It's "Hands-Off" for Cap Torque Testing

Automated torque testers can reduce the influence of human variability.

If you need to measure the cap torque for your bottles and containers, you may want to think twice before buying a handheld or manual torque-measuring device. Manual torque measurement devices are inexpensive and easy to use, with some versions providing digital data. However, there is a flaw with the concept of manual torque testing devices, related to the use of the human hand. Torque is a function of acceleration, and acceleration must be constant in order to obtain accurate, repeatable data.

Here is a simple equation to remember: **F = M × A**, meaning **force** equals **mass** multiplied by **acceleration**. In measuring torque, **mass** corresponds to the friction of the cap rotation. The **acceleration** component of torque measurement relates to the rotational acceleration applied to the cap as a means of making the cap rotate, which is done by the human hand in manual cap testing.

Another short equation to remember is: **T = F × D**, meaning **torque** equals **force** multiplied by the **distance** to the center of rotation (i.e., the distance from the exterior cap wall to the center of rotation for the cap or bottle neck). In these equations, there are two variables, the friction of the movement of the cap on the neck finish of the bottle, which is the value that needs to be measured, and the acceleration applied to the cap by the human hand.

In manually operated torque-testing systems, acceleration is applied to the cap by the operator's hand, either directly or through a handheld torque device. The hand operation generates several concerns with data accuracy and repeatability, especially if the operator does not turn caps with the same acceleration in each test. It is, of course, impossible for an operator to apply exactly the same amount of acceleration in each test cycle. Additionally, there may be several different operators performing the cap tests on the production line, or in the quality lab, and the results may vary dramatically from operator to operator. For instance, if one operator were to apply muscle when rotating a cap, compared with another operator who gently rotates a cap, the resulting data will differ dramatically for the same cap and container. It is a matter of simple physics.

Adding a motorized function to the testing process, however, can eliminate human influence. By motorizing cap rotation, the variable acceleration problems caused by human rotation of the cap are eliminated, which then allows for greater accuracy and repeatability in testing.

Another variability found in manual cap testing relates to the squeezing force of the human hand, which may deform a cap and alter the friction characteristics of the cap and neck finish. This is a common problem, but it is rarely considered when evaluating unexplained data fluctuations. To address this problem, most automated (motorized) cap test systems use non-compression type chucks for

holding the cap during testing. The non-compression chucks are machined out of stainless steel and manufactured with precision to fit over the cap and side-serrations. By design, these chucks do not squeeze or deform caps, but also do not allow the cap to slip during the testing process, because slippage can directly influence the accuracy of cap torque data. Although these chucks can be expensive (EDM stainless-steel tooling can be costly), they are effective and offer the operator many years of testing without needing replacement.

Depending on the closure and product type, some motorized cap test systems provide testing programs for performing nondestructive tests. This type of testing is accomplished by performing tests in the following steps:

Removal Step. Torque is applied in the open direction until the point at which the cap begins to slip on the neck of the bottle, and as soon as the machine detects the rotational movement of the cap, the system stops rotation in the open direction.

Application Step. The cap is reapplied to the bottle to a preset application torque. This is a precision application of the cap; highly accurate and measured to a precise torque value.

By stopping the opening rotation as soon as movement is detected, the seal of the cap is not compromised, and therefore the product remains sealed and available for reentry into the production line. The maximum removal torque reading, which is measured at the moment slippage occurs in the opening direction, will be taken without actually opening the container and exposing the product to environmental contamination.

Removing the human influence in cap testing can provide greater accuracy and repeatability than the less expensive hand-operated devices. Motorized cap test systems provide useful data related to capping control and operation, while also allowing for nondestructive testing. These features provide bottling and packaging companies greater production control and efficiency and provide benefits long after the products leave the plant.

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