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IMPROVING YOUR MANUFACTURING PROCESS

Three-Step Approach to Force Measurement

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Is It Good?

A simple 1-2-3 process using force measurement techniques can differentiate between an acceptable product and a reject. **BY MARK FRIDMAN AND ISTVAN MATE**

How does one know if the product his company manufactures is "good"? How exactly would one qualify a good product?

There are a large number of factors that contribute to the quality of a good finished product. From receiving raw materials and components to fabrication and final assembly, every step in the production process has an influence on the quality of a product. In today's competitive manufacturing environment, it is more important than ever to ensure quality throughout the manufacturing process.

There are many ways with which to assess product quality, and these vary depending on the item being manufactured. Typical parameters to check include physical dimensions, chemical composition and hardness. One parameter of particular interest to

companies in virtually every industry is force.

When using products in everyday life, varying amounts of force are constantly exerted on them. Similarly, these products contain numerous mechanical components, each of which interact with and produce force on each other. In order for one's experiences using products to be pleasant, it is often critical to perform force measurement testing to ensure the product performs to expectations.

THREE-STEP PROCESS

Determining if a product is good entails a simple three-step process:

1. Understand what needs to be tested and how.
2. Obtain appropriate force measurement instrumentation. Subject samples to standardized or internally developed test procedures.

3. Analyze and interpret the results, using simple criteria or advanced analysis software.

WHAT NEEDS TO BE TESTED?

In short, almost everything needs to be tested. Virtually every industry has applications for force measurement. A selection of typical applications includes:

- *Automotive industry.* Vehicles' bills of materials typically include many different types of springs. In a compression spring test, the sample will typically be compressed to a specified height, and the force will be measured at that point. The resulting relationship of force to displacement is called the spring rate. A similar procedure is performed with tension and torsion springs.

Vehicles also have many driver-operated electronic controls, such as the turn signal stalk, buttons on the climate control panel and knobs on the radio. A common force test is to press on the control until it makes contact or snaps to its intended position.

Other applications in the automotive industry include door latch

TECH TIPS

- ▶ One of the most basic force measuring instruments is the electronic force gage.
- ▶ Force data can yield a wealth of information.
- ▶ Force measuring instruments are capable of providing a continuous stream of real-time force data that can be output to a PC or data collector for further analysis.



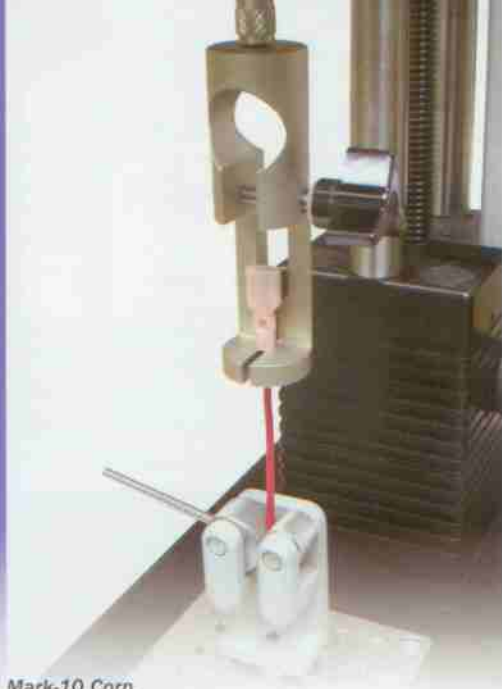
From left to right:

The automotive industry has many applications for force measurement. Source: Mark-10 Corp.

Medical tubing terminal pull-off ensures proper functioning in the field. Source: Mark-10 Corp.

A tension spring test yields force and deflection values. Source: Mark-10 Corp.

A typical wire terminal pull-off test performed in the wire harness industry. Source: Mark-10 Corp.



opening force, wire terminal pull-off testing and weld force testing.

- Medical and pharmaceutical industries.** In recent years, the medical and pharmaceutical industries have adopted many stringent requirements for quality testing, some of which are related to force measurement. One example is medical tubing. When healthcare professionals use this tubing in the field, it is essential that the tubing does not become disconnected from fittings and devices. In order to prevent this from occurring, tubing is typically subjected to terminal or connector pull-off testing. The force at which it disconnects from the body of the tube is of crucial importance.

Sutures need to be tested in the same fashion. When a surgeon has completed a procedure and is using sutures to close a wound, he should be confident that the stitches will hold long enough for the skin to heal. Manufacturers of sutures need to test their products prior to shipping to ensure durability in the field.

Other applications in the medical and pharmaceutical industries include needle sharpness testing, catheter torque testing and pill crush testing.

FORCE MEASUREMENT INSTRUMENTATION

Force measurement instrumentation is generally quite affordable when compared to the materials testing machines many quality professionals are familiar with from their engineering classes or their company's research and development lab.

One of the most basic force measuring instruments is the electronic force gage, a handheld instrument that integrates a load cell with electronics and display. The gage will typically display

force in units of pounds (lb), Newtons (N) or kilograms (kg).

Force gages are typically used in conjunction with a manually operated or motorized test stand. By regulating the speed of tests, test stands help ensure consistency between tests.

Force gages and test stands are available in a wide range of force capacities, reflecting the great number of different products that need to be tested. Various grips and fixtures are available for use with these instruments, which vary based on the sample being tested. Many force gages and some test stands can output measurement data for further analysis.

Components of a typical force measurement system.



Source: Mark-10 Corp.

INTERPRETING FORCE DATA

Force data can yield a wealth of information for quality assurance professionals. The value of most interest in many testing applications is the maximum force, that is, the force at which a sample broke, engaged or loosened. This ultimate strength is often how companies gauge the performance of their product.

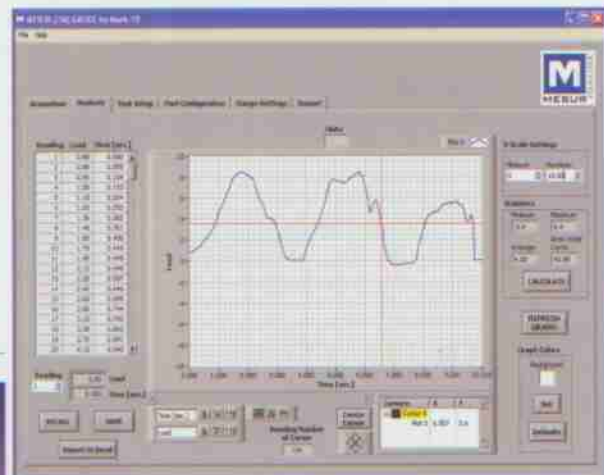
As important as the maximum force is, in many cases more data is desired. That is where having the correct instrumentation and software is important. Force measuring instruments are capable of providing a continuous stream of real-time force

data that can be output to a PC or data collector for further analysis. Force measurement software can accomplish a number of goals for quality professionals, including:

- Plot force vs. time or force vs. distance. Graphical force data can be helpful in analyzing a sample and visualizing its behavior under stress. The slope and behavior of a curve can be analyzed to yield such values as the modulus of

Force measurement software can help analyze the behavior of a particular product. Source: Mark-10 Corp.

elasticity, modulus of toughness, resilience, yield point and work. Besides plotting real-time data for a single



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test, software may be used to accumulate results from multiple tests in order to provide statistical analyses of the production process for an entire batch or lot.

- Statistical calculations.** Values such as minimum, maximum, mean and standard deviation can help quantify the quality of a product.
- Data management.** Data can be formatted into customizable reports that include data in tabular and graphical format, or only selected data points. Data export capabilities allows the operator to customize data presentation to their needs through the use of programs such as Microsoft Excel.

There are many reasons to consider assessing quality through force measurement. Facility audits often require documentation for such testing. Government regulations in some industries may also necessitate some testing. But even if these factors were not present, it still makes sense to force test your products.

This 1-2-3 process is a quantifiable approach to quality testing, enabling one to make a well-informed assessment of a product's quality. Use these techniques so when the next time someone asks you how good your product is, you can say with certainty that it is in fact "good." **Q**

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