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Computed Tomography for Non-Destructive Investigation of Connectors

Case Study µCT

Computed Tomography for Non-Destructive Investigation of Connectors

Connectors appear in numerous electronic components. They are used in the industrial, automotive and consumer electronic sectors, as well as in medical, data and information technology. Increasing demand for proof of quality and safety highlight the importance of non-destructive testing processes, such as computed tomography (CT). Molex Ireland Ltd. has adopted the Viscom X-ray inspection system X8011 with CT function in its Shannon facility, to investigate their electrical connectors and track down failure sources on individual parts without having to destroy the test piece. Color section images and three dimensional volumetric displays document the results and convince customers and suppliers equally.

Molex Ireland Ltd.: Worldwide specialist for electrical connectors

Molex Incorporated, headquartered in Lisle, Illinois (USA), can draw on over 60 years experience in the production of electrical, electronic and fiber optic connection systems. They manufacture every conceivable type of industrial connector. In 1969 the company opened its first subsidiary in Japan; 1971 saw the opening of Molex Ireland Ltd. in Shannon as their first production site in Europe. The company places immense value on the quality of its products and with this claim, has rapidly established itself as preferred supplier to the automotive industries. Entry to global growth markets such as telecommunication, industrial automation technology and internal communication networks was equally strong. Today, Molex ranks among the leading manufacturers of connection products and systems worldwide, represented by 58 production sites in 40 countries.

F.l.t.r.: John Boland, Molex Ireland Ltd. and Dr. Udo E. Frank, Viscom AG, in front of the Viscom X8011

Computed tomography – The extension of classical X-ray inspection

The complexity of industrial products increases steadily alongside escalating requirements for safety and reliability. Rapid determination of defect sources for failures in the field permits fast reaction and strengthens trust between supplier and customer. Furthermore, innovation cycles within the company are ever shorter, so a new, fast and non-destructive investigative method for prototype qualification is in demand. Computed tomography reduces the time expended on these processes, improves the quality of technological products and guarantees their long-term reliability.

Conventional microfocus X-ray inspection reveals the inner structures of the test object with brilliant images, right down to the micrometer range. The more complex and compact the inner structures, the more overlays in the 2-dimensional projection X-ray image. Computed tomography unravels this image to deliver a complete volumetric display with non-destructively sectioned images, in any desired spatial orientation. In the process, a series of 2-dimensional images taken as the object is rotated through 360°, then reassembled to generate the 3-D interior structure of the test sample, within a very short space of time.

Computed tomography is a leading-edge 3-D inspection method; with it, the interior and exterior structure of objects can be analyzed in three dimensions. Material defects accompanying changes in density are portrayed and characterized according to type, geometry and position within the component. CT is used for reverse engineering, in-process inspection and examination of returns. Cast parts, electronic components, ceramic pieces and more are quickly and reliably inspected to determine their freedom from defects and dimensional accuracy. In numerous industrial sectors, this 3-dimensional advanced X-ray inspection method presents a new and previously unavailable glimpse into the interior structure of a test piece without having to destroy it.

Defect detection in connectors

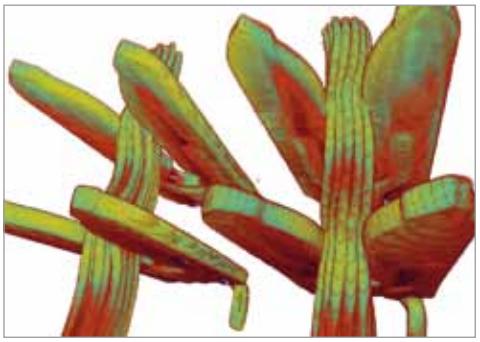
Molex Ireland Ltd. has established its central inspection laboratory for Europe in Shannon, Ireland; here, it conducts mechanical, electrical and environmental tests to ensure that their connectors satisfy the required standards (IEC, etc.). Product reliability is tested in a lengthy and demanding series of tests. Tracking down the root causes of failures also demands a great deal of effort – for automotive suppliers especially, one very strong argument in favor of Molex.

Previously, in order to disclose defects within a test piece, an arduous, destructive microsectioning process was employed. „A test piece was cast in epoxy; after hardening it was sliced away, layer by layer, until the defect was located. The result was a completely destroyed connector; sometimes even the defect was destroyed in the process. On occasion, cutting up the test piece failed to reveal flaws. And if we only received one or two samples from the customer, we simply could not perform destructive tests", asserts John Boland, test engineer at Molex Ireland Ltd. Thus started the search for a solution to this dilemma.

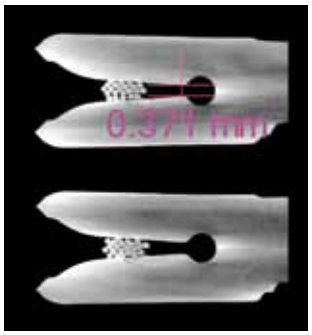
2006 brought Molex the necessity to inspect BGAs for a new customer. Because this connection technique requires X-ray technology to inspect it with positive reliability, Molex began to evaluate X-ray inspection systems. By this time, Molex had accumulated very good experience with their AOI inspection system S3088AV from Viscom; proven performance capability, support and service from the local distributor Maxem Engineering Ltd. contributed to the decision for the X-ray system X8011 from the same supplier. In addition to manual and fully automatic BGA inspection, the X8011 provided excellent CT images that the microsection images could not come close to. „Each of us was overwhelmed when we saw the CT images for the first time and we quickly agreed: we need this and we want to have this machine", recalls John Boland. „The greatest benefit of the X-ray system is that the testing is non-destructive. Daily we receive new applications; the CT is already utilized after normal work hours, as we often run CT scans in the evenings.

CT analysis as sales argument

The major plus point for computed tomography is the detailed problem assessment it allows. John Boland: „Sometimes we only have one piece available for testing so a destructive test is out of the question. With the CT, however, we can quickly determine whether the difficulty should be searched for within the connector itself, or whether the problem is due to other components such as the cable."



µCT reconstruction of wire bundling in crimped connections



Distance measurement in a µCT-reconstructed contact level of a crimp contact non-destructive 3-D slice

Insulation displacement technology (IDT) connections (wire bundle circumference = 1 mm)

On one occasion, when a production defect was discovered too late, the bulk of the production run could be salvaged by sorting out the defective parts with help from the X-ray system: „The time spent on the X-ray system was less expensive than scrapping the parts, or any other option available to us."

John Boland also points out, the CT system presented wholly unexpected advantages as a sales tool. „As soon as the Marketing Department saw the CT images from our new inspection system, they jumped on them and distributed them to all our sales colleagues. I can assure you, our capabilities for CT analysis have won us many new customers. Naturally we intend to further expand this advantage." Moreover, the CT system is increasingly employed in product development, where it facilitates rapid feedback to accelerate the development process.

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„As soon as the developer has a prototype available, he inspects it with CT and can resume development based on the test results, because the prototype is not altered by the CT. We have received great benefits from the new CT system; it has already saved us a great deal of money. The CT system has brought us much more than we could have expected", states John Boland.

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