THE SCIENCE OF BOND TESTING

All Semiconductors and All Electronics are a Series of Bonded Interconnects
In most products there are Hundreds if not Billions of Bonds
Good Bond Quality is Essential

As with many things for most of its life bond testing has evolved. **The Science of Bond Testing** replaces this evolution with a more scientific approach and understanding. It has been shared and applauded globally by many leading companies and industrial conferences. This article aims to give you an introduction to it.

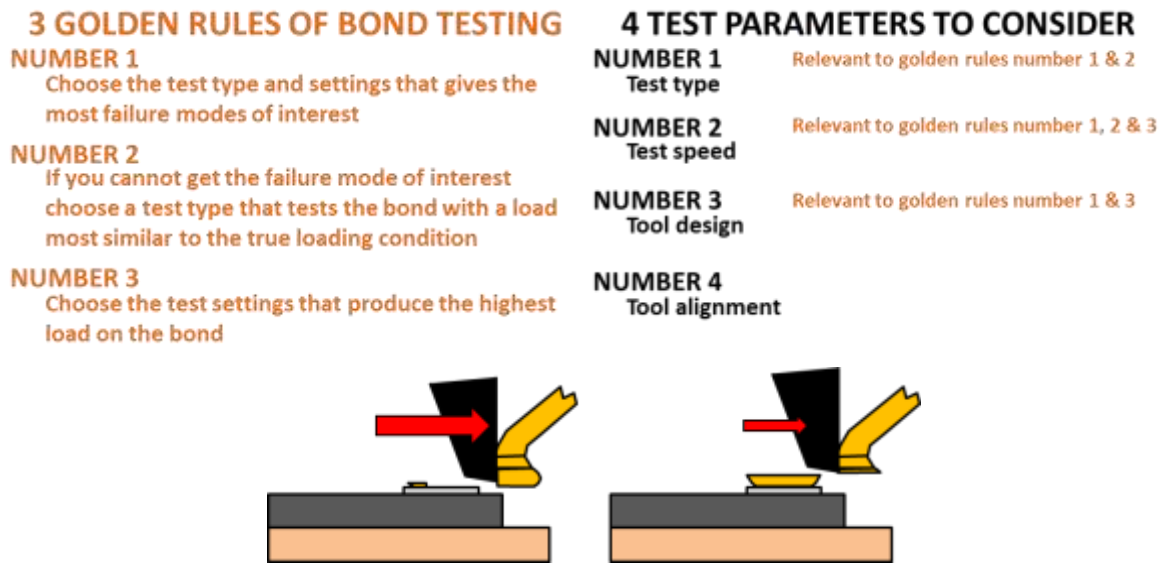
The success of the very latest developments in semiconductors and electronics, together with those that went before, depend on good and reliable bonds. Because of this the Bond Strength Tester has become an invaluable tool. Early tests were relatively simple but bond testing developed in line with the industry leading to the methods currently available. At the same time test standards were developed by individual manufactures and consortiums with common interests. This development has up to now been an evolution. This meets most of what we think we need but lacks any common understanding of the fundamental objectives. The Science of Bond Testing is derived from decades of experience designing bond tests for the widest range of applications. It elevates bond testing to a science that takes you through the process of designing the optimum bond test for any process. For example it shows you how to decide if you should use a pull test or a shear test, what speed to test at, what the best tool shape is. You may wonder why tests are done a certain way. The Science of Bond Testing will help you to both understand and challenge accepted practice. It is essential to anyone who relies on Bond Test data.

Electrical and thermal bonds are such an integral part of electronic and semiconductor construction that they may often be taken for granted. Modern construction methods employ a myriad of bonding processes, each one a vital step in the construction of the final product. A typical consumer product such as a laptop computer or mobile phone may contain hundreds of thousands of bonds yet if one fails it will probably result in a system breakdown.

Bond strength measurement is far from the highest profile part of the industry but it has matured with it, in some cases unnoticed. This doesn't alter the fact that a precise knowledge of bond strength quality measurement during product design and subsequent manufacture is directly related to product success and profitability. To serve this need a modern bond test system must be capable of accurately testing bond wires, solder bumps, dies, leads, chips, lids, films as well as other applications with strengths varying from a few grams force to hundreds of kilograms force. The Science of Bond Testing analyses the roots of bond testing and teaches what is required to design and perform the optimum bond test. When considering the optimum bond test there are an infinite number of decisions to be made; to mention but a few, which type of test, pull or shear, what test speed, what tool design, where to apply the test load. How do you decide what to do?

At the core of The Science of Bond Testing are **3 Golden Rules** and **4 Test Parameters** that guide you through this otherwise confusing maze.

To illustrate the difference in this new approach there is no better example than Golden Rule Number 1 and what is the best shear height to use.



The first step is to ask, what are we trying to achieve with the bond test? This might sound obvious but is it? The most important question to answer is, what is the **Failure Mode of Interest**? If you do not know precisely what you want to measure how can you possibly design the test to achieve it? In the case of Gold Ball Shear the target failure mode is often Gold shear. This might be what we get but it is not definitely not what we want. We are not interested in the strength of Gold! We have insufficient space in this article to fully explain what the Failure Mode of Interest is but let's simplify and say we want a particular **bond failure**. Golden Rule Number 1 tells us,

Choose the test type and settings that gives the most failure modes of interest

There are many different opinions on what the shear height should be, like for example, 10% of ball height or a specific dimension. These may or may not be derived from an appropriate understanding but neither are the fundamental answer and both are capable of promoting a false truth. The best shear height is the one that produces the most failure mode of interest. In the same way the first Golder Rule applies to all of the 4 Test Parameters.

As your understanding becomes more structured you learn that getting the Failure Mode of Interest is not easy or even possible, so what then? This is where the next 2 rules come in. The Rules are our objectives and the Parameters the design options, structured together they are The Science of Bond Testing.

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