REEDHOLM

# SUPPORT NOTE

**SN-104**

# Ceramic Load Board Strength

## Introduction

The purpose of this experiment was to demonstrate that ceramic substrates could be used as load boards without concern of breakage. The machined ceramic substrates are expected to withstand a breakage force that is an order of magnitude larger than that required for device insertion.

The strength of sintered alumina ceramic is dependent upon the thickness, material characteristics and length of the board that is unsupported. Laser processing of the ceramic boards introduces stress that weakens the material. Given the difficulties in calculating the strength of machined ceramic, an empirical method of determining ceramic board strength was chosen for this experiment.

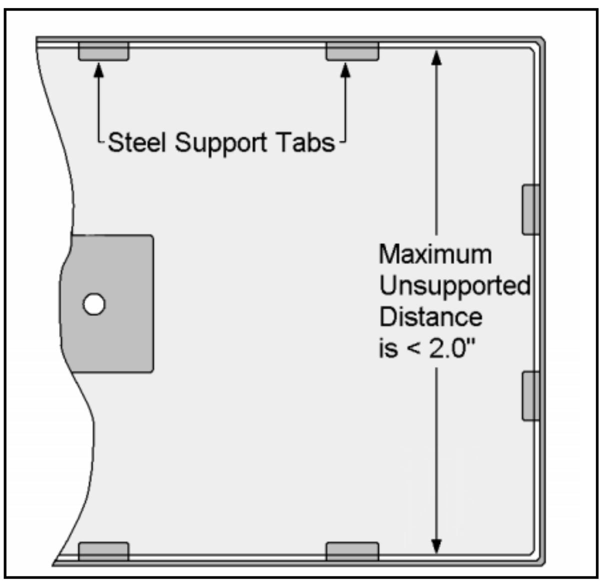


Figure 1 - Load Board Carrier

Reedholm load boards take advantage of the high volume resistivity (>$10^{12}$ ohm-in at 300$^{o}$C) and flexural strength (>400 Klb/in$^2$) of ceramic. Ceramic substrates are laser processed to allow up to 32 devices per experiment. Devices can be packaged in 0.30", 16-pin or 0.60", 24-pin dual-in-line packages. Five receptacles per DUT are sandwiched between two 0.040" thick ceramic substrates for four terminal measurements and extrusion monitoring. Bonding configuration is customer selectable.

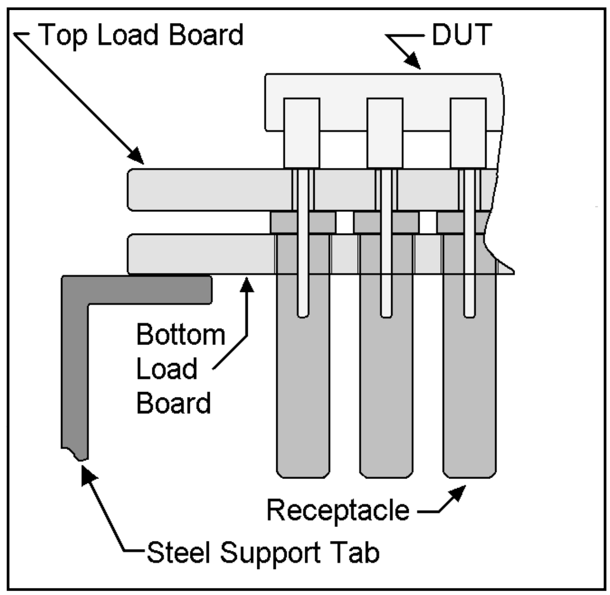


Figure 2-DUT Insertion Cross Section

## DUT Insertion Force

The force required to insert a device is determined by the beryllium nickel contacts within each receptacle and the diameter of the packaged part pins (0.015-0.025”). Over time and temperature, the force required to insert one device with typical 0.020” diameter pins is reduced from about 3.5 pounds to 2.0 pounds. The force required to insert devices with the 0.025” maximum diameter pins will change from about 7.5 pounds to less than 4.0 pounds.

## Force Comparison

Verification was made that the insertion force required for load boards matched the contact manufacturer’s specifications. This was done using a general purpose shipping weight scale as the measurement tool. Since an error as high as 10% was considered allowable, no effort was made to recalibrate the scale in advance of the experiment. A load box was placed on the scale, and the scale was zeroed. Packaged parts with 0.020” diameter pins were inserted into all DUT locations on the load board. The scale was monitored as force was slowly increased until the devices were fully seated. As expected, measurements varied between 3.0 and 3.5 pounds.

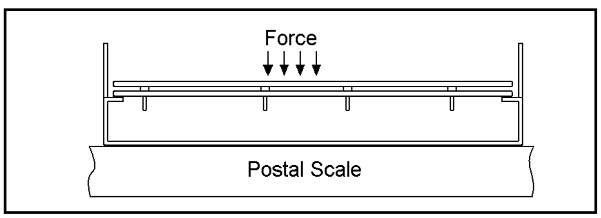


Figure 3 - Diagram of Force Test

Reedholm employees were instructed to supply the maximum reasonable amount of force that they would use to install any packaged part regardless of the PCB material. Using the same scale as before, force measurements ranged between 12.0 and 18.0 pounds. The same employees were then asked to apply the maximum amount of insertion force to the DUT while inserting it into a load board. Only two fingers were used to install the DUTs. Thus, the amount of force that could be generated was greatly limited and representative of how devices are installed in the field. Reedholm female employees were able to generate a maximum of only 25.0 pounds of force, while male employees generated about 35.0 pounds of force. The boards did not break at this force level. Because the force would have to be unreasonable and beyond normal expectations, the experiment was concluded with no effort given to determine at what point the ceramic load boards would break.

## Conclusion

The maximum amount of force that one could generate while inserting a device is an order of magnitude higher than the force required to insert a device. Yet no breakage occurred. Trying to apply more than 20.0 pounds of insertion force is highly unreasonable and can only be considered a destructive act.