



**Torque measurement**

## How to measure the torque?

Torque plays an important role in many applications. For smooth operation and maximum effectiveness, it is important to measure this nominal value. Only by precisely determining the torque can processes, procedures and components be optimally matched to each other. For this purpose, it is important to measure the torque as precisely and without the influence of other forces (cross-talk). There are various solutions for this.

## The use of torque sensors in industry and other fields of application

The measurement of various applied torques is enormously important in many areas. This includes not only industry with its various production facilities and production lines, but also motors and motor technology, among other things. Electric drives in cars or e-bikes also require precise measurement of the applied torques in order to be able to operate effectively and efficiently. This is because torque measurement in these areas serves primarily as a control variable and must therefore always be able to be determined reliably and without deviations. For this, a clean and clear torque measurement is of course of decisive importance.

## Static or rotating: Measuring torque through the ages

At the beginning of the development, only static torque measurement was possible. Strain gauges were used for this purpose, which made it possible to determine the torque using simple principles. However, the core application areas for the measurement were to be found in the so-called rotating shaft train. Accordingly, sensors had to be developed which were capable of measuring the torque in such a shaft train. Based on these systems and the developments initiated at that time, various systems are in use today that allow the torque to be measured reliably and without difficulty.

## Five different ways to measure torque

There are currently five different methods for measuring torque. There are other solutions and possibilities, but these are neither applicable nor efficient enough for normal use. Most of these solutions only work under perfect laboratory conditions and are therefore not viable for use in industry. So if you want to measure torque accurately, you should rely on one of the five methods presented.

### Strain gauges: The classic torque measurement

Strain gauges have been in use for an enormously long time and are still used today. However, successful measurement requires an enormously high level of accuracy during installation and maintenance. Although a strain gauge can be used to measure torque in many areas, these systems are not particularly robust against external influences.

## Optoelectrical torque measurement

With this form of measurement, different sensors and sensor combinations are used to measure the angle of rotation as well as the direction of rotation, the speed and the torque. This is important and helpful in many areas of application, but also comes at the price of the size of the measuring system. However, the extremely precise measurement (0.01%) with a robust signal cannot be used in all areas and applications.

## The magnetoelastic torque measurement

This measuring method is only suitable for so-called ferromagnetic substances, as these special substances allow a macroscopic magnetisation, which can be checked by the corresponding sensors. In this way, the torque can also be measured very effectively and without interference by changing the various magnetic states. However, this method also shows that it cannot be used in all areas. It is always important to adapt the method to the existing conditions.

## Measurement by means of SAW method

The term „Surface Acoustic Wave“ is used for a special measuring method. Here, a sound wave is generated by a sensor, which then propagates over the surface of the measuring medium. A change in torque also changes the propagation and properties of this sound wave. This change can be measured and evaluated very easily with the appropriate sensors. The torque can be determined very easily with this method. However, this method is very susceptible to interference and for this reason can only be used to a limited extent in various areas.

## The piezoelectric torque measurement

Certain crystals generate a proportional electrical charge under an existing pressure load. Through an amplifier, this voltage can be converted into an output voltage. This system also works with very low tolerances and is therefore versatile and flexible. However, it is very susceptible to interference and can therefore only be used under certain conditions in the individual areas of application.

## Measuring the torque: Choosing the right method

When measuring torque, it is important to choose a suitable method that fits the current and desired application and has a low error tolerance. In order to measure the torque reliably, the system must also have as little interference as possible. Selecting the right solution is therefore not always easy and, above all, not possible across the board. In principle, magneto-elastic measuring methods have become established in many areas, as they can often be used very flexibly. Here, a further distinction is made between passive and active measuring methods. This means that a suitable solution can be developed and used quickly and easily for every area of application.

## The integration of the measurement methods into the own data processing

However, purely measuring the torque is not helpful in most areas of application. The data must also be transmitted to the corresponding systems. Depending on the measuring method used, amplifiers must be used to transmit the torque and thus make it usable for other systems. Often it is complete packages that ensure optimum results and enable interference-free transmission of the measurement results. In such a case, the measurement tolerance can be particularly low and thus stabilise the results.



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