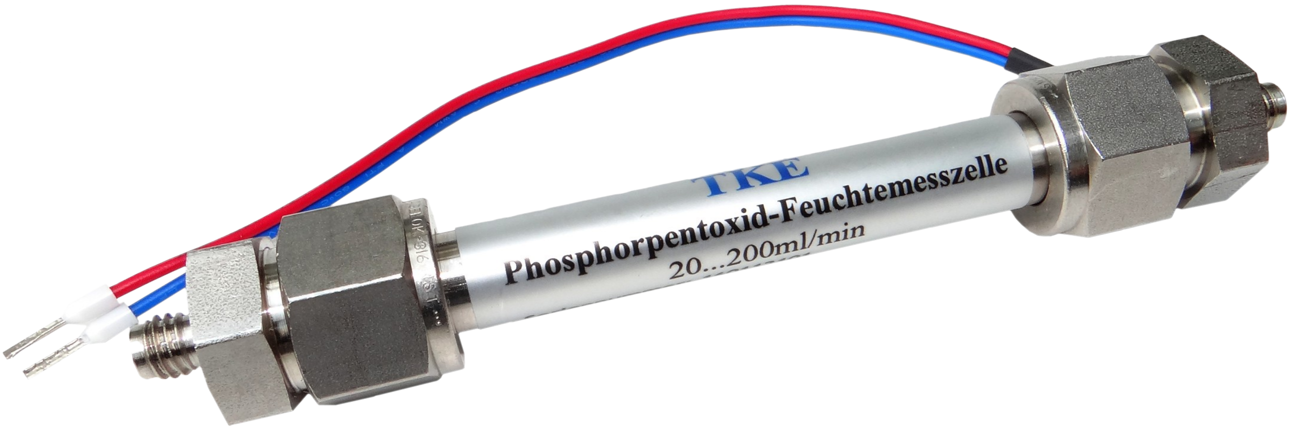
Phosphorus Pentoxide Moisture Measurement Cell

For the Determination of Trace Moisture in Gases



Advantages

- Low cost solution due to re-usable cell.
- Cleaning and re-coating of the sensitive surface can easily be done by the operator.
- TKE offers a replacement and regeneration service at an attractive fixed price.
- The cells can be operated at a wide range of gas flow rates.
- The standard cell comes with 1/8" Swagelok fittings, alternative fittings are free of choice.
- Complete measurement solution available with the TMM-1 moisture meter.

Technical Specifications

Principle	Electrolytic cell with phosphorus pentoxide coating (also known as Keidel cell or coulometric cell). The coating attracts water molecules from the carrier gas which will then be dissociated electrically. The current measurable at the electrical terminals is directly proportional to the amount of water in the carrier gas.
Dimensions	Tube length incl. fittings 133mm (5,2"), outer diameter 22mm (0,86").
Electrical Connections	130mm (5") wires, custom configurations available on request.
Gas Flow	100 ml/min maximum (linear range)
Operating Voltage	25 ... 70V DC (dry cell)
Power Dissipation	1W maximum
Materials	Tube: Electropolished stainless steel, Sensor: aluminium oxide ceramic with platinum tracks, Sealing: Epoxy resin.
Refurbishment	The tube can be opened for cleaning and recoating of the P_2O_5 surface.

TKE Service

TKE offers the following services in conjunction with these cells:

- Replacement of existing cells in analyzers from Ametek, Dupont and others.
- Customization of fittings and electrical connectors.
- Regeneration of the cells in the TKE service lab, test certificate included.
- Annual maintenance contracts: The user can always rely on having intact cells at hand.
- Consulting: TKE helps you out with their expertise in moisture measurement.

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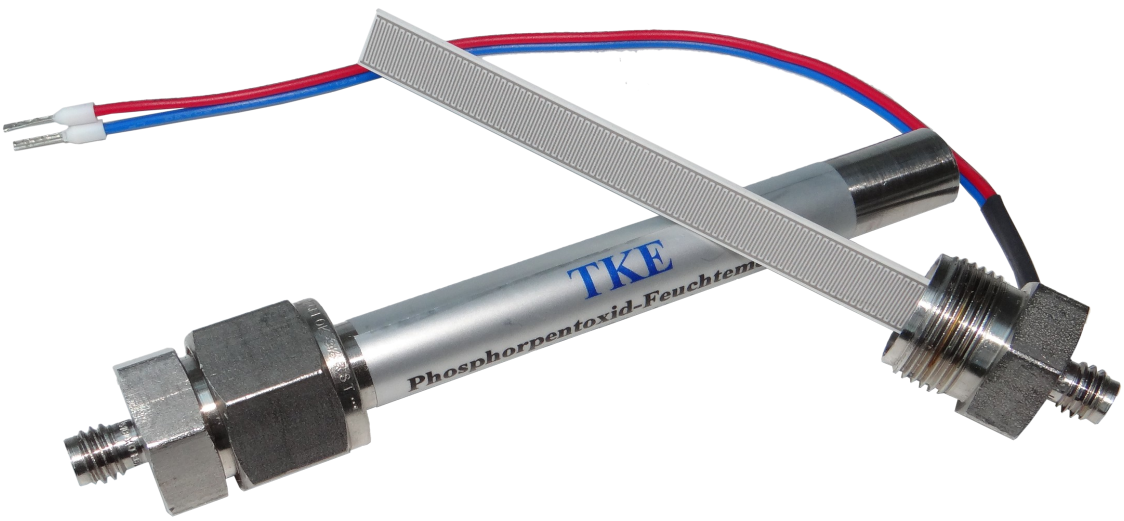
Operating Instructions

- When not in use, always put caps on the fittings while the cell is in dry condition.
- Before first applying voltage, dry down the cell 12 hours with dry carrier gas at the rated flow. Also dry down all supplying gas tubes.
- Do not apply voltage when the cell is in wet condition as this will destroy the sensitive surface.
- Do not overheat the cell. The maximum power dissipation should be limited to 1 Watt by electronic means. Higher power will reduce the lifetime.
- When opening the cell, take care not to crack the ceramic substrate of the sensor. After being opened the cell is in wet condition due to air humidity and must be dried again.
- Aggressive components in the carrier gas can be used as long as they don't react with P_2O_5. Esp. Ammonium (NH_4^+) should be avoided.
- Oxygen in the carrier gas affects the results because of recombination.
- From time to time check the sensitivity with a reference sample.
- If the cell becomes insensitive it needs to be regenerated. This is best done by TKE, a comprehensive test protocol is included.



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Typical Applications

The cell behaves linear in the range up to 100 ml/min. In this case the P_2O_5 layer is able to absorb all water from the incoming gas. The measured current is directly proportional to the number of water molecules per time unit. In a first application the volumetric moisture shall be determined in units of ppmV (parts per million of the volume). In this case the flow rate needs to be controlled at a known level.

The gas flow is typically set to 100 ml/min at room temperature and atmospheric pressure. In this case the cell will conduct 13,14 µA per 1 ppmV. This constant is derived from Faraday's law which says that two electrons are needed to split up one water molecule. This constant therefore does not need to be calibrated.

When operated with a gas flow of more than 100 ml/min the cell goes into the nonlinear region. The gas runs too fast, so not all of the contained water will be absorbed before the gas stream reaches the outlet. In this case the cell constant will be smaller than expected from Faraday's law. The cell can be operated in this way, but the constant needs to be determined individually for each cell and each time after regenerating.

A third case is using the cell within a moisture evolution analyzer such as the MEA 903 or a permeation analyzer. In a MEA a sample is heated up and evaporates water, in a permeation analyzer the water goes through a membrane, for example a polymer film. In both types of instruments the gas is just used as a carrier to transport the water from the sample to the electrolytic cell. The gas flow therefore has no influence on the observed current as long as it is kept in the linear region.

In the MEA the absolute amount of evolved water is of interest. The electric current must be integrated over the entire time of the experiment. In the permeation analyzer the current is directly proportional to the permeation rate.

However it is advisable to run MEA and permeation experiments with controlled flow rate to achieve a comparable response time. The response time also depends on the voltage applied to the cell. Higher voltage will make the slope faster, esp. at very low humidity (<10ppmV). With higher humidities the voltage should be reduced to avoid excessive heating and electromigration between the electrodes.

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