



Some unexpected benefits of AOI for small electronics production environments



YESTech-Europe BX Benchtop Inspection System installed at Stonegate, Leeds, UK

YESTech-Europe Case Study

Some unexpected AOI benefits

Why Automated Optical Inspection offers particular benefits to small electronics production environments

Control system manufacturer Stonegate Instruments has found that their recently installed Automated Optical Inspection system gave the inspection flexibility essential to small, responsive production operations – and some added benefits besides.

The immediate benefits of Automated Optical Inspection (AOI) are by now well known within the electronics manufacturing community. AOI can achieve a throughput, consistency and reliability not achievable by manual inspection. In fact, manual inspection is increasingly no longer even an option in an environment where PCBs are becoming ever more complex and densely packed.

However AOI can offer other, more subtle benefits to production efficiency as well, as Stonegate Instruments discovered after recently installing their first fully-automatic AOI system. Based near the centre of Leeds, Stonegate specialises in designing and manufacturing refrigeration and temperature control, alarm and annunciator systems for the refrigeration and food industries. Stonegate has always carried out 100% inspection, but until their installation of a Nordson YESTECH BX benchtop AOI system early this year, this was an entirely manual affair. If we look at the nature of Stonegate's customers and their customer relationships, we can understand the benefits – including some extra to expectation – yielded by the new AOI regime.

In the thirty years or more since their inception, Stonegate has seen a steady increase in the complexity of the circuits they are called upon to produce. In the beginning, the demand was for simple PCBs to support relays and other electromechanical devices, which they could build using a single-sided manual layout and etch approach. Inevitably though, customers' demands for increased functionality led to microcontroller based solutions with much higher complexity and component density. SMT devices were used from the Nineties, and automated SMT production has predominated for the last seven years or so.

AOI includes change tracking

Control equipment users may have moved on from electromechanical relay type solutions, but they can often profitably re-use these early designs for many years, calling off relatively low quantities as and when they need them. This means that Stonegate frequently receives requests from customers to produce, say, 20 PCBs that they first designed and manufactured a number of years ago. The underlying PCB layout may be stable, but many changes could, and often did occur since the original production run. Maybe one of the original chips has undergone a design change – nothing major, but enough to call for an adjustment in the PCB's pad detail. Alternatively, the chip may have become obsolete, or a newer, better device may be available as a replacement. Sometimes a need arises to reroute some of the tracks on the PCB.

In the past, these factors imposed a need for a rigidly managed paperwork system – one that not only handled filing for the original design, but also allowed accurate tracking of all the changes that the above circumstances could invoke. Maintaining and accessing this system, and handling any filing queries that arose, imposed a significant overhead as different operators confirmed their inspection reference data and then checked production boards for compliance. By contrast, the AOI system automatically stores images of known good boards for reference at any later date – including variations arising from different chips, different markings on the chips, or modifications to the PCB track layout. The functions of change tracking and filing as well as of inspection have become automated.

Why flexibility is essential

Stonegate's flexible approach, supporting rapid changes between different low volume product runs, is important in facilitating their responsive service to their customers, with same day order fulfilment sometimes requested and delivered. With batch sizes of typically 10 – 100 units, the production profile often changes hour by hour. But this flexibility in a relatively small production environment means that work has to be shared flexibly, with every production team member occasionally performing inspection. And as inspection results, particularly for soldering, are often subjective rather than obvious go/no go decisions, inconsistencies between inspectors have always been a problem. A solder joint accepted by one inspector may be failed by another. Apart from judgement, differences in operators' eyesight quality can be considerable.

AOI irons out these inconsistencies. In setting up the reference board, tolerances such as size and position of solder pad areas can be defined and stored for later reference during tests by different operators. Then, operators with varying eyesight capabilities are presented with easily read computer images rather than having to peer through a magnifying glass to see the board and its possible faults. All of this adds up to far more consistent and predictable results.

But to maintain production competitiveness, throughput as well as consistency must be optimised. Once again, Stonegate's business pattern has a direct bearing on how AOI can contribute to its productivity. Because of Stonegate's tendency to process large numbers of small production runs, often in a single day, they regard modern AOI's facility for fast programming as highly important. They still use their manual inspection system for a single board, but turn to the AOI for any quantity. With programming times down to half an hour, depending on board complexity, this has become a viable option. After completing programming for each board, Stonegate reaps the real benefits of AOI, with the improvements to consistency and throughput available from an automated rather than a manual operation.

AOI purchasing factors

Shaun Evers, Managing Director of Stonegate, explained that he started shopping for an AOI solution during 2009. After becoming aware of the wide choice and price range on offer, he went to online forums to gauge opinion on the issues and favourites. The Nordson YESTECH B3 AOI was originally chosen for its good pedigree and specifications – but then the more highly specified BX was announced, which Stonegate purchased accordingly. “I was first attracted by its appearance and by its apparent benchtop-scale dimensions” Shaun explained, “Some rival offerings were trolley mounted, which would have created real difficulty within the production area planned for our AOI. I also liked the fact that, unlike some larger machines, the BX is not a cut-down version of an in-line system. Instead, it runs the same software, which gives us the flexibility that we had to have. Setup time is further reduced as Nordson YESTECH provides a key allowing us to prepare programs offline on another PC.”

Operating experience

After selection, the BX machine was installed by YESTech-Europe, who also carried out AOI training for Stonegate's production team. There is a learning curve to using the new technology, especially as all the production staff are involved, but this has been factored in to Stonegate's plans. Meanwhile the staff are comfortable with the system, and progress is being paced by the arrival of new boards for production. Sometimes, several inspection setups are programmed during one day. And, for inspection, the technical advances offered by the BX are already well appreciated. The four side view cameras capture faults, such as pins bent under certain ICs, which are invisible from above. This facility often eliminates having to remove the board from the AOI during inspection and lose its status within the inspection program. The main top view camera has a 5 MPixel resolution, allowing inspection of much smaller components than with any earlier AOI machine, as well as much faster throughput.

The BX can record images of every production board tested as well as the original 'known good' benchmarks. These can be used in resolving situations in which boards are returned with claims that they were shipped in a damaged state. This is another aspect to the AOI's role as an automated records database as well as an inspection resource.

"So far, we have focused on inspecting ICs, but we intend to cover resistors and other discrete as well. Meanwhile the BX has already increased the speed and accuracy of our inspection, without disrupting our production process – even at 100% inspection rate." Shaun commented. "It's difficult to quantify and measure the total ROI, but the benefits are there as the BX does its job and staff time is freed up. In my view, the pinnacle of what's possible is represented by a zero returns rate – and we now have the capability of achieving this pinnacle."