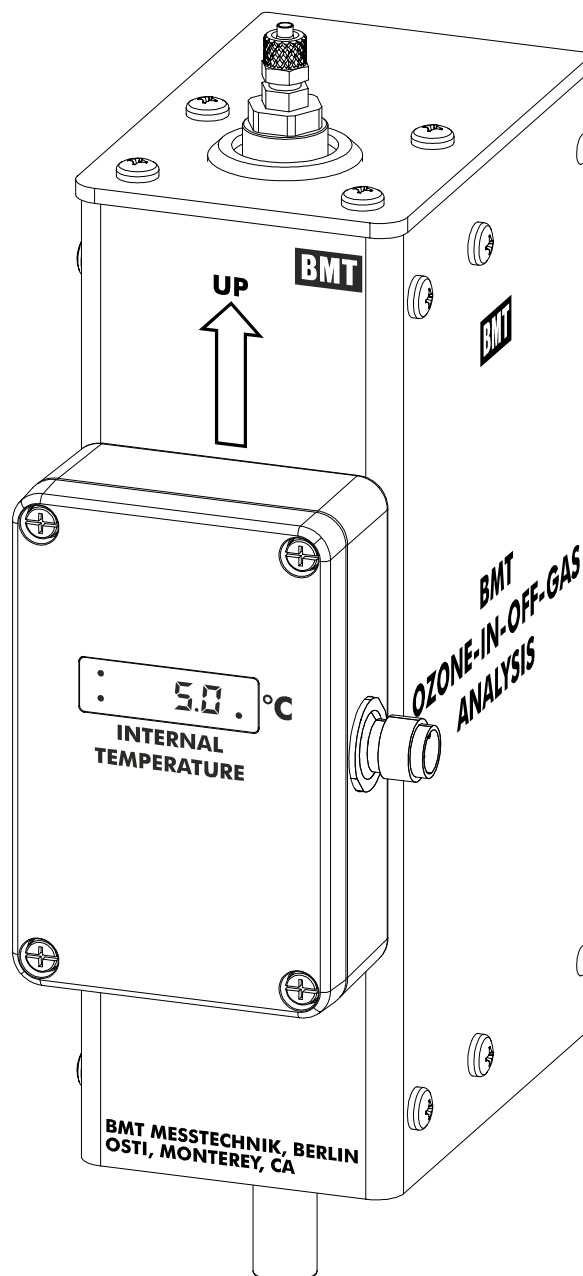


# SAMPLE GAS DEHUMIDIFIER DH6

## Manual

Rev. 02/2018



# Sample gas dryer DH6

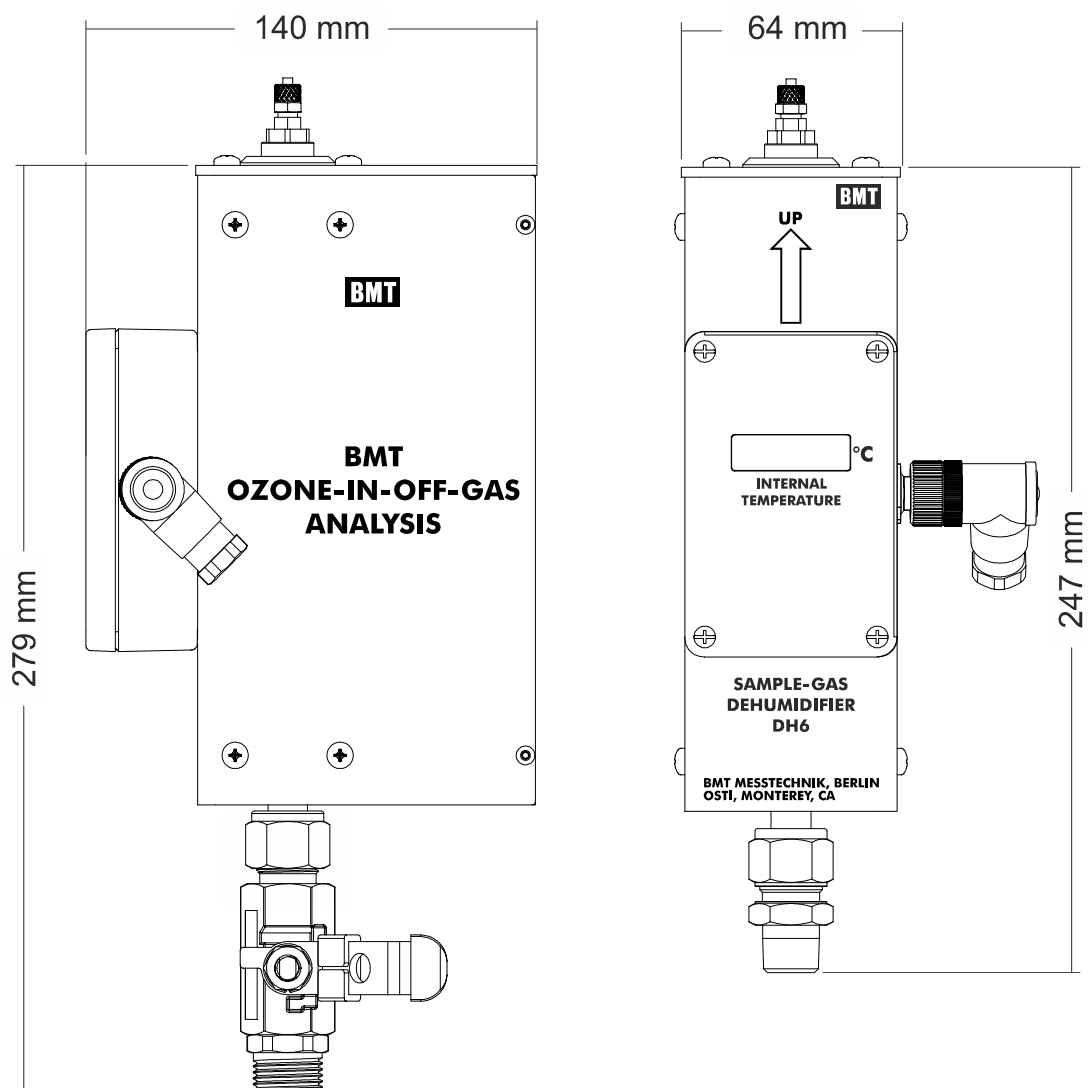
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## 1 General Description

The DH6 electric cooler/dryer is a flow-trough cooling device for removing water vapor (or other vapors) from a sample gas e.g. for photometric measurement of its ozone content. The heat exchanger is a perpendicular oriented SS tube, cooled from the outside by a Peltier-electric cooling system. The temperature of the inner surface of the tube is automatically controlled to a temperature which can be set between 1°C and 15°C.

The DH6 is a box about 279x140x64 mm (HxDxW) standing upright on one "leg" (upright position is inevitable because the condensate formed inside the cooler has to flow back into the off-gas system). On top of the reaction vessel, or in a large diameter off-gas tube, the "leg" is plugged into a big SS fitting with PTFE seal. The fitting can be screwed into a 3/8" NPT threaded bore hole, or it can be welded into a bore hole 17 mm ID. A PVC plug is provided to tightly close the fitting when the dryer has to be removed for service or repair (this plug is permanently fixed to the mounting fitting by a thin SS stranded wire). When the off-gas is at a significant overpressure an (optionally available) shut-off ball valve should be used.



DH6 with SOBV (shut-off ball valve)

DH6

The cooler/dryer DH6 (mounted at the point of sample) and the 24VDC/40W power supply are connected with an electric cable. The maximal length of this cable may be 10 meters. An FEP tubing 3x5 mm (optional Swagelok) is leading the sample gas from the DH6 to the ozone analyser. The dehumidified sample gas now will not form any condensate inside the sample tubing.

An optional Dirt Trap DT 100 can be provided in the tubing line for safety, and to watch the sample gas after passage through the sample gas cooler/dryer.

## 2 Cautions & Warnings



The **exclamation point** within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the instrument.

**Warning:** Ozone is a highly toxic gas. The ozone concentrations fed through the SAMPLE GAS DEHUMIDIFIER DH6 might be above the lethal limit. Appropriate safety devices (ozone monitors) should be used.

**Warning:** Before opening the sample gas connections make sure that the sample line does not contain ozone gas, and is not under pressure.

**Caution:** Before opening the lid of the electronics, the user should ground himself by touching grounded points in order to prevent damage of the electronics by electrostatic discharge.

## 3 Installation

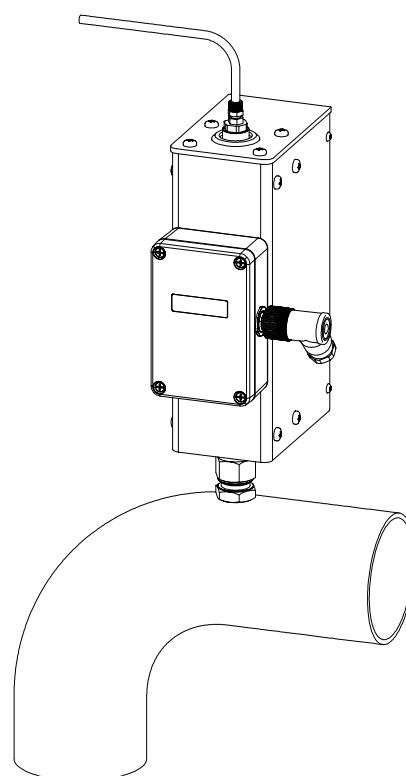
The DH6 removes water vapor from the sample gas. This reduction of the water vapor dew point obviously has to be performed at the point of sample (e.g. on top of a reaction vessel, or on a large diameter off-gas tube) to avoid condensate build-up in the sample gas tubing leading from the sample point to e.g. a photometric analyser. This patented principle allows for any condensate to drop back into the reaction vessel.

If the dryer is located only just in front of the photometer, condensation of the water vapor takes place in the sample gas tubing.

See our TechNotes TN-3 and TN-10 ([www.bmt-berlin.de/technotes](http://www.bmt-berlin.de/technotes)) for a detailed discussion.

Take care of the orientation of the dryer in order to let any condensate easily drop back into the vessel or tube!

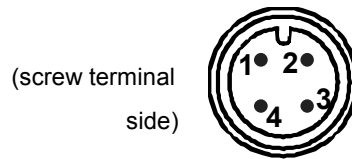
After power-up the LEDs "warm" and "max. power" are activated, until the desired internal cooling temperature has been reached, see chapter 5 (Display) for details.



#### 4 Electrical connection

The pinout of the 4-pole electric connector is as follows:

black	1	GND (24VDC & cable shield)
white	2	+24 VDC
brown	3	contact DRYER ERROR
green	4	contact DRYER ERROR

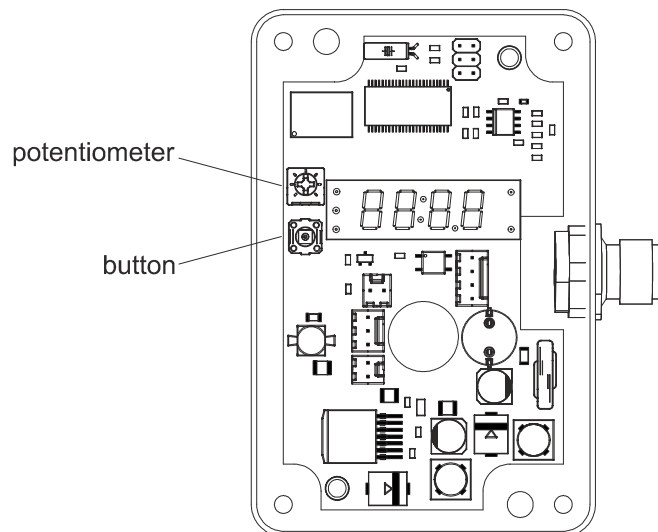


The electronics are protected by a fuse rated 2A slow blow, type TR-5 (Wickmann). It also has a reverse polarity protection, which will not burn the fuse in case of the wrong polarity. If connected to a BMT 964 OG off-gas analyser, no external power supply is needed.

#### 5 Display

The digital display shows the actual temperature of the inner wall of the cooler. After the user has opened the lid of the display module using a screw driver (Pozidriv), a pushbutton switch and a potentiometer are accessible.

**Caution:** Before opening the lid of the electronics, the user should ground himself by touching grounded points in order to prevent damage by electrostatic discharge.



To adjust the set point temperature, the button has to be pressed. The display will show the set point temperature, which now can be adjusted to a new value between 1°C and 15°C in one degree increments by turning the potentiometer with a small screw driver (supplied with the DH6). Default setting is 5°C. The button has to be pressed and held all the time during setting the new set point temperature. After releasing the button, the display will show the new set point temperature flashing three times, and the parameter is saved.



Three LEDs on the digital display additionally are signaling the status as shown above.

The "warm" LED is activated if the set point temperature is exceeded by more than 1 K. The Error relay is not activated. The LED is deactivated if the temperature reaches the set point temperature (hysteresis of 1 K).

The "max. power" LED is activated upon maximum cooling power. This does not necessarily mean any failure.

After power-on, both LEDs are activated for several minutes until the conditions for normal operation are met.

In normal operation, all three LEDs are off, and the temperature inside the cooler is below the set point plus 1 K. With increasing flow rate, temperature or dew point temperature of the sample gas, the cooler would increase the cooling power to compensate for the higher demand. If any of the "warm" or "max. power" LEDs is on, the user should use the displayed temperature to decide whether this still is well below the ambient temperatures around the gas path following the dryer.

## 6 Error Messages

The display shows several alphanumeric error messages:

message	description
Err 1	temperature sensor defect (short or open)
Err 2	fan standstill
Err 3	no current flowing through Peltier block
Err 4	Peltier block shorted
Err 5	overtemp inside display module

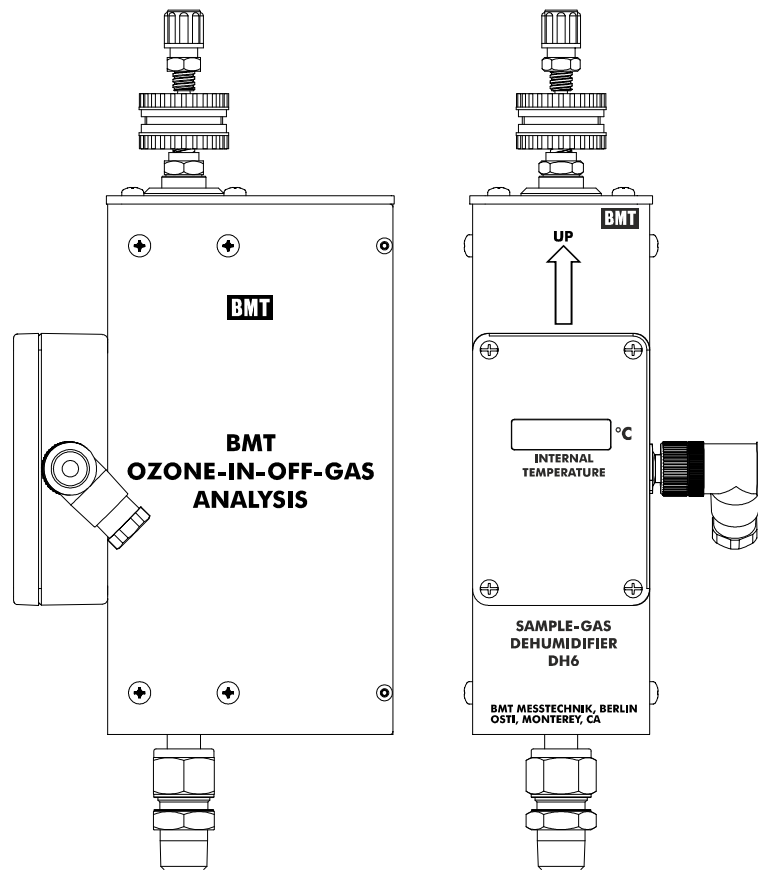
In case any of the above errors the Peltier cooler and the fan are switched off. The error relay opens. And the DRYER ERROR lamp in the front door of the BMT 965 OG is lit.

The error relay is also in it's error position while the power to the DH6 is switched off.

## 7 Low Concentration Version DH6-LC

For measurement of very low concentration ozone, e.g. in humid vent gas behind an ozone destruct, the model DH6-LC is available. It has an inner PTFE lining, and a particle filter installed at its outlet, assuring that the full length of tubing leading the sample gas to the ozone monitor is protected against contamination by any particles contained in the sample gas.

The fitting at the outlet of the sample gas filter is accepting 1/4" (or 4x6 mm) FEP or PFA tubing for direct connection to an OZONE MONITOR BMT 932.



## 8 Maintenance

The mechanical design of the dryer allows for cleaning of its gas path. After disconnecting and removing the dryer from the system, the top four screws need to be removed, which allows for removing the top plate and the insulating material below.

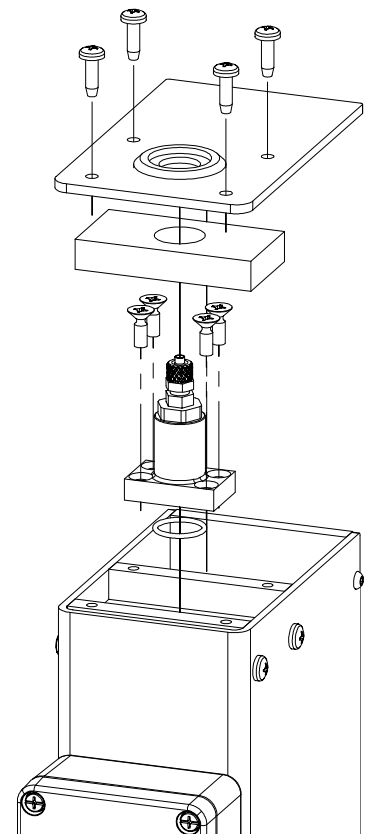
Next, the four screws holding the fitting block must be removed, followed by the fitting block itself. Note the O-ring at the bottom of the fitting block.

The inner side of the cooling tube may now be cleaned by using a bottle brush or similar – the smallest diameter of the tube at the bottom is 9 mm. Have a look at the inside of the fitting and the SOBV (if ordered) as well. Avoid the spilling of fluids outside of the gas path.

Before assembling the dryer, again, thoroughly inspect the O-ring. A damaged O-ring may not be used again.

Re-assembly of the DH6 must be done in reverse order, followed by a leak test.

Other maintenance is not necessary.



## 9 Specifications

principle	Peltier-electric cooling system, no moving parts
flow rate	0.3 to 0.5 l/min
MTBF	40.000 h (fan)
proof pressure	min 1 bar gauge
pressure drop	0.1 mbar @ 0.5 l/min; DH6-LC with filter: approx. 6 mbar @ 0.5 l/min
ambient temperature	0 - 40°C (non-condensing)
cooling power	4.5 W @ $\Delta T$ ( $T_{\text{ambient}} - T_{\text{set}}$ ) = 20 K
power-on to operational	max 10 minutes @ $\Delta T$ ( $T_{\text{ambient}} - T_{\text{set}}$ ) = 20 K and recommended flow rate
materials in contact	SS, PTFE, PVDF
inlet gas port	tube with OD 12 mm, 3/8" NPT thread, with PTFE seals
outlet gas port	for FEP tubing 3 x 5 mm (1/8" x 3/16"), or for FEP tubing 4x6 mm (1/4" x 5/32") or Swagelok 6 mm or 1/4"
display	4 digits LED
power	24 VDC, 40 W (via separate power supply), reverse polarity protected
relay outputs	60 V, 1 A
dimensions (W x H x D)	64 x 279 x 140 mm
weight	1.5 kg
protection	IP 55 (including fan)