

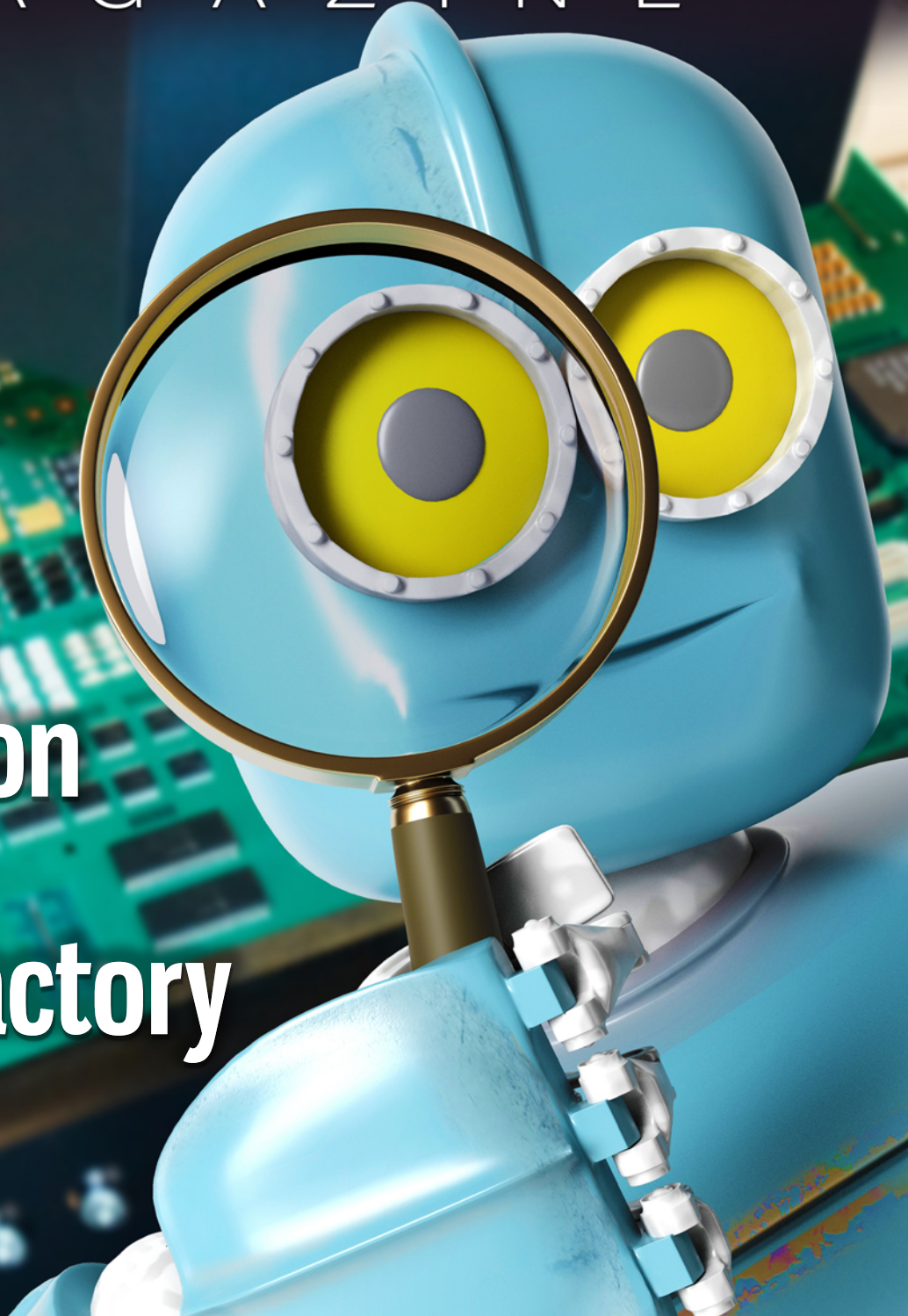
NOVEMBER 2020

I-Connect007

SMT007

M A G A Z I N E

Test and
Inspection
in the
Smart Factory





Brian Smith

Feature by Kevin Jobsky ICM CONTROLS CORPORATION

“Quality starts with the design.” That is one of the favorite sayings of Brian Smith, a quality manager at ICM Controls. Truth be told, it is the mantra of many quality managers from every industry throughout the world. Still, Smith and his peers would all be out of jobs if all product designs proved flawless right out of the gate and moved smoothly throughout the entire manufacturing process.

Quality control has an additional set of challenges. Previously a “captive shop” only, where its primary customer was itself or involved the manufacturing of custom turn-key OEM products that were designed in-house, we opened our doors earlier this year to contract manufacturing work in an effort to help other manufacturers struggling with disruptions caused by the COVID-19 pandemic.

We are a U.S.-based, ISO-certified manufacturer of electronic controls. In committing to CM work, we knew that we would need to rely heavily on tight statistical process control (SPC) up front to help make the transition and

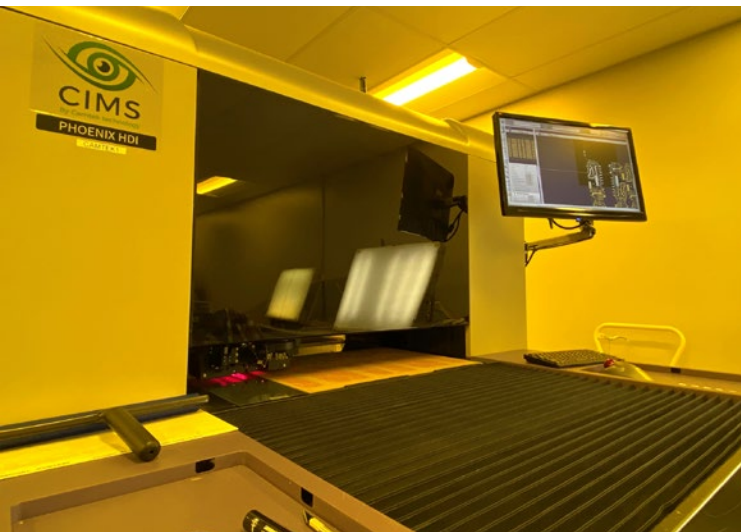
Quality Starts With the Design

overcome some CM shortfalls, knowing there is room for improvement.

A member of IPC, we adhere to IPC standard protocols for bare board fabrication but rely on AOI technology and light table visuals vs. electrical testing to inspect for indents, opens, trace shorts, and other potential board defects before the board moves on to assembly. For bare-board-only customers requiring higher levels of inspection, we currently use a third-party service to validate the work until we have our own internal electrical testing process in place.

Where we might lag in some areas, however, we make up for in others by adhering to tight tolerances, to ensure the highest quality standards are maintained. We have been in the business of fabricating and assembling PCBs for over 36 years, and we leverage statistical data to be proactive in areas like equipment maintenance to help it maintain a nearly 99% overall (entire production) first-pass yield.

Quoting W. Edwards Deming, Smith notes that “without data, you’re just another person with an opinion.” It’s through the application of data compiled that we strive to achieve the



ICM runs each board through an AOI system, resulting in higher first-pass yields.



Operator Dan Kranze conducting a highly accelerated life test (HALT).

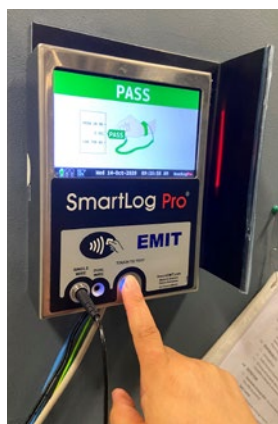
Six-Sigma goal for a first-pass yield of 99.99966%—a mark that Smith admits is “tight but doable.”

By continually measuring with precision laser guidance the lengths and widths of drill bits and other tooling involved in the board manufacturing process and changing them out on a rigid “preemptive” schedule, we mitigate the risk of producing inferior quality boards.

Overall, we spend millions of dollars annually in our CapEx budget to follow an aggressive preventative maintenance schedule. As a true vertically integrated company, we need to continuously reinvest in the company to stay globally competitive, where quality and efficiencies are concerned.

Quality Assurance, Dock to Dock

To get a genuine sense of the quality assurance program and process controls that are in place, one need only to venture to the company’s receiving docks. When materials are first received in, we perform inspections and tests on the raw laminate, including a series of measurements that check each panel for its copper and laminate thickness, rigidity, and more. These pre-board inspection measurements are essential as they are later compared to each plated panel using coating measurement



instrumentation (CMI) to ensure there is even plating on both sides of a board.

Overall, just in the manufacture of a bare board, there is a myriad of process controls in place to ensure the highest results. Everything from custom jigs that hold the panels in place during the drilling and routing stages, to the constant testing and analysis of wet chemicals, all the way through to the scoring of

the board itself—every operation is controlled by processes that have served the company well for more than three decades. As the old saying goes, “If it ain’t broke, don’t fix it.”

As boards move into the auto assembly area, the processes controlling quality are even more apparent and more abundant. Redundant first-piece inspections are the norm throughout the assembly area for each of the 1,000+ active part numbers that flow through the shop. With multiple mixed-technology lines (surface-mount and through-hole components) running three shifts per day, process controls and regularly scheduled equipment maintenance are critical to maintaining the high quality standards that customers have come to expect.

One of the biggest challenges in a busy shop is finding the time to perform maintenance on machines. Specialty equipment like

reflow ovens and wave solder machines have to be inspected and cleaned daily to ensure consistency in quality. Each piece of equipment has its own temperature profile, which is verified weekly to make sure it remains in compliance.

As all boards begin their journey through the assembly process, they are lasered with a barcode for tracking purposes. As the boards make their way down the lines, cameras and vision systems capture each pick and/or placement of each component. Dashboards are located throughout each assembly line that monitor missed insertions, missed picks, etc., and tabulate an overall reject rate.

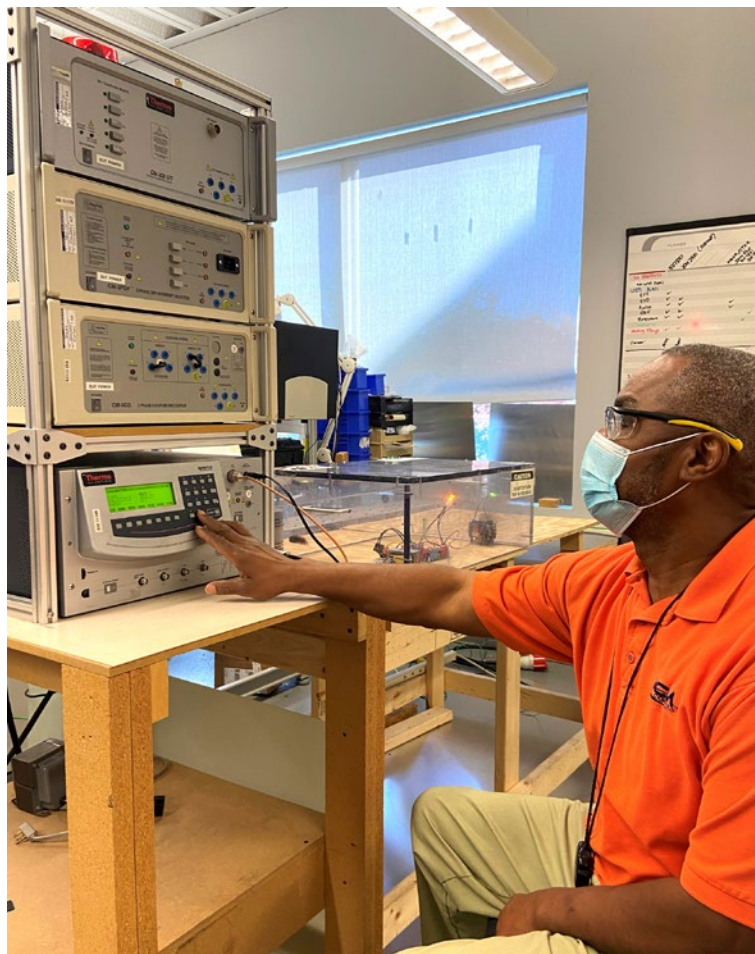
Here is where CM work can sometimes present a challenge to long-time captive shops that have traditionally standardized the component library to strategically leverage specific equipment to maximize shop efficiencies and control costs. As we migrate toward becoming a true CM, however, the company will undoubtedly be forced to expand its component library, thereby requiring additional layers of scrutiny as boards move between operations.

The Human Element

While modern technology is relied on heavily throughout the shop to maintain quality, there is still a human element that also comes into play, particularly in the assembly area. Each time we change out a component reel, we mandate that two operators inspect and verify that the component being selected is correct.

This same multiple inspection requirement carries over to several other areas on the assembly floor—including at the end of the flex line, as well as the solder wave—and requires an operator and supervisor sign-off. Holding multiple people accountable for the quality of a process and product has proven to be an extremely effective and reliable deterrent to making mistakes.

While everyone on the shop floor has some responsibility for the quality of the products



Operator Walter Hudson conducts an electromagnetic compatibility (EMC) test.

that leave the factory, the quality team is often placed under a customer's microscope and held accountable to the outside world. For this reason, we invest heavily in personnel to support our quality efforts.

We employ more than 20 full-time employees on the quality team, which represents more than 10% of overall first-shift production personnel. From QA auditors and engineers to test technicians and document control, the quality team is a highly visible force throughout the company's shop floor.

We typically test products to a Level 3 Production Part Approval Process (PPAP) standard, which is a modified version of the Automotive Industry Action Group (AIAG) format. It conducts and reviews the tests in parallel with all necessary agency approvals, with most products subjected to a minimum of 18 elements.



With the optical video probe (OVP), Operator Julio Placeres gathers detailed full-color images.

To this end, the company's Pre-Production Engineering and Reliability Department is one of the busiest and most important in the building. From conducting simple temperature and pressure tests to using its HALT chambers to perform highly accelerated life testing, the quality team is deliberate in its attempt to find manufacturing flaws that could ultimately compromise a product.

While several test technicians enjoy the practice of "blowing things up," they do so for much more than their own enjoyment. We want to ensure that controls "fail safely" when under duress. The company uses the internal data it collects to improve upon product designs that can help its branded products gain a competitive edge in the marketplace. It's all part of its Six-Sigma "lessons learned" approach.

Additionally, the team performs load testing and has an EMC chamber with a capacitive clamp, and even a salt spray chamber to replicate environmental extremes. Quality uses a standard design, validation, plan, and report (DVP&R) method for selecting the appropriate tests for each of our products. Only when reli-

ability and quality sign off on a product is it released into production.

The quality team has already undergone Six Sigma training with several members holding Black or Green Belts, and it is Smith's goal to have everyone at ICM Controls trained to at least a Yellow Belt level. Additionally, Smith invokes the Japanese term "Gemba" (meaning "the actual place") and encourages his peers and colleagues to join him on a "Gemba walk" of the production floor to see and learn first-hand where quality begins.

We continue to grow. As the company becomes more entrenched in the world of contract manufacturing, we will continue to invest in the tools and personnel that will cement our reputation as a manufacturer of products that are backed by American-made quality and reliability. **SMT007**



Kevin Jobsky is a senior marketing manager at ICM Controls Corporation.