

## WatchGas BAT-1, 2, 3

Breathing Air Quality Test Kit



Full Compliance with BS EN12021

Edition 11, August 2021

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# 1. Safety Information

## Important:

Failure to perform the procedures detailed within this user guide may impair the performance of this equipment. For maximum safety and optimal performance please read and follow the following procedures and conditions. The volume flow and quality of the supplied air should be thoroughly tested at intervals as specified by a competent person after risk assessment.

The WatchGas BAT kit is to be used to test compressed air for; oil mist, water vapor, carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), oxygen (O<sub>2</sub>), temperature, humidity, flow, pressure and odour in accordance to your local governing body (see section 2). Gases like NO<sub>x</sub>, H<sub>2</sub>S, SO<sub>2</sub>, NH<sub>3</sub>, PH<sub>3</sub> can be detected with optionally available gas detector tubes.

The BAT kit should be checked on the correct flow every 6 months. This can only be performed by a trained and authorized person. How to perform the flow check can be seen in section 10.

Any attempt to repair components or to substitute components can cause error and possible damage of components. Only replace consumable items (Gas Detector Tubes + WatchGas PDM O<sub>2</sub>) with genuine components specified for use as direct replacement for the BAT kit. Use of different components or attempts to repair components can cause error and possible damage of components.

The quality of the air supplied to a breathing apparatus should be tested at least every three months and more frequently when the quality of the air supplied cannot be assured.

The regulators and flow restrictors are factory set to deliver the required flow rates specified by the manufacturers. Flow rates can only be adjusted by trained and authorized personnel.

When disposing of old parts always follow local waste disposal regulations.

## Additional Warnings concerning the use of the WatchGas PDM O<sub>2</sub>:

- Before operating this device, please read the manual carefully.
- If calibration and self test fails continuously, please do not use the device.
- For the O<sub>2</sub> detector, perform calibration every 30 days in a fresh air environment, preferably outside.
- Before use, please check the activation date, and if the activation date is past, please do not use the device. The PDM O<sub>2</sub> has a life span of 2 years from start up. A countdown timer shows the remaining life of the PDM O<sub>2</sub>. At the end of the PDM O<sub>2</sub> life it automatically shuts off. Once the software shutdown is complete, discard the detector and contact WatchGas for a replacement.
- Clean detectors with a soft cloth and do not use chemical substances for cleaning
- To maintain 24 months life time, avoid the below activities except the necessary cases to check events (Max/Min), lifetime/concentration, and alarm set points. Otherwise, the frequent use of the button will deplete the battery lifetime less than 24 months. Do not push the button frequently without valid reasons.  
\*Normal Alarm Use 1 time and 2 minutes per day
- View the serial number on the label at the back side of the device.
- WARNING: Explosion Hazard - The PDM O<sub>2</sub> contains no serviceable parts.
- WARNING: Substitution of components may impair intrinsic safety.
- WARNING: The PDM O<sub>2</sub> contains a lithium battery which may leak or explode if the instrument is mistreated. Do not attempt to disassemble or dispose of in fire.
- Never cover or insert foreign objects into the alarm signal opening, the opening must remain clear and free of foreign objects, otherwise any alerts made during an alarm state may not be heard or identified.

## 2. International Standards

Table 1

Substance	Europe	USA	Canada	Australia		
Standard	BS EN12021	29 CFR 1910.134	CSA Z180.1-00	AS/NZS 1715:1994	Pharmaceutical: EP 01/2009 : 1238	Pharmaceutical: USP35-NF30
Oxygen (O <sub>2</sub> )	21% (+/-1%)	19.5% - 23.5%	20%-22% By Volume (Dry Air)	19.5%-22%	20.4 – 21.4%	19.5 – 23.5%
Carbon Dioxide (CO <sub>2</sub> )	≤ 500ppm	≤ 100ppm	≤ 500ppm	≤ 800ppm	≤ 500 ppm	≤ 0.05%
Carbon Monoxide (CO)	≤ 15ppm	≤ 10ppm	≤ 5ppm	≤ 10ppm	≤ 5 ppm	≤ 0.001%
Oil Mist/Vapor	≤ 0.5mg/m <sup>3</sup>	≤ 5ppm	≤ 1mg/m <sup>3</sup>	≤ 1mg/m <sup>3</sup>	≤ 0.5 mg/m <sup>3</sup>	0 mg/m <sup>3</sup>
Odour/Taste	Without Significant Odour or Taste	Without Significant Odour or Taste	Without Significant Odour or Taste	Without Significant Odour or Taste	Without Significant Odour or Taste	Without Significant Odour or Taste
Water Vapor (H <sub>2</sub> O)	Air for compressed air line breathing apparatus shall have a dewpoint sufficiently low to prevent condensation and freezing. Where apparatus is used and stored at a known temperature, the pressure dewpoint shall be at least 5oC below the likely lowest temperature. Where conditions of usage and storage of the air is not known, the pressure dewpoint shall not exceed - 11oC.	4oC (39oF) pdp @ 50psig.	The pressure dewpoint of the compressed breathing air shall be at least 5oC (9oF) below the lowest temperature to which any part of the compressed breathing air pipeline or the accepted respirator maybe exposed at any season of the year.	Airline pressure should be at least 5oC below the lowest known temperature or -11oC if the lowest is not known.	≤ 67 ppm	0 ppm
Nitrogen Oxides (NO <sub>x</sub> )	-	-	-	-	≤ 2 ppm	≤ 2.5 ppm
Sulfur Dioxide (SO <sub>2</sub> )	-	-	-	-	≤ 1 ppm	≤ 5 ppm

### 3. Technical Specifications

#### 3.1 Gas Detector Tubes

Table 2

Gas	Tube	Range	Liter air	Flow	Sample time in min.	Colour change →		Shelf life years
Carbon Monoxide	7182524	5 - 70 ppm	1.5	0.3 l/min	5 min	White	Brownish Green	2
Carbon Dioxide	7182525	100 – 2000 ppm	1.5	0.3 l/min	5 min	White	Violet	2
Water Vapor	7182526	5 – 70 mg/m <sup>3</sup>	10	1 l/min	10 min	Yellow	Brownish Green	2
		20 - 160 mg/m <sup>3</sup>	5		5 min			
Oil Mist	7182523	0.1 - 1 mg/m <sup>3</sup>	60	2.5 l/min	Please read below instructions	White	Yellowish Brown	2
<b>Optional, available on request:</b>								
Nitrogen Oxides	7182528	0.2 - 2.5 ppm	3	0.3 l/min	10 min	White / Light Blue	Dark Blue	2
		0.5 - 6 ppm	1.5		5 min			
Water Vapour	7192124	10 – 80 ppm	10	1 l/min	10 min	Yellow	Brownish Green	2
		30 – 200 ppm	5		5 min			
Water Vapour	7192123	2 - 200 mg/m <sup>3</sup>	50	2 l/min	25 min	Yellow	Reddish Brown	2
Oil Impactor	7192118	0.1, 0.5, 1.0 mg/m <sup>3</sup>	20	4 l/min	5 min	Empty	Black dots	2
Sulfur Dioxide	7192116	0.25 – 1 ppm	2	2 l/min	10 min	Greyblue	White	2
		1 – 25 ppm	1	1 l/min	5 min			
Sulfur Dioxide	7192117	0.5 – 2 ppm	2	0.2 l/min	10 min	Greyblue	White	2
Phosphine	7192122	0.1 – 4 ppm	1	0.2 l/min	5 min	White	Greyviolet	2
Ammonia	7192119	0.6 – 9 ppm	1	0,2 l/min	5 min	Yellow	Blue	2
Hydrogen Sulfide	7192120	0.04 – 1 ppm	4	0.8 l/min	5 min	White	Palebrown	2
Hydrogen Sulfide	7192121	1 – 20 ppm	1	0.17 l/min	6 min	White	Brown	2

### 3.2 Manifold

Table 3

Outlets:	4
Standard Flow: Flow is adjustable according to the required flow of the tubes.	Outlet 1: 0.3 L/min Outlet 2: 0.3 L/min Outlet 3: 1 L/min Outlet 4: 2.5 L/min

### 3.3 Pressure/Flow Reducer

Table 4

Pressure	25 - 300 bar reducing to 4.5 bar
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### 3.4 Flow Meter

Table 5

Flow range:	0.3 – 3 LPM
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## 4. BAT layout

Table 6

7192115	Temperature & Relative Humidity Meter <b>(Available on request)</b>
7182519	IR Thermometer <b>(only for BAT-1)</b>
7182517	0.3 - 3 lpm Calibration Flow Meter
7182515	Manifold for 4 tubes
7182520	4 Rubber Tube Holders
7182516	Pressure / Flow Reducer 25-300 bar to 4.5 bar
7182518	Timer / Stopwatch
7182521	Tube Tip Breaker
7182523	10 Gas Detector Tubes for Oil 0.1 - 1mg/m3
7182524	10 Gas Detector Tubes for CO 5 - 70ppm
7182525	10 Gas Detector Tubes for CO2 100 - 2000ppm
7182526	10 Gas Detector Tubes for H2O 5 - 160 mg/m3



Figure 1: Breathing Air Tester (BAT) kit



7182528	10 Gas Detector Tubes for NOx 0.2 - 6ppm <b>(Available on request)</b>
7192116	10 Gas Detector Tubes for SO2 0,25 - 1ppm <b>(Available on request)</b>
7192117	10 Gas Detector Tubes for SO2 0,5 - 2ppm <b>(Available on request)</b>
7192118	10 Oil Impaktor <b>(Available on request)</b>
7192122	10 Gas Detector Tubes for PH3 0.1 - 4ppm <b>(Available on request)</b>
7192119	10 Gas Detector Tubes for NH3 0,6 - 9ppm <b>(Available on request)</b>
7192120	10 Gas Detector Tubes for H2S 0,04 - 1ppm <b>(Available on request)</b>
7192121	10 Gas Detector Tubes for H2S 1 - 20ppm <b>(Available on request)</b>
7181411	WatchGas PDM O2 Gas Detector 0 - 30% Vol. <b>(Available on request)</b>
7182528	200 bar adapter <b>(Only in BAT-2)</b>
7182529	300 bar adapter <b>(Only in BAT-2)</b>
-	Manual
-	Suitcase Keys
-	Air Quality Analysis Form
7182514	BAT-1 total kit
7182528	BAT-2 total kit
Coming soon	BAT-3 total kit

## 5. Operating Instructions

### 5.1 Preparing for Measuring

**First follow these steps before performing the test in 5.2 or 5.3.**

- First it is important to determine the detection limit of the oil typ using table 7.
- Determine sampling time according the threshold value to be detected using table 8.

Table 7: Detection limits

Oil	Detection limit
Mobil Rarus 425	5 µg
Mobil Rarus 427	10 µg
Mobil Rarus 827	25 µg
Liqui Moly LM 750 SAE 40	40 µg
Dräger U10822/U10823	40 µg
Other oils on request	-

Table 8: Measurement time for evaluated reference value

Detection limit	Evaluated detection limit 0.1 mg/m3	Evaluated detection limit 0.3 mg/m3	Evaluated detection limit 0.5 mg/m3	Evaluated detection limit 1.0 mg/m3
5 µg	25 min	8 min	5 min	3 min
10 µg	50 min	17 min	10 min	5 min
15 µg	75 min	25 min	15 min	8 min
20 µg	100 min	33 min	20 min	10 min
25 µg	125 min	42 min	25 min	13 min
30 µg	150 min	50 min	30 min	15 min
40 µg	-	67 min	40 min	20 min
50 µg	-	83 min	50 min	25 min

- Clean valve of compressed gas cylinders or charging connections of compressor with brief burst of air.



Figure 2: 200 & 300 bar compressor adapters



- Chose and connect the adapter suitable for the prescript maximum pressure of the compressor charging panel (300 or 200 bars). When using the BAT kit on a gas cylinder, you can skip this step.



Figure 3: Screwing the adapter on the pressure reducer.

- Connect pressure reducer to compressed gas cylinder, or to charging connection of compressor using the 200 or 300 bar adapter.



Figure 4: Pressure reducer

- Insert and firmly fit the nozzle of manifold on the pressure reducer as shown in fig. 5.

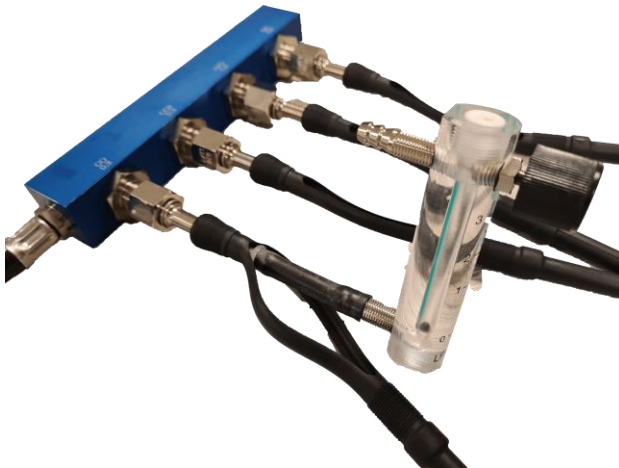


Figure 5: Connecting manifold to the pressure reducer

## 5.2 Measuring on Compressed Gas Cylinders

*(for measuring on compressors go to 5.3)*

- Slowly open cylinder valve.
- The flow rate of air through each port of manifold can be confirmed if necessary by using the flow meter provided with the kit. (To measure the flow rate connect tubing of flow meter to the desired manifold port- Fig. 6)



*Figure 6: Checking the outlet flow with the flow meter*

- Insert the detector tube holders in the manifold ports- Fig. 7.



*Figure 7: Connecting rubber tube holders to the manifold*

- Flush device for sufficient time to make the test device free from other gases if any.

When the test device is clean and dry flushing for 2 min. is sufficient. If the condition of device is not known, or if during a previous measurement higher values were found than are permissible according to EN 12021, flushing at 2 l/min. must be continued. This must be done until 2 water vapor measurements, made at an interval of approx. 15 min., give identical results within the permissible measuring accuracy range. It then can be assumed that the test device is sufficiently clean for making measurements.

Liquid / water (droplets) can only be removed from the test device through long flushing with dry, if necessary warm air.

Observe arrow on the detector tube. The arrow points in the flow direction of the test air; therefore, after inserting the tube, the arrow must point away from the test device.

Each outlet of the manifold is made for a particular detector tube. The flow has been engraved above each outlet on the blue manifold:

- CO<sub>2</sub> 0.3 l/min
- CO 0.3 l/min
- H<sub>2</sub>O 1 l/min
- Oil 2.5 l/min

- Break off the detector tube tips at air exit side (see fig. 8)



Figure 8: Breaking off both tips of a detector tube

- Put detector tube into the correct tube holder, inserting broken-off end tightly into holder side away from test device.
- Break off other end of the detector tube (air entry side) and immediately insert open tube tightly into other end of detector tube holder (close to test device). (see fig. 9).



Figure 9: Placing the detector tube in the rubber tube holder

- Immediately thereafter start the timer to the time designated for the type of detector tube.



Figure 10: Timer

- Remove the detector tube of CO, CO<sub>2</sub> and H<sub>2</sub>O after 5 minutes from the tube holder and take the readings from the printed scale on the tube, on the Air Quality Analysis Form.
- After concluding the sampling time remove the Oil detector tube from the sampling device and bend at the indicated point (between two arrowheads) to break the internal reagent filled ampoule (Caution: the ampoule contains concentrated sulfuric acid).
- Allow the ampoule fluid to flow onto the indicator layer, apply suction using a detector tube pump until the indicator layer is covered approx. 10 mm with the ampoule fluid.
- Wait 1 minute before evaluating the indication. If no color change occurs, the oil content within the pressurized gas sample is below the detection limit of the detector tube and below the evaluated reference value of interest 0.1 mg/m<sup>3</sup>, 0.3 mg/m<sup>3</sup>, 0.5 mg/m<sup>3</sup> resp. 1.0 mg/m<sup>3</sup>.

**Optional:**

- When requiring to test NO<sub>x</sub>, please contact WatchGas for instructions.
- When requiring to test O<sub>2</sub>, please contact WatchGas for instructions.
- When requiring to test SO<sub>2</sub>, please contact WatchGas for instructions.
- When requiring to test PH<sub>3</sub>, please contact WatchGas for instructions.
- When requiring to test H<sub>2</sub>S, please contact WatchGas for instructions.
- When requiring to test NH<sub>3</sub>, please contact WatchGas for instructions.

### 5.3 Measuring on Compressors

- Switch on the compressor
- Wait until 200 or 300 bar is reached
- Switch off the compressor
- Slowly open valve on compressor
- Perform the test as described in para 5.2

The water content that is measured in air from a compressor only corresponds to the water content of compressor gas cylinders simultaneously charged, or cylinders charged immediately after measuring, if a pressure retaining valve is built into the compressor at the exit side of the drying cartridges. A prerequisite, however, is that the cylinders to be charged are dry.

The pressure retaining valve assures that the pressure inside the compressor drops only insignificantly from the maximum pressure of 300 or 200 bar, when cylinders are being charged. With compressor that has no pressure retaining valve behind the filters, water from the drying cartridge can be released to the sudden decompression when the charging connection is opened. The air has then higher water content as was measured on the compressor charging panel.

## 6. Interpreting Tube Readings

(a) When the end of the colour change layer is flat, Read the value at the end of the layer. In this example, the reading should be 5%.



(b) When the end of the colour change layer is slanted. Read the value in the middle of the slant. In this exaggerated example, the reading should be 5%.



(c) When the demarcation of the colour change layer is pale. Read the value in the middle between the dark layer end and the pale layer end. In this exaggerated example, the reading should be 5%.



## 6.1 OIL MIST TUBES



The reading is obtained directly off the tube in mg/m<sup>3</sup>.

NOTE: High water vapor levels can affect accuracy of reading (see note below Table 3).

### **Ambient Conditions During Sampling**

The test result applies only to the sampled portion i. e. to the expanded portion of air. In order to validate the oil content of the total air in the compressed air system, variations in place and time resulting from surface adsorption and desorption processes must be taken into account. Such processes strongly depend on temperature. The measurement must be taken from the same system (machine, compressor tube line etc.) that will be placed in operation.

**Temperature:** 10 °C to 30 °C; 50 °F to 86 °F

**Humidity:** see table 8

**Pressure:** only for use with de-pressurized air

### **Interferences and Cross Sensitivities**

Vapors of many other organic substances will be indicated too. The sensitivity of indication is different.

### **Overall Uncertainty**

Due to the varying chemical composition within compressor oil types and ambient conditions the indication shall be regarded only to semi-quantitative.

### **Storage and Transport**

Up to 25 °C (77 °F) and protected from light. Expiration date: see back of package.

### **Safety Advice/Disposal**

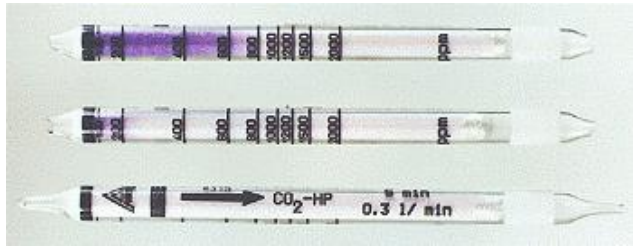
For tubes contents the following indications of danger apply:

Indication of danger R: 20/21/22-35-37

Safety advice S: 2-24/25-28.1

Tubes must be kept away from unauthorized persons. For disposal of tubes as waste observe the legal regulations applicable in the individual country of use.

## 6.2 CARBON DIOXIDE TUBES



The reading is obtained directly off the tube in parts per million.

NOTE: High water vapor levels can affect accuracy of reading (see note below).

### Ambient Conditions during Sampling

Detector tubes can be used between 10°C and 30°C (50°F and 86°F) and in the humidity range up to 8 g/m<sup>3</sup> (90% rh at 10° C (50° F), 26% rh at 30°C (86°F))..

### Interferences and Cross Sensitivities

No interference from:

– hydrogen, methane, ethane, propane, carbon monoxide, mineralic oil (vapor and mist).

### Overall Uncertainty

Up to ± 15% in the range above 500 ppm.

Up to ± 25% in the range 100 ppm ... 500 ppm.

(expressed as relative standard deviation).

### Storage and Transport

Up to 25°C (77°F) and protected from light. Expiration date: see back of package.

### Safety Advice/ Disposal

For tubes contents the following indications of danger apply:

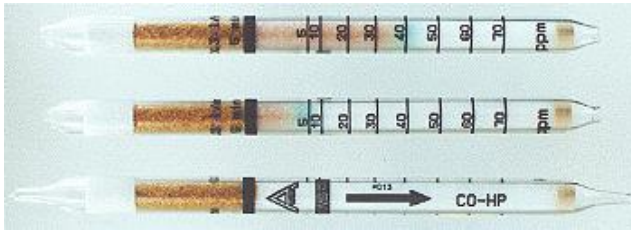
R: 20/21/22-34.

Safety advice S: 2-23-24/25-26-28 (water).

Tubes must be kept away from unauthorized persons. For disposal of tubes as waste observe the legal regulations applicable in the individual country of use.



## 6.3 CARBON MONOXIDE TUBES



The reading is obtained directly off the tube in parts per million.

NOTE: High water vapor levels can affect the accuracy of the reading (see note below).

### General Information and Cautions

- The white mist appearing at the air outlet of detector tube during measurement is caused by an emission of small droplets of sulfuric acid with the air flow. The amount is very slight. Any irritations will not happen.
- Used detector tubes without any color change cannot be used repeatedly.

### Influence of Temperature

Detector tubes can be used between 0 °C and 40 °C (32 °F and 104 °F) and up to 90 % rh (46 g/m<sup>3</sup> at 40 °C [104 °F])

### Interferences and Cross Sensitivities

No interference from:

hydrogen, methane, carbon dioxide, mineralic oil (vapor and mist).

### Overall Uncertainty

Up to ± 15 % in the range above 15 ppm.

Up to ± 25 % in the range 5 ppm ... 15 ppm.

(expressed as relative standard deviation).

### Storage and Transport

Up to 25 °C (77 °F) and protected from light. Expiration date: see back of package.

### Safety Advice/Disposal

For tubes contents the following indications of danger apply: R: 20/21/22-35-37-43.

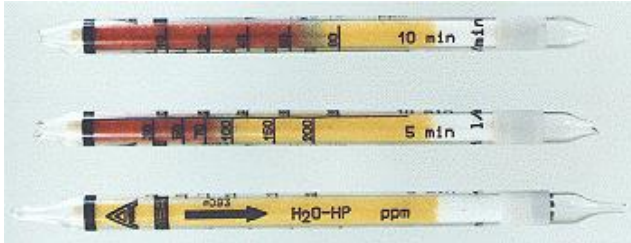
Safety advice S: 2-23-24/25-26-28 (water).

Tubes must be kept away from unauthorized persons. For disposal of tubes as waste observe the legal regulations applicable in the individual country of use.

## 6.4 WATER VAPOR TUBES 5-160 MG/M3

Available on request:

- in PPM range
- in a range of 2-200 MG/M3



The reading is obtained directly off the tube in parts per million.

NOTE: High water vapor levels can affect the accuracy of the reading (see note below).

### General Information and Cautions

- The measurement result applies only to the sampled portion i. e. for the expanded portion of air. In order to validate the water content of the total air in compressed air system, variations in place and time resulting from surface adsorption and desorption processes must be taken into account. Such processes are strongly dependent on temperature.
- The white mist appearing at the air outlet of detector tube during measurement is caused by an emission of small droplets of sulfuric acid with the air flow. The amount is very slight. Any irritations will not happen.
- Used detector tubes without any color change cannot be used repeatedly.

### Influence of Temperature

- Detector tubes can be used between 0 °C and 35 °C (32 °F and 95 °F). The calibration scales on detector tube are exactly valid if tubes have a temperature of 20 °C (68 °F) during measurement. If detector tube temperature deviates from 20 °C (68 °F), multiply reading (mg/m<sup>3</sup>) with appropriate correction factor (see table). Normally, detector tube temperature is equivalent to ambient temperature.

Table 9: Correction factors

Temperature of detector tube (°C)	0	5	10	15	20	25	30	35
Temperature of detector tube (°F)	32	41	50	59	68	77	86	95
Correction factor	1,85	1,55	1,35	1,17	1	0,85	0,7	0,57

### Overall Uncertainty

Up to ± 15 % in the range above 50 mg/m<sup>3</sup> (5 l sample) resp. 20 mg/m<sup>3</sup> (10 l sample).  
 Up to ± 25 % in the range 20 mg/m<sup>3</sup> ... 50 mg/m<sup>3</sup> (5 l sample) resp. 5 mg/m<sup>3</sup> ... 20 mg/m<sup>3</sup> (10 l sample). (expressed as relative standard deviation).

### Storage and Transport

Up to 25 °C (77 °F) and protected from light. Expiration date: see back of package.

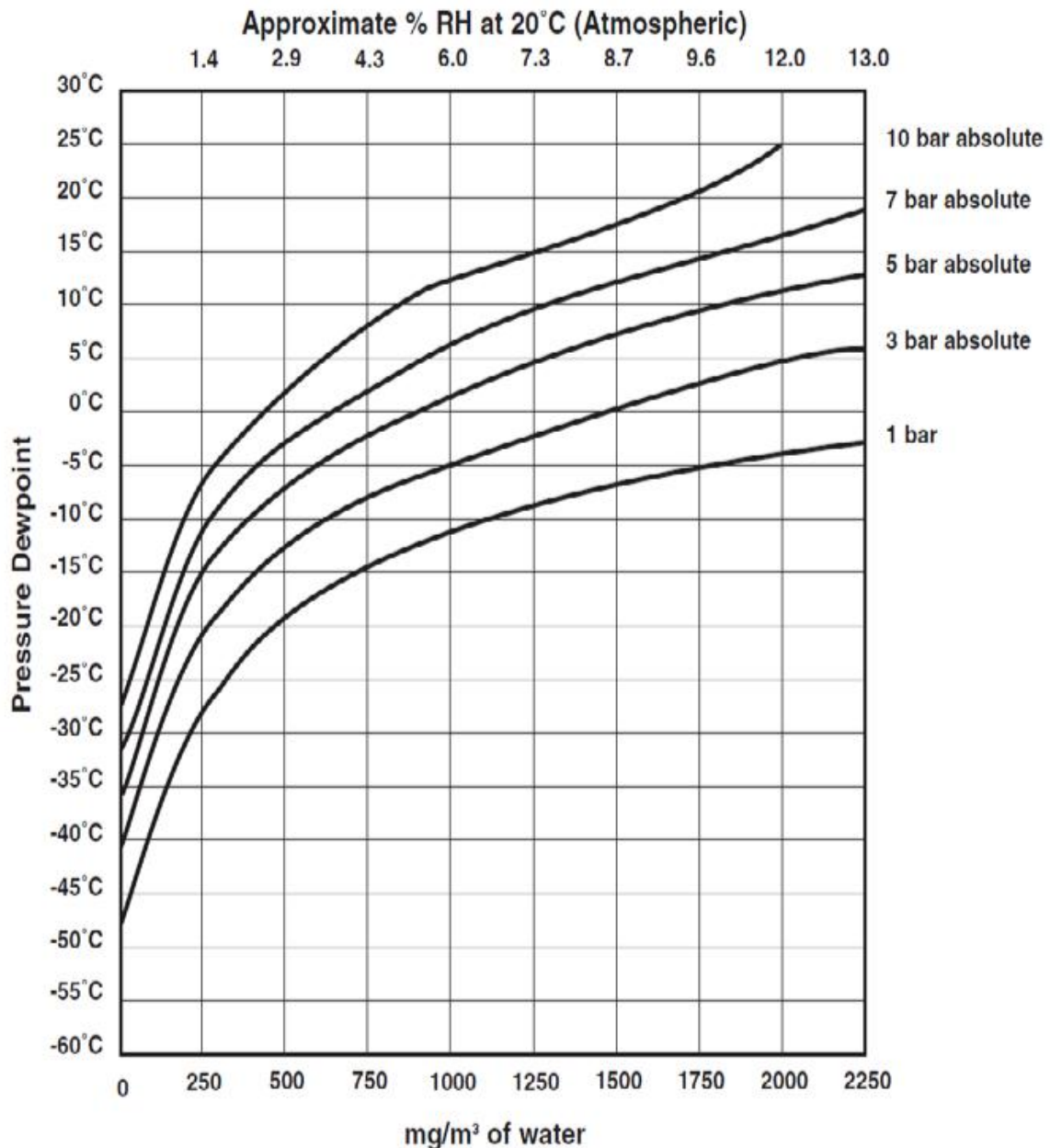
### Safety Advice/ Disposal

For tubes contents the following indications of danger apply: R: 20/21/22-35-37.

Safety advice S: 2-23-24/25-26-28 (water).

Tubes must be kept away from unauthorized persons. For disposal of tubes as waste observe the legal regulations applicable in the individual country of use.

## 7. Pressure Dewpoint



To establish pressure dewpoint, take the point where the water tube reading in mg/m<sup>3</sup> intersects system pressure and read off pressure dewpoint from vertical scale

**NOTE:** Pressure dewpoint is the temperature at which free water is likely to occur at system pressure, therefore this will be the minimum operating temperature of the system.

**NOTE:** The above graph is for a guide only and can be used to estimate dewpoint from reasonably high water level readings. These dewpoints are normally obtained in systems with little or no drying capability. Refrigeration dryers normally produce dewpoints around +3 oC at 7 bar g. For desiccant systems dewpoints of better than -40 oC can be obtained and the above graph should not be for calculating water at these low levels <250 mg/m<sup>3</sup>

## 8. Service & Maintenance

### 8.1 General

In view of the significance of the accuracy of measuring results, the test device must be treated with care. Dirt must be avoided at all time, especially at the high-pressure connection. Flushing and cleaning of the test device must be made as described in para. 5.2. After measuring is completed, the test device shell is stored in the suitcase. The high pressure regulator connection should be closed with the white protective cap. Function checks should be made every month, and if erroneous measurements are suspected. It is advised to do a full service check and recertify the BAT kit at a WatchGas factory trained company every 12 months.

### 8.2 Disorders

- If the hand wheel of the test device cannot be loosened while it is connected to a compressed gas cylinder or compressor, check if connection is under pressure. In this case close the cylinder valve or compressor valve and release air from test device.
- Leaks at the connection to the cylinder or compressor could be due to a defect gasket. In this case replace the gasket.
- If the high pressure regulator or the detector tube holder is defective, they must be replaced.
- In case of other disorders the device should be returned for repair to WatchGas or any authorized service station.

## 9. Ordering & After Sales

Provided by:

**WatchGas B.V.**  
**Klaverbaan 121**  
**2908KD - Capelle a/d IJssel**  
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