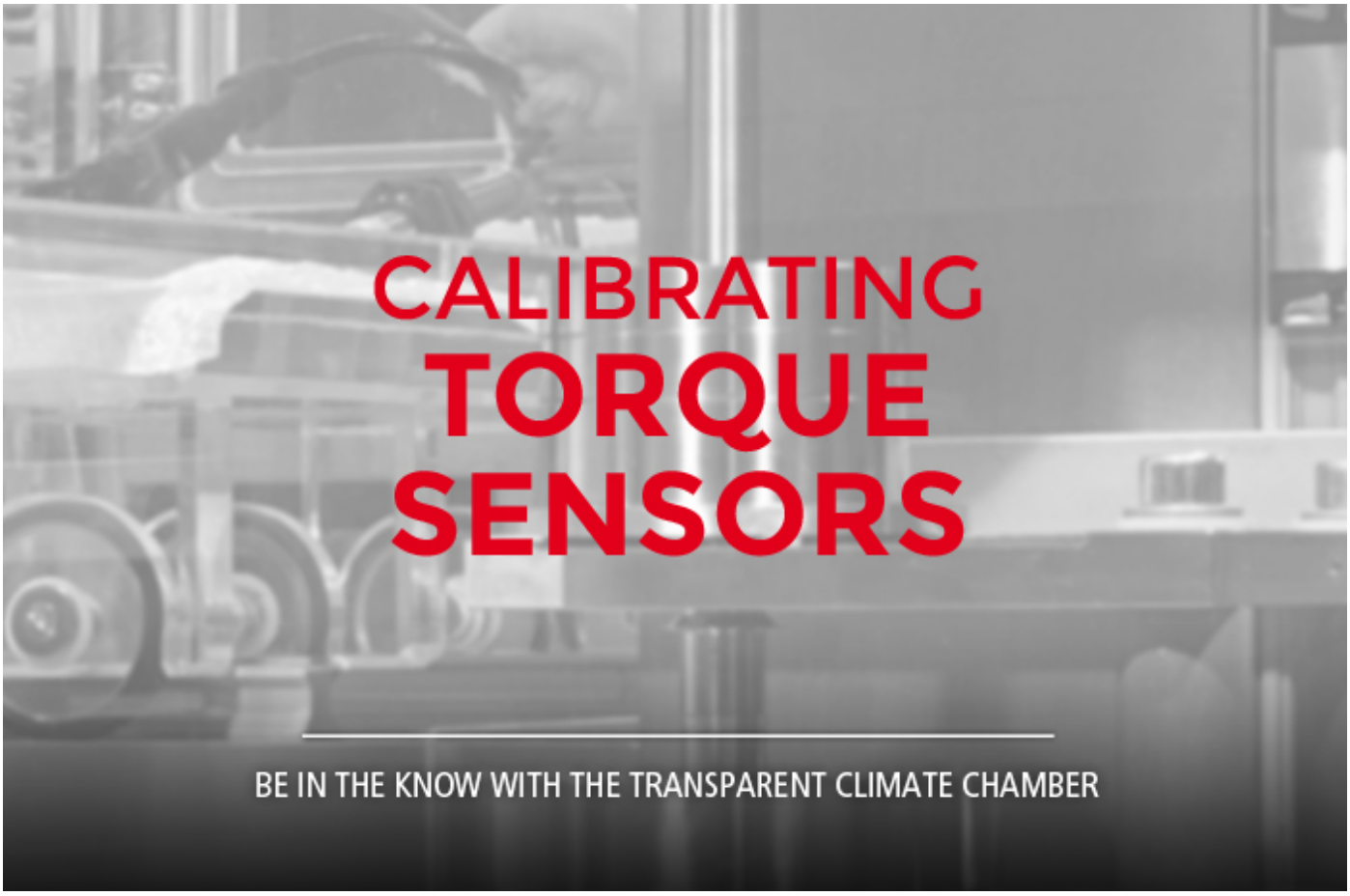
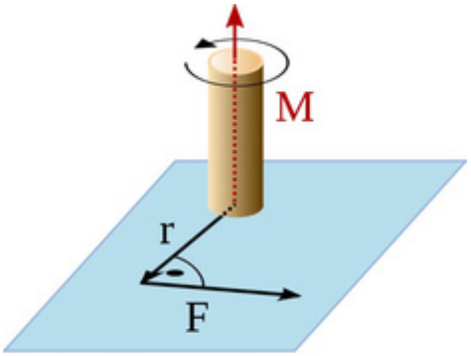


Germany's national metrology institute, the Physikalisch-Technische Bundesanstalt, is a higher federal authority for physical units and makes an invaluable contribution to industrial quality assurance. The Memmert customisation department developed an exceptional unicum for research on torque: a transparent climate chamber with Peltier elements for heating and cooling.

If you ask someone which are the most interesting cities in Germany and the answer is "Brunswick", you are probably talking to a scientist. Apart from the ***Physikalisch-Technische Bundesanstalt*** (PTB), almost 30 renowned research institutions have their headquarters there. Founded on the initiative of Werner Siemens and Hermann von Helmholtz in Berlin in 1887, nowadays **PTB** is one of the most important institutes for **metrology** worldwide. It expresses measurands at the highest level of accuracy (primary standard) and thus directly influences product quality via subordinated calibration laboratories, quality assurance and test laboratories.

Reception building of the *Physikalisch-Technische Bundesanstalt* in Brunswick (Germany)

Expressing torque

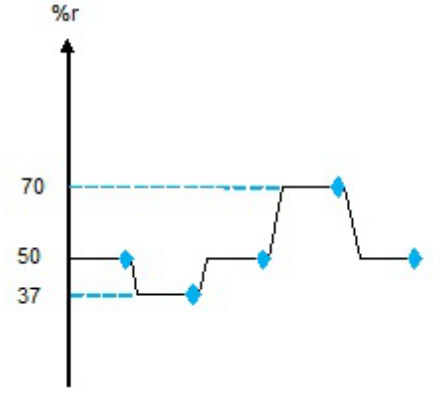


If a force F acts on an object with a fixed rotation axis, this object has the tendency to rotate. The greater the distance r of the force from the axis, the higher the torque. Torque generally is defined by the vector product. If the force is perpendicular to the rotation axis, and if r is the vertical (shortest) distance between the axis and the line of action of the force, the formula can be simplified to $\vec{M} = \vec{r} \times \vec{F}$; unit: newton metre.

Torque

A team within the solid mechanics division of the department for mechanics and acoustics of **PTB** focuses on expressing **torque** with the aid of high-precision measuring instruments. The practical use of this **unit** basically lies in the transmission of torque and thus in optimising the performance of drives and motors. Expressing **torque** as precisely as possible and with minimal measurement inaccuracies is thus indispensable for development and **quality assurance** in the automotive industry and in mechanical engineering. By using calibrated **torque sensors**, this unit is passed on as reference standard for measuring systems in calibration laboratories. Such a **sensor** determines **torque** by measuring the elastic deformation of its body, on the surface of which sensors (so-called **strain gauges**) have been attached at specific locations. If this torque sensor is twisted, the **strain gauge** deforms and its electrical resistance changes. The resulting deformations are minimal. For example, a reference length (measuring length) of 10 mm increases or decreases by 0.1 mm during the usual elongation of 1 %. However, this minimal change in length can be electrically split into more than 1 million pieces by using high-precision measuring amplifiers that are connected to the **strain gauges** in order to form a Wheatstone bridge. Consequently, one step in the last digit of the display would correspond to an incredibly tiny length variation of 0.1 nanometres. This technology makes it possible to accurately measure torque, whereby a measurement range from millinewton metres to meganewton metres is currently covered by different measuring instruments.

Energy-efficient Peltier technology for heating and cooling



As part of a research project supervised by Dr. Dirk Röske, the ***Physikalisch-Technische Bundesanstalt*** ordered a **constant climate chamber** made of transparent plastic – based on the standard model HPP110 – from the **Memmert** customisation department to analyse to what extent

changing the temperature and humidity conditions influences the properties of the **torque sensor**. The **climate chamber** is inserted into a standard torque measuring instrument. By means of axial feed-throughs, the torque flow can be lead from the generating side to the opposite side via the **torque sensor**. Only a small gap of air remains on both ends. Due to the resulting mechanical bypass, it is impossible to completely seal it. The interior can be accessed via two lateral flaps (e.g. to connect the torque sensor and further sensors). During the study, permanently equal and precisely termed **torques** act on the **torque sensor**. The climatic conditions (relative humidity and temperature) can be adjusted. By comparing the sensor's output signals under reference and deviating conditions, the influence of differing ambient conditions can be quantified and can be taken into consideration when expressing or passing on the unit. Depending on the stage of the experiment, the temperature changes between 18 °C and 40 °C and the humidity changes between 37 % and 70 % (relative humidity) within a period of 72 hours.

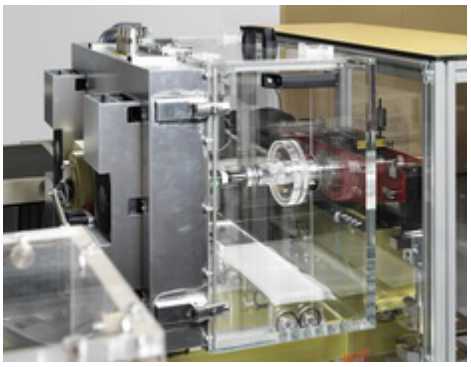
Example humidity test cycle

Standard torque measuring instrument at the *Physikalisch-Technische Bundesanstalt*

Durable for long-term stable measurements

Besides the naturally high precision to measure the mechanical value of torque, numerous further requirements influenced the customisation of the climate chamber. It had to be compact, durable and energy-efficient and emit as little noise and heat as possible so it wouldn't disrupt the laboratory's operations. From the start, Memmert Peltier technology was preferred to a compressor for heating and cooling. The Peltier elements, high-precision temperature and humidity sensors, as well as fans were placed in a unit at the rear panel of the working chamber. The component is operated with a separate Control COCKPIT. In its day-to-day work, Dr. Röske's team also appreciates the easy and intuitive operation of the provided AtmoCONTROL software, because especially for long-term studies, a connection to a computer is indispensable.

The text of this article is essentially based on the explanations provided by the Physikalisch-Technische Bundesanstalt in Brunswick. AtmoSAFE would like to thank Dr. Dirk Röske for his kind assistance.



Customised Memmert climate chamber in the standard torque measuring instrument at the PTB

Climate testing of packaging

At Hoffmann Neopac, pocket packs made of metal or metal and plastic are put to the acid test in an HPP Memmert constant climate chamber. more

Overview of the main topics

- Physikalisch-Technische Bundesanstalt, PTB
- Torque
- Torque sensor
- Metrology, unit
- Climate testing
- Constant climate chamber
- Memmert climate chamber
- Peltier technology, Peltier elements

Memmert laboraty equipment

Constant climate chamber HPP
Climate Chamber ICH
CTC climatic test chamber
Humidity chamber HCP

Photo Credit: Wikipedia, PTB Braunschweig

Autor: Memmert GmbH + Co. KG