To Test or To Inspect, What is the Coverage?

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As a Test Engineering Community we have been fighting to standardize on a method to provide a realistic means to calculate board coverage at test. We have made progress with certain equipment types like In-circuit test (ICT), but have been unsuccessful to date encompassing the full spectrum of test and even less successful at accommodating the full manufacturing process. Bottom line is that we can calculate test coverage for a single test process based upon the capability of the equipment that we are using, but we can’t calculate defect coverage for all test processes.

In order to accommodate all tests, one first has to ask them self, what is test? Test has typically been an electrical inspection that is performed to verify a device or an assembly’s specification.

Test as an inspection, blasphemy or reality?

If we look at what really is important, other than the cost factor in manufacturing, it is the quality of the product one produces. If a company were to produce product perfectly, there would be no reason to test or inspect to a standard. If it truly is quality, why hasn’t the industry standardized on a quality specification, and why has the industry not come up with a mechanism to calculate defect coverage throughout the manufacturing process for a given board? This would include all inspection points in the manufacturing process, like manual visual inspection, ICT, Automated Optical Inspection (AOI), Automated X-Ray Inspection (AXI) and Functional Test. Maybe the answer to this question is because we, as a test centric community, have not fully defined what a defect is, before we have determined how to measure it.

Test is only an inspection point in a very large process, which is designed to add electrical and some IPC Quality related coverage to the whole manufacturing process. The community should be looking at expanding coverage to better indicate overall quality of product in the manufacturing process. At a bare minimum, we should use the same standards as the rest of the manufacturing process, like IPC-610-C to measure it.

If a board passes electrical test, which theoretically has 100% functional coverage, is it defect free? It is our experience, and there are many examples, that it is not. Looking at this from a cost standpoint, reworking a cosmetic defect can be the same or more in some cases, than removing a simple solder short from a board.

Electronic Manufacturing Service providers and Original Equipment Manufacturer’s build to a quality specification. This is the contract to which we manufacture. These specifications have manufacturing defects well defined in order to give guidance to manual visual inspectors. Innovations, such as Agilent’s PCOLA/SOQ account for most type defects, and is definitely a step in the right direction, but still does not cover all quality aspects of the process. There is also another factor that one needs to account for. Communication between manufacturing, quality and test must be in the same language. Being that manufacturing and quality already speak the same language, test should follow with the addition of an electrical attributes category of defects. With a common standard like defect coverage in accordance to IPC-610-C, the same or different equipment technologies can be compared directly against one another, to provide a best fit test strategy. Another added benefit is an efficiency gain in trouble shooting root cause for a given defect. For example, if a test station detects a simple short, there is much time is lost in determining what the short actually was. Was the short a bridge between two nets? Was the short an electrically damaged component or was the short a component skew? Having the repair technicians following a quality standard will reduce the amount of time to correct the issue, which caused the defect.

Contrary to historical beliefs, test is an inspection and in today’s manufacturing environment, more pressure is being put on test to catch non-electrical inspection type defects. Progress on such platforms such as AOI, and AXI, has lead to the solution of additional defect coverage through test and is bridging the two disciplines, but it is still not enough to properly gauge defect coverage for a given product.