Interplex

Press Fit Tech Bulletin

Mechanical Force Analysis for Press Fit Applications

The following three primary requirements must be addressed for verification of press-fit zone designs:

- Plated Through Hole integrity (cross-section analysis)
- Mechanical Forces (insertion & retention forces)
- Contact Resistance (electrical measurement)

Before considering the use of any press-fit zone design, it is critical to know that it has been through and has passed a comprehensive environmental test program based on IEC-60352-5 requirements.

This Tech Bulletin addresses the second of these key factors: Mechanical Forces

Maintaining sufficient retention force is absolutely critical for the long-term operational integrity of any press-fit interconnection. Therefore press-fit zone designs must be tested to meet the application's minimum retention force requirements and operating environments using IEC-60352-5 requirements as a baseline guide. Testing both before and after multi-axis environmental stress includes but is not limited to: thermal shock, high/low temperature exposure, vibration, climatic cycling, temperature and humidity cycling and other similar test requirements. In addition, to assure a wide process control window for assembly and to minimize deformation to the plated-through hole, it is important that press-fit zone designs conform to maximum insertion force parameters.

The analysis of insertion and retention forces should be performed for both minimum and maximum plated-through-hole (PTH) size specifications. Retention force must be measured for both pre and post environmental stress conditions.

The whisker plots in Figure 1 show insertion and retention forces for an Interplex press-fit interconnect (0.80mm) in a test PCB with immersion tin plating.

IF = Insertion force,
RF 7-DAY = Retention force after 7 days from insertion
RF POST-ENVIRO = Retention force after completion of environmental tests

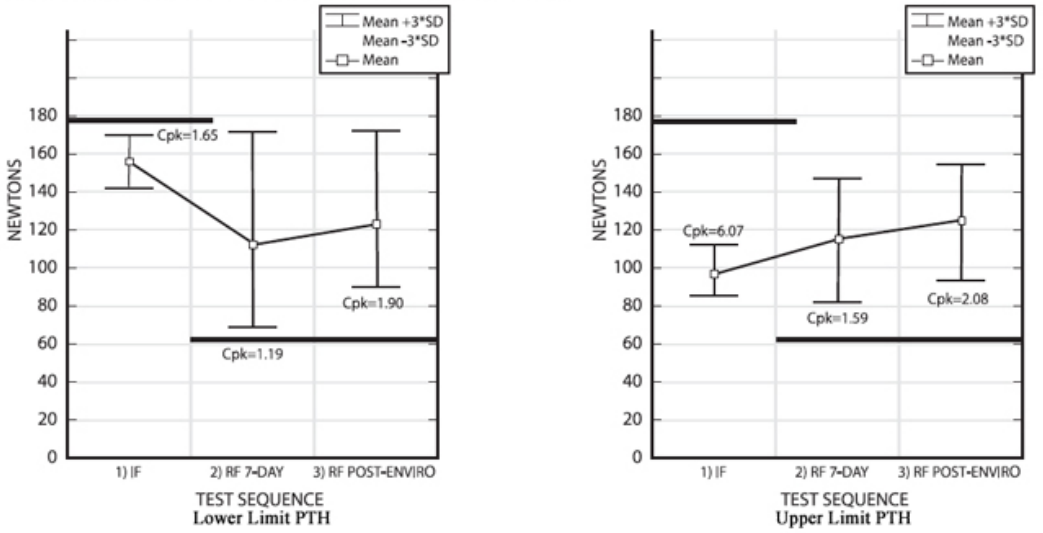

Figure 1 - Insertion & Retention Force Analysis - Immersion Tin Plating

Figure 2 below shows a comparable insertion and retention force analysis for the same Interplex press-fit 0.80mm pin inserted into a test PCB with immersion silver plating.

IF = Insertion force,
RF 7-DAY = Retention force after 7 days from insertion
RF POST-ENVIRO = Retention force after completion of environmental tests

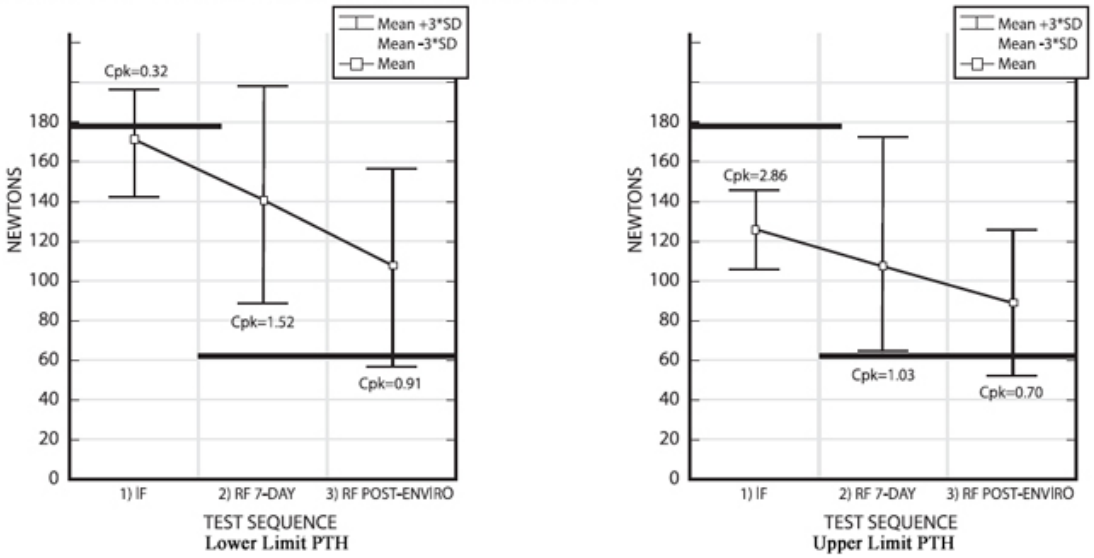

Figure 2 - Insertion & Retention Force Analysis - Immersion Silver Plating

Tables 1 & 2 below show the specific data for mechanical force analysis of the 0.80mm press-fit pin in immersion tin and immersion silver plating respectively. Similar data is also available for the Interplex 0.64mm press-fit pin.

Table 1: *Summary Test Data for* ***Immersion Tin*** *PCB*

	Insertion Force (N)		Retention Force 7-Day (N)		Retention Force Post-Environmental (N)	
PTH Size	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Maximum Value	169.9	107.2	136.1	138.8	141.0	137.9
Mean Value	155.2	98.3	112.1	113.9	122.3	124.6
Minimum Value	140.6	81.4	75.2	65.8	87.2	64.1
Sample Size	174	174	72	72	72	72

Table 2: *Summary Test Data for* ***Immersion Silver*** *PCB*

	Insertion Force (N)		Retention Force 7-Day (N)		Retention Force Post-Environmental (N)	
PTH Size	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
Maximum Value	179.7	140.1	167.3	138.3	139.7	107.2
Mean Value	172.6	126.8	139.7	107.6	105.4	88.1
Minimum Value	147.2	105.0	73.8	63.2	59.6	52.0
Sample Size	288	288	144	144	144	144

Summary of Mechanical Force Analysis Results

The mechanical force analysis confirmed that the 0.80mm press-fit interconnect conformed to all of the required insertion and retention force specifications, including both pre and post-environmental stress testing.

Key results for the 0.80mm pin are as follows (similar results are also available for the 0.64mm pin):

- The maximum insertion force measured was 179.7 N (40.4 lbf) and occurred at lower limit hole size condition in the Ag plated PCB.
- The minimum retention force was 52.0 N (11.7 lbf) at upper limit hole size in the Ag plated PCB after environment conditioning.
- The minimum retention force prior to any environmental testing was 63.2 N (14.2 lbf) in the Ag plated PCB.

In general, the immersion tin samples have higher retention forces than the immersion silver samples. This is due to a cold-welding between the tin finish on the pin and the tin on the PCB. This cold-weld effect is not apparent with immersion silver printed circuit boards because of dissimilar finishes between the PCB and the press-fit pin. However, the press-fit interconnects passed all requirements for both immersion tin and immersion silver, thereby providing a comprehensive process window for use across a wide range of applications. Gold pin to gold PCB designs have also been tested and qualified.

Mechanical analysis of insertion and retention forces is one of the three key techniques used to assure the integrity of solderless press-fit interconnects. The other two test areas, Cross Section analysis and Contact Resistance are covered in separate Press-Fit Tech Bulletins.

More information regarding Press-Fit technologies and products can be found on the web by visiting www.interplex.com/pressfit or by calling (718) 961-6212.