

# OPERATING INSTRUCTION

Humidity reference cells  
for adjustment of humidity sensors



Description



# OPERATING INSTRUCTION

## Humidity reference cells for adjustment of humidity sensors



### Table of contents

1	General dangers and precautions	3
1.1	Dangers and precautions about the salt solutions	3
1.2	Important application notes	3
2	General description	4
3	Operating principle	4
4	Application guidelines	5
4.1	Intended use	5
4.2	Checks before application	5
4.3	Ambient conditions	5
4.4	Storage conditions and durability	5
4.5	Temperature dependence	6
4.6	Tolerance and accuracy	6
4.7	Removing the protection cap	6
4.8	Humidity sensor checking	6
4.9	Humidity sensor cleaning	6
4.10	Guidance for adjustment	7
4.11	Stabilisation time	7
5	Checking and adjustment procedure	7
6	Technical Data	8
7	Ordering data	8
8	Warranty	9
8.1	Repair and Calibration service	9
9.	Salt tables	10

# OPERATING INSTRUCTION



## Humidity reference cells for adjustment of humidity sensors

### 1. General dangers and precautions



Please read the following precautions carefully before putting into operation! The symbols used in the operating manual are to make you careful, before hand, regarding safety considerations and dangers. But all these symbols cannot substitute the text of the associated safety instructions in any way. Therefore, the instructions should also be always read completely!

This symbol indicates likely danger for persons, material or environment. The information provided in the associated text should be duly followed to avoid any kind of risk.



This symbol refers to important application notes and tips, which are necessary for successful working and should to be absolutely followed to ensure good results.

#### 1.1 Dangers and precautions about the salt solutions



Most of the used salt solutions are not physiological harmful, and hence, are not dangerous products as per definition provided in the guidelines 67/548/EWG. Please take care of the following special precautions: CAUTION! Please note that Lithium chloride (LiCl) is injurious to health (harmful). Avoid physical contact and contact with clothes!



Follow the respective rules and regulations. Keep the reference cells out of reach of children. Immediately separate out the leaking cells. Spilt out liquid should be removed. In case of contact with eye or skin, immediately wash with plenty of water. Consult physician if swallowed inadvertently. The disposal in laboratory is to done as normally applicable for inorganic salt solutions. Defective cells can be sent to us for free of charge disposal or repairs. You can find the respective material safety data sheets of the salt fillings on the CD.

#### 1.2 Important application notes



The B+B Thermo-Technik GmbH humidity sensor is produced through a sophisticated calibration procedure. A further adjustment of newly supplied sensors isn't reasonable, since higher accuracy can not be further achieved.

The sensors, for which a calibration certificate has been issued in accordance with ISO- or DKD-Calibration standards, may be only cross checked but must not be adjusted again, otherwise the calibration certificate expires!

Reference cells are not considered to use as a standard of humidity values. For verification, the cells should be checked at regular intervals with respect to a certified reference device. The requirement as per the application should also be cross checked through an additional comparative measurement with a certified reference device.

### 2. General description



The humidity reference cells are meant for checking and adjustment of humidity sensors. In the test chamber of the cell, a saturated salt solution is created with a defined level of relative humidity. The accuracy of humidity value in the reference cells is determined by the physical and chemical properties. Under laboratory conditions, an accuracy of  $\pm 1$  % RH can be achieved.

The test chamber is separated from the salt solution by a diaphragm so that the sensor under test is protected against contamination by the solution.

The humidity reference cells always work correctly irrespective of their placement and can be used in horizontal positions.

Owing to the high accuracy and simple checking method, the cells are also ideally suitable for checking and adjustment of hygrometers.

The complete humidity range of 11,3 % to 75,4 % RH (other humidities on request) is covered through different models which differ in salt content. For checking purposes, at least one cell is required. For adjustment of sensors, at least two different cells (e.g. 11,3 % RH and 75,4 % RH) should be used. The values shall be well apart within the preferred measuring range in order to achieve good adjustment results over the complete applicable range.

For simple adaptation of cells with probes, they can be fitted either with G $\frac{1}{2}$ " threads or with M20 x 1.5 mm threads with the connection arrangement provided together. The mounting arrangement provides airtight connection with the probe (D= 10 ... 14 mm).

Delivery of 1 to 3 pieces in styrofoam packing.

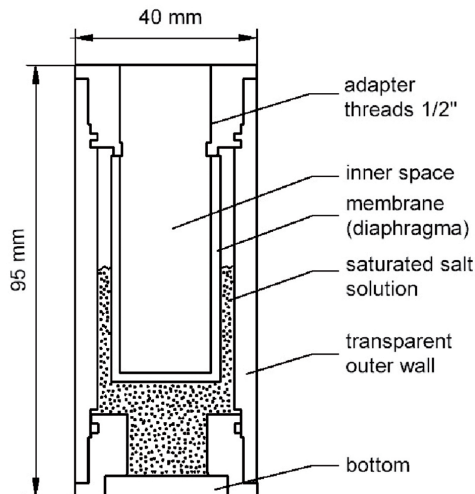
# OPERATING INSTRUCTION

## Humidity reference cells for adjustment of humidity sensors



### 3. Operating principle

The operating principle is based on a saturated salt solution over which a particular value of relative humidity gets adjusted. For this purpose, it is important, that the solution is properly saturated i.e. both un-dissolved salt in crystalline form is available in the solution and liquid is also visible above that.



The cells have a mechanically stable and leak-proof construction. The inner wall forms a membrane (also referred to as the diaphragm) which separates the test chamber from the salt solution. The diaphragm is a micro-porous, water vapour permeable wall, which restricts contact of test objects with the salt solution. The sealing is also effective for a short time use in "overhead".

The outer wall of the cell is made up of transparent plastic material. Hence, the level of liquid and also saturation of the solution can be judged and monitored from outside.

The saturated salt solution is present between the inner wall and the outer wall. The water vapour (or more exactly the water vapour partial pressure over the salt solution) penetrates through the diaphragm in the inner space of the test container and forms a water vapour air mixture of relative humidity specific to the salt.

### 4. Application guidelines

#### 4.1 Intended use

The reference cells are used for checking and adjustment of capacitive, resistive and electrolytic humidity sensors and probes.

The reference cells are not suitable for application in psychrometers, dew point mirrors or other thermal working measurement systems due to its type of construction.

The cells are to be used only within the temperature range of 20 °C to 40 °C. Rapid change in temperature or pressure and mechanical shocks should be avoided otherwise the cell or the diaphragm can get damaged.

#### 4.2 Checks before application



The reference cells must be checked before use. Due to sudden change in temperature or pressure, some salt solution can ooze out of the diaphragm. This is a normal physical phenomenon and is not considered as a defect. Hence, the required functioning is not affected.



**CAUTION !** In any case, the split out liquid should be absolutely removed and inner space should be cleaned with a dry cloth as per the safety guidelines. If there is still some liquid inside, it can damage the sensor, metal housing or electronics of the sensor through inadvertent contact or salt corrosion!

Leaking cells, e.g. due to damaged diaphragm, are subject to be replaced.

The salt solution must be always in saturated condition i.e. both crystalline salt and liquid should be visible at the base of the reference cells.

In an unsaturated salt solution (i.e. either only liquid is visible without crystals or only dry crystalline salt is visible) a defined value of relative humidity can no longer be warranted.

Before application, the cells should be briefly tossed.

# OPERATING INSTRUCTION



## Humidity reference cells for adjustment of humidity sensors

### 4.3 Ambient conditions



In order to achieve maximum accuracy, it is recommended that the activity should be carried out in a laboratory room. The measurement and calibration area should be air-conditioned. The ambient temperature should be within  $23\text{ °C} \pm 2\text{ K}$  and relative humidity in the environment should be within  $50\% \pm 5\% \text{ RH}$ .

The closed styrofoam container can also be used to improve the temperature stability. During application, the temperature gradient of the environment must be  $<1\text{K/h}$ . And effect of environmental factors like wind blow or direct heat radiation should always be minimised during the application.

The testing space in the reference cells should pick up the sensor head to extent possible and should be tightly sealed from atmosphere. If the sensor is not compatible with the coupling threads, a suitable adapter must be used.

Unnecessary touching of the reference cell with hands should be avoided, otherwise it takes longer time for thermal stabilisation.

Unnecessary opening for a long time should also be avoided, since this is likely to extend the stabilisation time and reduces the durability of cells.

### 4.4 Storage conditions and durability



The reference cells can be used for a large number of times over many years.

The salt solution creates humidity in the test chamber for stabilisation. Apart from this, the solution absorbs or releases water depending on the humidity level of the laboratory environment.

In European climate, the average relative humidity value is approx.  $55\% \text{ RH}$ . Therefore, the reference cells normally in average absorb water for drier values. Thus, with the increase in liquid level, more salt gets dissolved. As soon as no more salt crystals are visible, the cell becomes unusable and should be replaced.

As soon as the internal compartment is completely filled, the solution in the inner compartment forces out and this can damage the diaphragm, the sensor or the sensor housing.

The reference cells release water above relative humidity value of  $55\% \text{ RH}$ . Because of this, the interior dries up slowly. For correct functioning, the liquid should be still visible. Just when only crystalline salt is visible without any liquid content, the cell becomes unusable and should be replaced.

The effects described above take place only after opening the cap. Hence, the reference cells should not be unnecessarily opened for a long time. In order to retain the functional effectiveness of the cells for a long time as much as possible, care should be taken to immediately plug it back after use. It should be ensured that the gasket on the cap is dry and is effectively performing the sealing function.

In tightly closed condition, the cells have practically unlimited life.

Reference cells, in which the saturation level of solution has gone down, can be sent to us for processing (chargeable service). Mechanically defective cells, (e.g. damaged diaphragm) can be sent to us for free of charge disposal.

# OPERATING INSTRUCTION

## Humidity reference cells for adjustment of humidity sensors

### 4.5 Temperature dependence



In the most frequently used Lithium chloride, Magnesium-chloride and Sodium-chloride salts, the effect of temperature on humidity values is practically nil. Details of temperature dependence are as per the humidity tables provided in the appendix section of this documentation. To apply this, the ambient temperature of the salt container is to be measured with a thermometer and humidity value is to be worked out from the tables through interpolation.

### 4.6 Tolerance and accuracy

With proper use, under laboratory conditions, an accuracy of up to  $\pm 1$  % RH can be achieved at the test point. During applications in open field, a temperature stable environment is important for attaining the desired accuracy. An additional error of  $\pm 2$  % RH should be taken into account.

The accuracy possible for the total system considerably depends on the characteristics of the sensor elements used (hysteresis effect, linearity error, secondary drift, consistency).

Since the capacitive sensor elements show typical backlash characteristics for both offset and gain value, the adjustment should be always done at two points.

Even if very good results are achieved with the reference cells, application errors should never be totally ruled out. To be safe, an additional comparative measurement should always be carried out with a certified reference device.

### 4.7 Removing the protection cap



If possible, the sensing units should be kept inside the reference cells without the sinter guard filters. If necessary, get details from the manufacturer of sensors as to how the cap is to be removed. While using with the protection cap, a clear increase in stabilisation time should be anticipated.



**CAUTION!** After removing the protection cap, the delicate humidity sensor is in exposed condition and can get damaged by inappropriate handling. The sensor surface should not be touched. Finger prints or scratches on the surface may lead to deviations or malfunctioning.



**CAUTION!** The sensor should be inserted in the cell only to the extent that it does not touch the base otherwise both sensor or diaphragm can get damaged.

### 4.8 Humidity sensor checking



The humidity sensor must be in error free condition. Damaged, scratched or broken humidity sensors must be referred to the works for replacement!

### 4.9 Humidity sensor cleaning



The sensor should not show any dust deposits or other contaminations. The humidity sensors are water resistant. If the sensor gets dirty, it can be cleaned with distilled water of max 65 °C. In addition, the sensor is to be rinsed in water for approximately 1 Minute. After that, the sensing element should be dried for 24 hours at 80 °C. Subsequently, the sensor should be kept under ambient conditions (30 % - 70 % RH) for 48 h before using again.



**CAUTION!** There is electronics circuitry inside the sensor housing which can get damaged due to contact with water. Therefore only the sensor should be immersed in water and not the complete sensing unit.

# OPERATING INSTRUCTION



## Humidity reference cells for adjustment of humidity sensors



CAUTION! The cleaning with distilled water is permitted only for sensors. Resistive or electrolytic humidity sensors get seriously damaged beyond repair through water contact and needs to be replaced! Humidity sensors of other manufacturers are normally not water resistant and can get damaged through water contact. If necessary, obtain clarification from the manufacturer about cleaning instructions of the sensing unit.

### 4.10 Guidance for adjustment

The guidance for adjustment of the devices are available in the appendix section of the respective operating instructions of the device. The relevant documentation can be obtained from us on request.

For hygrometers of other companies, please contact the respective manufacturer.

It is not necessary to adjust the device during the calibration process. It is often sufficient to record the deviation and take into account during future measurements.

### 4.11 Stabilisation time

The checking or adjustment should be carried out only after the system is stabilised, which means that all components (salt solution, atmosphere in adjustment chamber, and sensing unit which is to be adjusted) can be considered at the same temperature and humidity conditions.

In practice, an accuracy of up to 2 % (without adjustment) can be obtained for simple testing purposes, with a stabilisation time of at least 30 minutes. For adjustment or quality intensive calibrations, stabilisation time of at least 4 hours is required.

Stabilisation must be carried out in temperature stable environment. This can be done by keeping in a polystyrene box.

During stabilisation time, the cell or the sensing unit should not be touched. While assembling cells on sensors, unnecessary contact with the hands should be avoided.

## 5. Checking and adjustment procedure

The following items are required: At least two reference cells, a polystyrene container, adjustment instructions of the device, a calibrated thermometer, these guidelines with the salt tables and a measuring instrument. If a transducer without display have to be calibrated a display unit is additionally needed.

Either replace the battery of the device or connect it to power supply during adjustment. First check the device for error free functioning. Only reasonable measurements must be displayed. Defective devices must be first repaired before adjustment.

Take the device into operation so that measured values can be observed. Use an display unit or a calibrated current/voltage measuring instrument for transducers.

Then carefully remove the protection cap of the sensing unit. CAUTION! Remove the protection cap and then axial take out without tilting! The sensor is unprotected and hence, it is very susceptible to damage.

After that, check the condition of the sensor elements. Damaged or scratched sensors should be replaced. Contaminated sensing elements should be first cleaned and then dried. Please follow the security tips about the reference cells. Unscrew the caps of salt-reference-cells and check the inside area. Carefully wipe out the liquid outflow with a lint free cloth. Check the level and saturation status of the salt solution in the reference cell. Defective reference cells must be separated out!

Carefully mount the sensing unit on the adjustment adapter. Use an appropriate adaptor with suitable threads which can hermetically seal the assembly. Avoid unnecessary palm contact to the cell and sensor to rule out unwanted thermal instability. Place the sensing unit with the cell in the carry-case or in a closed polystyrene container for stabilisation. No further heat sources should be present in the polystyrene container.

# OPERATING INSTRUCTION



## Humidity reference cells for adjustment of humidity sensors

Close the cap of polystyrene container and wait for at least two hours.

Put the device into operation. You can read the measurements on the display panel and assess stability at the adjustment point. Start adjustment only if the values on the display vary less than 0.1 % RH in a span of 30 minutes.

After this, first you can start with the adjustment. Measure the ambient temperature in the vicinity of reference cells. The self measured temperature values of the meter can also be used for hygrometers with temperature measuring facility.

Determine humidity value of the reference cell, with respect to the measured temperature of the cell (or in the polystyrene container), from the salt tables through interpolation. Adjust the displayed value of the test piece with respect to the specified value of the reference cell as per adjustment instructions of the manufacturer.

Take out the sensing unit with the reference cell from the polystyrene container, carefully remove the cell and continue the process for the next adjustment point, if required. Take care to sufficiently wait for stabilization after changing the cell.

### 6. Technical Data

Parameter	Value
Available humidity values and fillings	See ordering data
Reference temperature	23 °C
Allowable operating temperature (only static operation - no temperature cycles)	20 ... 40 °C
Storage Conditions	0 ... 60 °C
Durability:	
Gasket sealed	practically unlimited
With cap open	approx. 2-4 weeks
Cell dimensions	D 40 x 105 mm (with cap)
Styrofoam packing dimensions	Ø 170 mm x 130 mm
Scope of supply	Reference cells with operating instruction on CD

### 7. Ordering data

humidity reference cell	Thread	humidity level	
REFZ-	M20 x 1,5 mm -M20	11,3 % RH	-11RH
	G1/2" -12Z	22,8% RH	-23RH
		32,9% RH	-33RH
		43,2 % RH	-43RH
		53,5 % RH	-54RH
		75,4 % RH	-75RH
		84,7 % RH	-85RH
		94,0 % RH	-94RH
		97,4 % RH	-97RH
Complete sets		Article no.	
Humidity-reference cell set with thread M20 x 1,5 mm: 32,9 % / 754% RH		REFZ-M20-SET1	
Humidity-reference cell set with thread G1/2": 32,9 % / 75,4 % RH		REFZ-12Z-SET1	



# OPERATING INSTRUCTION

## Humidity reference cells for adjustment of humidity sensors



### 8. Warranty

Congratulations on the purchase of this high quality product! The quality of our products is constantly monitored within the framework of our Quality Management systems as per ISO 9001 standards. Nevertheless, if still there are any reasons for complaint, we are ready to rectify the shortcomings free of charge within the warranty period of 24 months, if it is evident that the defect is due to some mistake on our part.

Prerequisite for the fulfilment of warranty service is that the details of defect should be informed to us immediately and within the stipulated warranty period.

Natural damages due to unintended use or due to non-compliance of operating instructions, is excluded from this warranty coverage. Moreover, defective sensors and sensing units and also calibration service are not covered in the warranty.

In addition, the warranty also turns invalid if the reference cells are opened. The serial number on the product should not be changed, damaged or removed.

Apart from the warranty service, if any essential repairs are required to be carried out, the service is free. However, further services and also postage and packing expenses are chargeable.

Compensation demands on the basis of claim for liability or damages during the warranty period are excluded if not in general legally covered.

### 8.1 Repair and Calibration service

During the tenure of warranty period, we are very much at your disposal with our service support. For any malfunctioning, you can simply send back the product to us with a short description of problems observed. Please don't forget to mention your telephone number to enable us to contact for any possible queries.

We shall inform you about the likely amount of repair charges before taking up the repair activity. The cost estimate is provided free. The postage and packing charges for return are to be added over and above the repair costs.

In our calibration laboratory, we can also calibrate your measurement and test equipment of other manufacturers with repeatability of National standards. Please send your enquiries to our attention. We are pleased to prepare an offer for you without any order commitment!

Service address:

B+B Thermo-Technik GmbH  
Heinrich-Hertz-Str. 4  
78166 Donaueschingen  
Germany

Telephone +49 771 8316-0  
Fax +49 771 8316-50

info@bb-sensors.com  
www.bb-sensors.com



# OPERATING INSTRUCTION

## Humidity reference cells for adjustment of humidity sensors



### 9. Salt tables (summary)\*

Salt	Lithium chloride LiCl	Potassium acetate $C_2H_3KO_2$
Temp. [°C]	Humidity value [% RH]	Humidity value [% RH]
20	11,31	23,11
23**	11,31	22,75
25	11,30	22,51
30	11,28	21,61
35	11,25	---
40	11,21	---

Salt	Magnesiumchloride $MgCl_2$	Potassiumcarbonate $K_2CO_3$
Temp. [°C]	Humidity value [% RH]	Humidity value [% RH]
20	33,02	43,16
23**	32,88	43,16
25	32,78	43,16
30	32,44	43,17
35	32,05	---
40	31,60	---

Salt	Magnesium nitrate $Mg(NO_3)_2$	Sodium chloride NaCl
Temp. [°C]	Humidity value [% RH]	Humidity value [% RH]
20	54,38	75,47
23**	53,49	75,36
25	52,89	75,29
30	51,40	75,09
35	49,91	74,87
40	48,42	74,68

Salt	Potassium chloride KCl	Potassium nitrate $KNO_3$
Temp. [°C]	Humidity value [% RH]	Humidity value [% RH]
20	85,11	94,62
23**	84,65	94,00
25	84,34	93,58
30	83,62	92,31
35	82,95	90,79
40	82,32	89,03

Salt	Potassium sulphate $K_2SO_4$
Temp. [°C]	Humidity value [% RH]
20	97,59
23**	97,41
25	97,30
30	97,00
35	96,71
40	96,41

\* Reference: Greenspan, NIST – USA

\*\* Note: The value for 23 °C can be linearly interpolated from value of 20 °C and 25 °C.