Metrology Systems that Tackle the Hard Problems

The tale of technology is one of unending miniaturization. Every few years we see increased functionality packed into smaller and smaller spaces. While much of the focus is on the electronics, the same applies to the mechanical aspects of a system – the boards, the housing, and the increasingly tight connections between user interface elements like buttons and the electronics they control.

Tightening dimensions are a trend both for components and for the increasing number of small consumer products and devices – including units intended for the evolving Internet of Things (IoT) market. Whether a wearable device, a smart thermostat, or simply the latest smartphone, such devices pack an enormous amount of technology into a small housing.

Even if these devices stay the same size (or even grow, as some phones have), more electronics are squeezed into that space than ever before. Tolerances become that much tighter, and overall dimensional control becomes that much more critical. Components sourced from multiple vendors in different geographic locations add to the problem. No longer simply an issue of cosmetics, incorrect dimensions can lead to long-term failure or recalls.

As a result, manufacturers are moving to 100% dimensional inspection as an essential aspect of their advanced manufacturing processes. Metrology is now a critical process control driver, with measurement data guarding against process deviations or providing feedback to component suppliers for their use in maintaining tight processes. Even for processes that don't require metrology, industries with an intrinsic need for quality, like the medical equipment industry, will still need to implement a thorough dimensional inspection regimen to meet the expectations of their customers.

Basic dimensions and parts with standard shapes are easily inspected, and many metrology equipment vendors provide customary tools that can handle these easy measurements. But, increasingly, complex cosmetic features have critical dimensions that require greater precision and handling flexibility – capabilities that are not available in standard systems. There's a growing need for custom inspection stations that can handle both the easy and the difficult measurements.

DWFritz's specific focus is on in-line metrology solutions requiring customization and precision unavailable in standard equipment. We serve the needs of high-volume manufacturers looking for complex metrology at the lowest cost per inspection. We tackle the hard metrology problems, and we have years of experience doing so.

**Complex features, complex dimensions**

When one thinks of critical dimensions, the obvious measurements that come to mind are length, width, and height. Planarity and the locations of ports, buttons, and other components are also frequently the targets of measurement, and they can be straightforward to handle.
The following, however, are examples of much more difficult measurements:

- Chamfer angles and dimensions
- The size and curvature of bosses
- Curve radii
- Curve-to-line or curve-to-curve tangency
- In addition, color and finish can make what should be easy measurements much more challenging than a standard solution can handle.

![Diagram of complex geometries and profiles]

*Figure 1: Complex geometries and profiles (left); Light and surface finish dependence (right)*

For these tough inspection scenarios, each DWFritz solution is unique.

- Illumination is tailored to account for the angles of illumination as well as the strength and diffusion of light.
- Timing of strobes is carefully optimized to ensure that a strobe for one measurement doesn’t send stray light that might interfere with another strobe being used for a different measurement.
- Cameras and lasers are positioned as dictated by the geometry and surface reflectivity and contrast of the artifact being measured.
- Depending on the number of measurements, a single camera will be used several times as the unit passes by on the conveyor; in other cases multiple cameras will be required.
- Lighting, lasers, cameras, and algorithms that interpret images are positioned and tuned to account for different finishes and colors.
- Multiple measurements may be combined to compute a single parameter.
A measurement result may not be a simple number; a 3D point cloud may be needed to ensure that complex shapes conform to specifications.

**Figure 2: 3D point cloud capture of razor blade cartridge**

DWFritz implements these custom solutions in our high-throughput, continuous motion, automated inspection stations using conveyances such as precision stages. Furthermore, delicate components are handled sensitively to ensure device integrity, from on-loading to conveyor movement to off-loading. High precision ensures correct positioning and registration.

For small consumer products (see Fig. 2) and IoT devices, DWFritz provides inspection stations that can process 35,000 units per day; for components, DWFritz stations can run 350,000 units per day. Each station is custom configured to meet the specific requirements of each customer and each device. The result is a complete set of measurements – easy and difficult – that can be accomplished for the lowest possible cost.

Contact DWFritz for more information on cost-effective metrology solutions that can handle the full range of measurements needed to ensure quality consumer devices and components.