

## Contact Resistance 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 third of these key factors: Contact Resistance**

Maintaining contact resistance within specified parameters is a critical performance factor for the success of any press-fit application. Therefore all press-fit zone designs must be tested to meet the specific application's contact resistance requirements within the targeted operating environments.

Resistance testing should be conducted both before and after multi-axis environmental stress, which includes but is not limited to: thermal shock, high/low temperature exposure, vibration, climatic cycling, temperature and humidity cycling and other similar test requirements. The test criteria should include the specified test current level and the maximum change of contact resistance for each application, using IEC-60352-5 requirements as a baseline guide.

### Contact Resistance Measurement Methodology

IEC-60352-5 stipulates that contact resistance testing should be carried out using the millivolt level method as specified in IEC 60512-2-1. In addition, care must be taken regarding the resolution of the micro-voltmeter as well as corrections for thermo-electrical voltage. The measuring points should be made as close as possible to the interface in order to minimize the bulk resistance. Figure 1 shows an example of the test arrangement and measurement points.

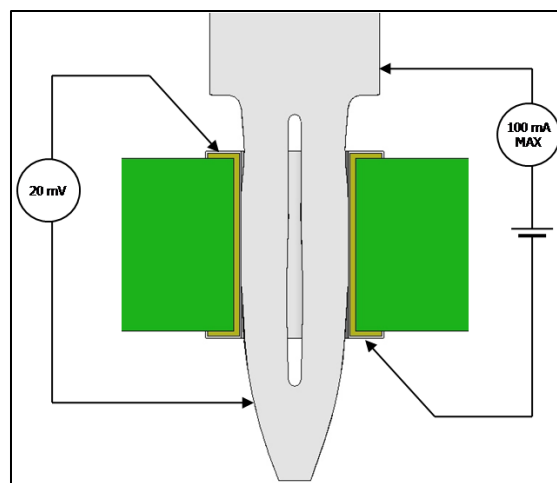


Figure 1 – Test arrangement for contact resistance

## Environmental Stress Factors with Pre & Post Testing of Interface Resistance

It is important that comprehensive testing of the interface resistance be conducted before and after a series of different environmental stress conditions. Figure 2 illustrates a representative example of test flow procedures that have been used for the qualification of Interplex press-fit pins. (Test flow procedures should be tailored to meet the specific requirements of each press-fit application.) IR indicates the Interface Resistance testing points in the process. IR testing is first conducted after initial insertion to establish the baseline and then additional IR tests are also conducted at specific points after random vibration, high-temperature, temperature/humidity, and mixed-gas flow conditioning in order to determine the amount of resistance change from the baseline measurement.

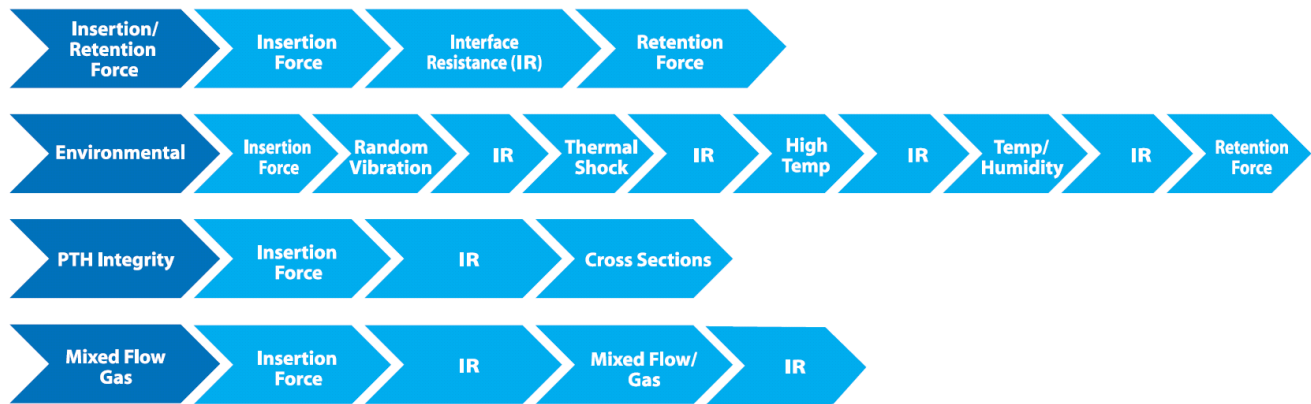


Figure 2 – Resistance test points within the environmental conditioning process flow

## Summary of Contact Resistance Analysis Results

IEC 60352-5 specifies that the maximum change of contact resistance shall be less than 0,5 mΩ for each test phase for press-fit components; however it further stipulates that the total contact resistance and maximum change limits will be established by the manufacturer's component detail specification and the specific requirements for each press-fit zone application.

While some press-fit component specifications allow total contact resistance as high as 3.0 mΩ, in actual practice, the maximum total contact resistance for press-fit interfaces should be much tighter than the IEC 60352-5 specification limits. In particular, automotive applications require a total contact resistance of less than 0.5 mΩ. Based on extensive research, development, testing and applications experience with press-fit technology, Interplex has determined that any acceptable press-fit zone application should consistently conform to a maximum total contact resistance limit of 0.5 mΩ.

The table below shows test results for contact resistance analysis of the Interplex 0.80mm press-fit pin, with the specified contact interface resistance increase limit of 0.5 mΩ. (Similar data is also available for the Interplex 0.64mm press-fit pin.)

Test Item	Acceptance Criteria	Testing for:	Result
Random Vibration	Increase of Interface Contact Resistance < 0.5 mΩ	Movement of contact points, fatigue	Pass
Thermal Shock		Movement of contact points, fatigue	Pass
High Temperature		Stress relaxation of Terminal & PCB	Pass
		Growth of oxide film	
Temp/Humidity Cycle		Growth of oxide film	Pass
Mixed Flowing Gas		Effectiveness of barrier plating	Pass

Table 1 – Interface Resistance Test Results (0.80mm press-fit pin)

All samples successfully passed all environmental tests as shown in Table 1. The maximum press-fit pin interface resistance measured was 0.12 mΩ after environmental conditioning. This value is well below the automotive application design requirement of 0.5 mΩ maximum. (Similar results are also available for the Interplex 0.64mm press-fit pins.)

Contact Resistance electrical measurement and analysis 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 Mechanical Force analysis 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](http://www.interplex.com/pressfit) or by calling (718) 961-6212.