

## Quality 101: Torque Test Fundamentals

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*Torque testing can help manufacturers attain consistent product performance and customer satisfaction.*

Torque is defined as a force applied to a given distance from an axis of rotation. We experience torque daily in numerous applications—from turning the volume dial on our alarm clock, to opening the door to our home, to loosening the cap on a soda bottle. For the manufacturers of these products, and numerous others, it is essential to verify that the amount of torque required to operate these products meets specifications.



*A typical torque gage is a handheld instrument or an indicator with a remote sensor, usually employing a strain gage-based transducer and microcomputer. Source: Mark-10 Corp.*

### Measuring Torque



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A typical torque gage is a handheld instrument or an indicator with a remote sensor. They usually employ a strain gage-based transducer which outputs voltage to an analog-to-digital converter. Voltage is then further processed by a microcomputer.

Gages for the measurement of static torque are available in a range of capacities and resolutions. For example, a manufacturer of low-friction bearings may need to test very low torque, while a manufacturer of large torsion springs will have higher requirements. Test units are commonly pound-inches, pound-feet, kilogram-millimeters and newton-centimeters.

It is important to select an instrument with a capacity that is as close as possible to the maximum anticipated load. For example, if the choice of torque gages includes 10-, 50- and 100-pound-inch capacities, and the requirement is for 40 pound-inches of torque, the 50-pound-inch capacity is most appropriate. Because accuracy is typically specified as a percentage of full scale, the lower the torque reading measured on any given instrument, the greater the possibility for error.

Correct axial alignment is another area of concern. If the axis of the torque transducer is not concentric with respect to the sample's axis of rotation, the displayed test result may be skewed.

Although a handheld torque gage is an economical and simple way to address many applications, test stands can be quite helpful in producing more accurate and consistent results. They help to fixture the torque gage and sample, ensuring axial alignment and consistent test speed. With these variables out of the picture, test results can be compared on an apples-to-apples basis for greater consistency.

Manually operated and motorized test stands are available. Some motorized test stands can be controlled by a PC to perform complex test sequences, such as cycling and automatic data output to a PC or other collector. Test stands can help to streamline processes, increasing throughput and efficiency. Application-specific grips and fixtures are available, although in many cases custom-designed fixtures are fabricated to address unique sample shapes.

### Typical Applications

Virtually every industry has numerous applications for torque measurement. In the medical device industry typical applications include catheter torque testing, fastener torque testing and connector torque testing. Common applications in the automotive industry include dashboard knob torque testing, bolt torque testing and key ignition torque testing. The packaging industry also is quite rife with torque testing applications, including bottle cap torque testing for medicine, shampoo, motor oil and beverage.

## Interpreting the Results

Of principal interest in most applications is the peak torque, or maximum observed torque, during the test. This value often determines whether a part is considered acceptable. Using the example of a soda bottle cap, an acceptable opening torque range may be between 15 and 20 pound-inches. A sample falling outside this range would be considered a reject, while a sample falling within the range would be considered acceptable.



Some other applications require more than just the peak. Certain tests call for the torque profile to be recorded and used to further analyze the behavior of the sample. Using the example of the bottle cap once more, analyzing the torque profile may highlight problem areas in the thread or other aspects of the cap. Materials testing of metals and plastics also often requires such testing, as well as the testing of components such as latches, bearings, connectors and springs.

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Source: Mark-10 Corp.*

Rotational travel measurement is a common additional requirement to torque measurement. It serves as a useful threshold to stop a test, establishing a criterion with which a specification can be developed. For example, an automotive parts manufacturer may specify a torsion spring with rated torque of 10 pound-inches at 180 degrees of rotation. Some test stands are available with integrated angle indication, and software is available to tabulate and graph torque vs. time or torque vs. angle.

Torque testing is an important step in achieving consistent product performance objectives and customer satisfaction. Given today's highly competitive manufacturing industry and a challenging economic climate, it is important for manufacturers to take torque measurement seriously.

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