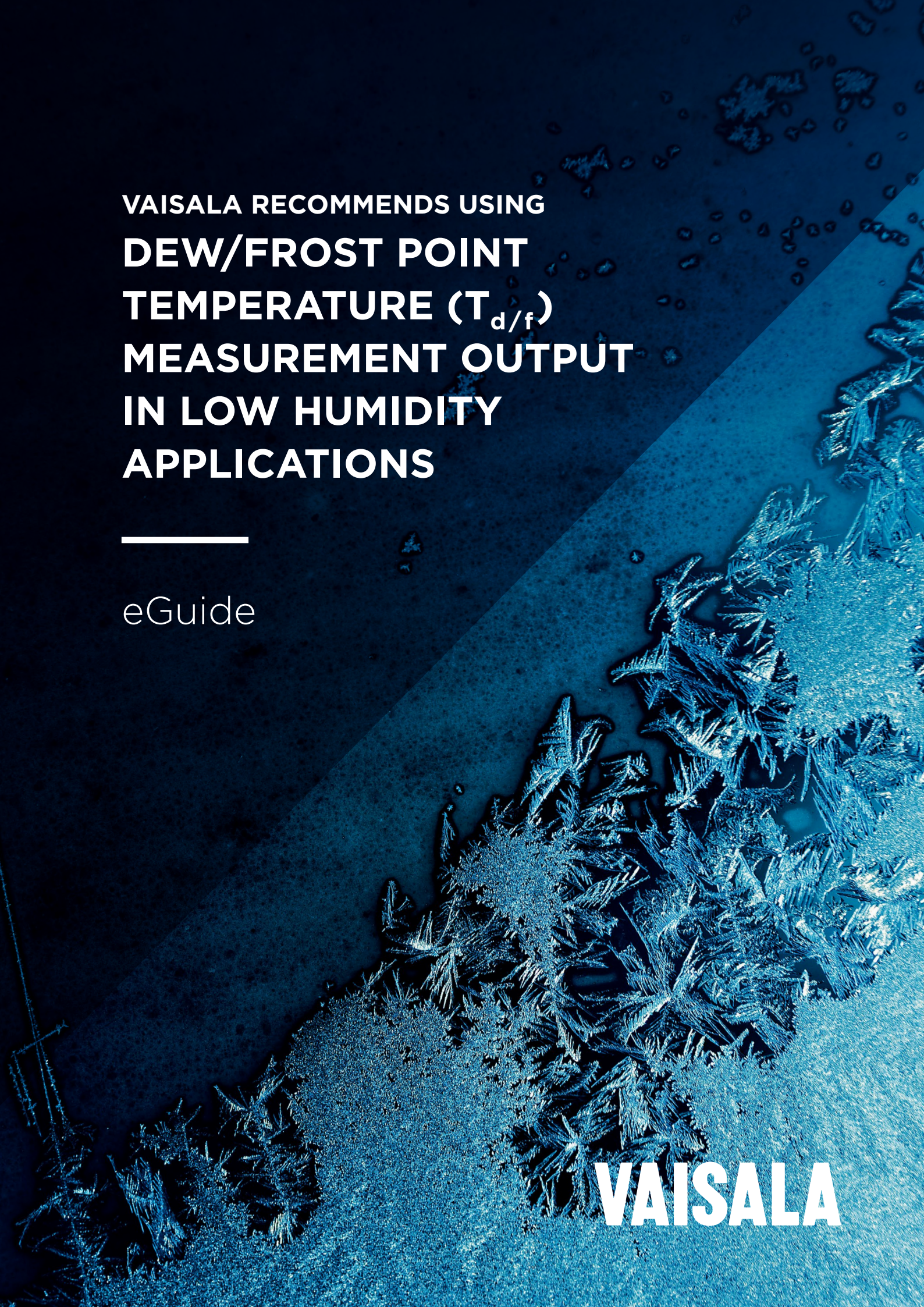

VAISALA RECOMMENDS USING

DEW/FROST POINT TEMPERATURE ($T_{d/f}$) MEASUREMENT OUTPUT IN LOW HUMIDITY APPLICATIONS

eGuide

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Table of
CONTENTS

DEW POINT TEMPERATURE

DEW/FROST TEMPERATURE POINT ($T_{d/f}$) MEASUREMENT OUTPUT IN LOW HUMIDITY APPLICATIONS

Vaisala recommends using Dew/Frost point temperature ($T_{d/f}$) measurement output in low humidity applications. This guide explains the meaning of the terms dew point temperature and frost point temperature and goes through the difference between them.

Understanding these two parameters and knowing when to use them is important because commonly industry speaks about dew point temperature, but actually means and measures frost point temperature.

1.

DEW POINT TEMPERATURE

Dew point temperature (T_d) is generally understood as the temperature at which a gas must be cooled for the water vapor to condense into water. Although this is not scientifically correct, it is a good generalization. At any temperature there is a maximum amount of water vapor that the air can hold. This maximum amount is called water vapor saturation pressure. Addition of more water vapor results in condensation. Also, when dew point temperature is equal with temperature, relative humidity is 100 %rh.

In the following picture there is an example about condensation taking place on a window. Due to cold window, temperature locally is less than dew-point temperature of the air leading to condensation. Therefore, water droplets are formed on the cold part of the window.

It's good to remember, at temperatures above freezing 0 °C (32 °F), saturation vapor pressure (P_{ws}) is always calculated with respect to water vapor at equilibrium over a water surface. This means that the corresponding parameter is dew point temperature.

FROST POINT TEMPERATURE

2. FROST POINT TEMPERATURE

Frost point temperature (T_f) can be similarly simplified as the dew point temperature to be the temperature at which a gas must be cooled for the water vapor to condense into frost. At temperatures below freezing 0 °C (32 °F) frost point temperature should be preferred. Also, it is typically used in applications where very low temperatures and dry conditions are required, such as compressed air systems, refrigerators and lithium battery manufacturing.

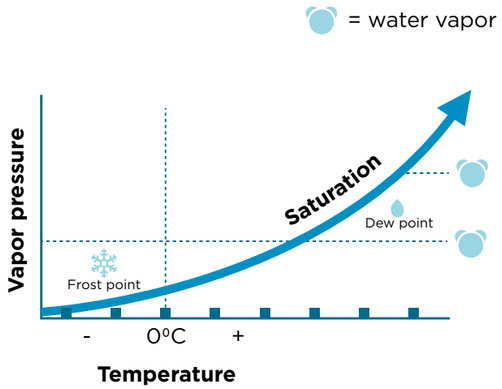
Let's continue with the window example by taking a look at the picture below, where we can see what effect a frost point temperature has on a window. In the picture we can see that there is frost and ice crystals on the surface of the window. Here, the window's surface temperature decreases below frost point temperature of the air, causing water vapor in the air to condense and freeze forming frost on the surface of the window. In other ways, this occurs because the air in contact with the window becomes locally saturated with water vapor and excess water vapor condenses to frost or ice.

3. WHICH PARAMETER SHOULD BE USED – dew point or frost point temperature

In the previous chapters, we defined that dew point temperature is used to describe the temperature at which moisture in the air will begin to condense as dew, while frost point temperature is used to describe the temperature at which moisture in the air will begin to condense as frost or ice.

When should you prefer frost point temperature? If we think about nature or a process where the temperature drops below zero, would water be liquid or ice? In most cases, water freezes, which is why the frost point temperature is a more representative option.

The picture below shows well when to measure the right parameter. The rule of thumb could be that when you are measuring below 0 °C (32 °F), frost point temperature should be used and vice versa, when you are measuring above 0 °C (32 °F), dew point temperature should be used.



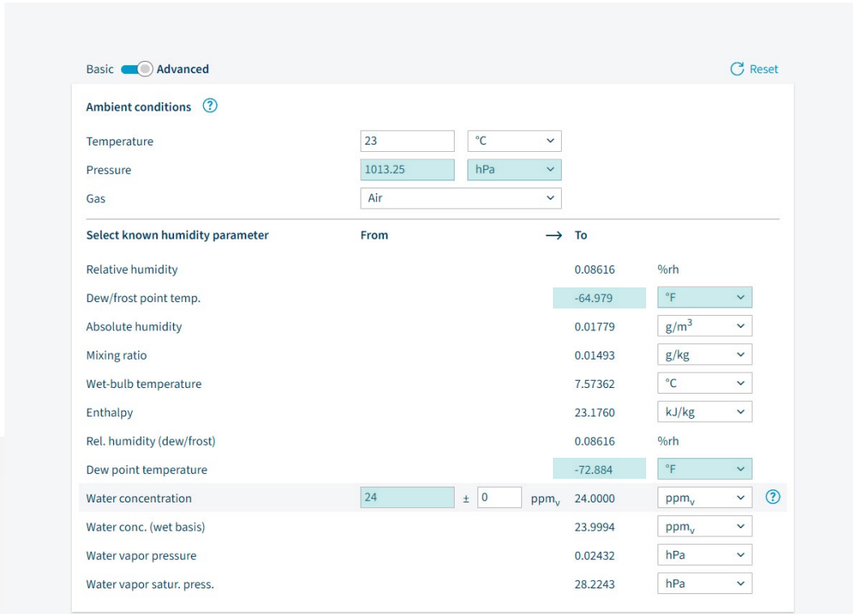
It's important to know which output parameter to use in order to get the most accurate process. If we look at a compressed air system, the frost point temperature is often around -40 °C (-40 °F). This equals about -44 °C (-47 °F) in dew point temperature. With these example values wrong parameter causes about 4 °C (7 °F) error.

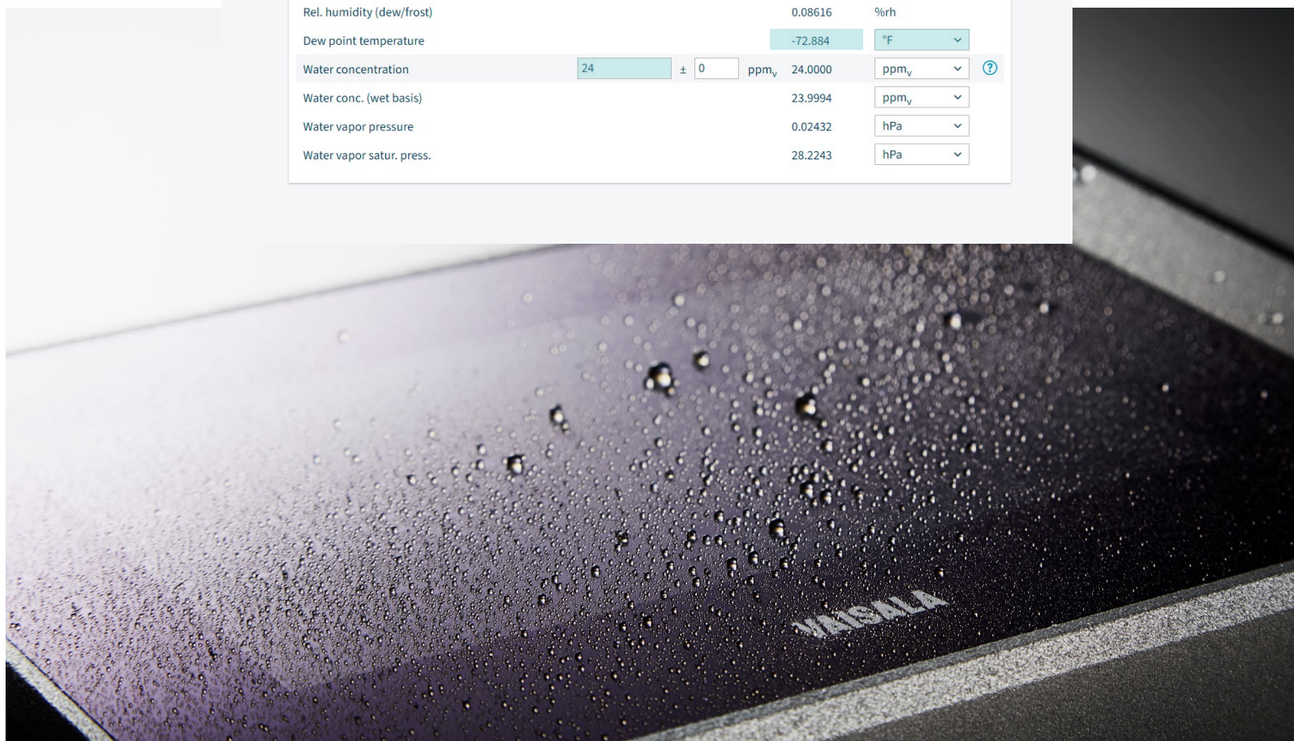
Let's have another example, where there is a note in the product's datasheet that in extreme cold temperatures, dew point temperature should be around -54 °C (-65 °F) which equals 24 ppm(v). To check if these values stand for frost point temperature or dew point temperature in a quick and easy way, Vaisala's online Humidity Calculator can be utilized. Unlike other calculators, the Vaisala Humidity Calculator calculates also the effects of pressure. This function is highly beneficial when calculating the dew point temperature because it is pressure dependent: the higher the pressure, the lower the dew point temperature. In some cases, there is a need to convert the dew point temperature to the frost point temperature or vice versa, and this is also possible with Vaisala Humidity calculator.

Let's calculate by using 24 ppm(v) as an input value and the pressure is 1013.25 hPa. This will show us that the frost point temperature is -54 °C (-65 °F) and dew point temperature -58 °C (-73 °F). Calculated frost point temperature equals initial value -54 °C (-65 °F) and therefore refers to frost point temperature.

By understanding the differences between frost point temperature and dew point temperature and when to use each one, it is possible to make more informed decisions about humidity control in different applications. This can help ensure that equipment operates safely and effectively and that products are stored or processed in optimal conditions.

Vaisala Humidity Calculator





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