

# IMPROVED Z-DRIVE

2006

The Z-Drive is a mechanical assembly that functions to move wafers on a chuck top (in the Z-axis) towards the pogo pins of Automatic Test Equipments (ATEs).

The current PZ-9 design had several reliability issues due to poor design and lack of considerations in tolerancing stackups. Additional factors including manufacturing variability and environmental conditions further complicate the problem and attributes to multiple die damages on customer wafers.

I was tasked to redesign the PZ-9 Z-Drive to rectify the design errors and provide a pragmatic solution that is both manufacturable and reliable.

**Research**

By studying the field samples and performing design analysis, an understanding of the problem was formed; that the bearings were not sufficiently preloaded during installation and/or service whereby the bearings were subjected to extreme thermal cycles and constraint vibrations. Further tolerance stack analysis concluded that the design dimensions were not optimized to cover variability in both manufacturing and service environments.

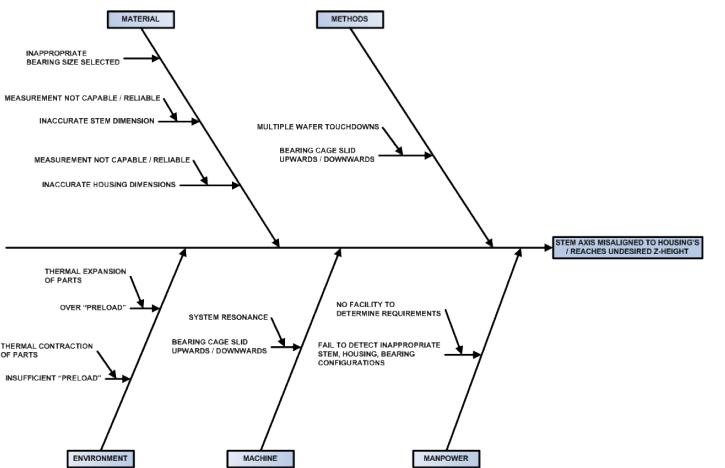
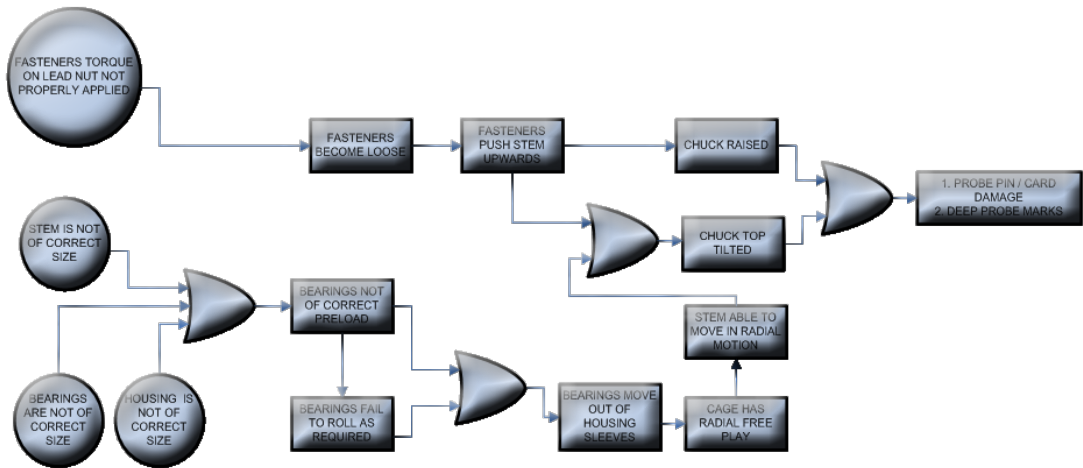
**Design and Documentation**

A number of concepts were evaluated based on fail-safe versus safe-to-fail design approaches. Throughout the design process, proper preload calculations and tolerance stack analysis were made, ensuring that the bearings or racers do not overload within the manufacturing specifications.

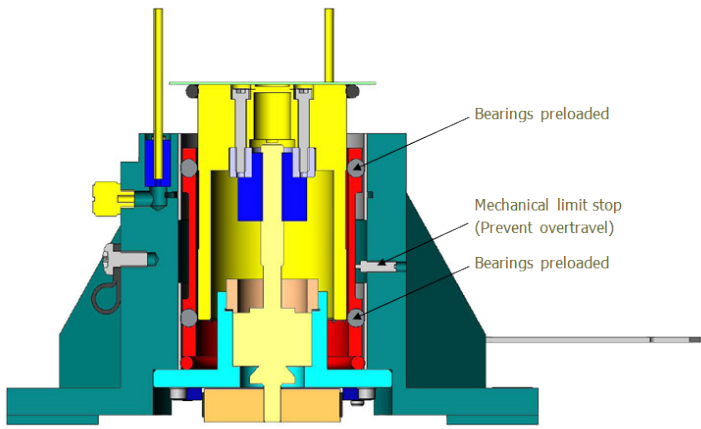
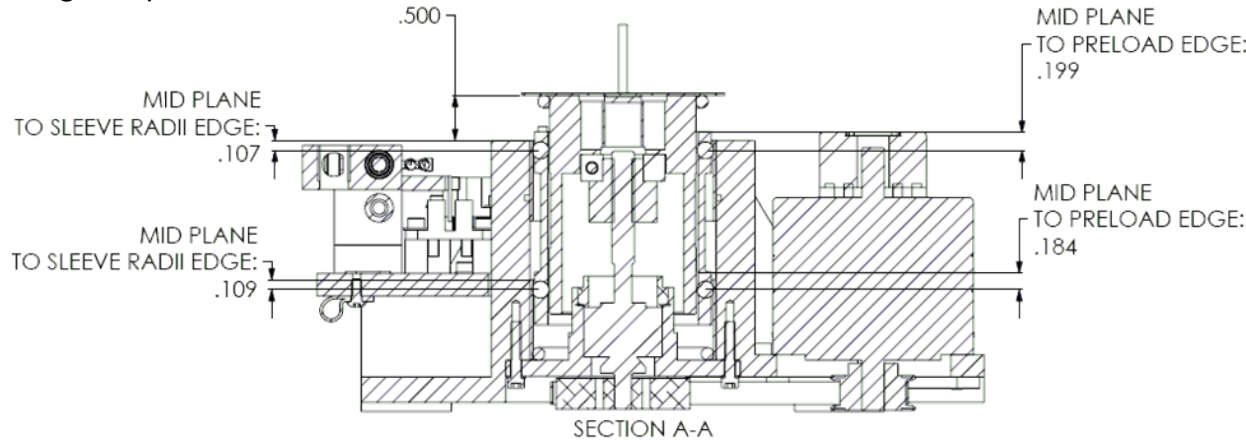
**Validation**

Several prototypes were built and the new design was validated in both highly accelerated life tests (HALT) and fatigue stress tests. Results of these tests helped me understand the location of the weakest link of the design; and prove the survivability and feasibility of the new design in extreme field conditions. The new design was then adopted for manufacturing.

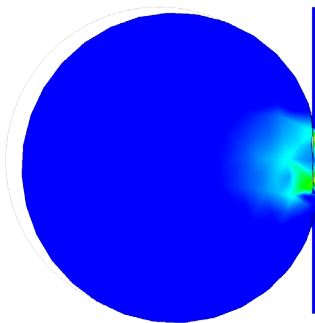
## Cause Analysis



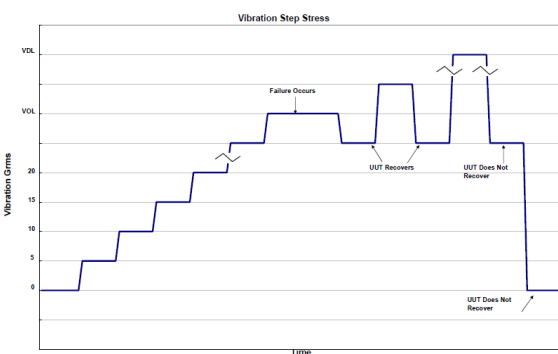
## Design Proposal



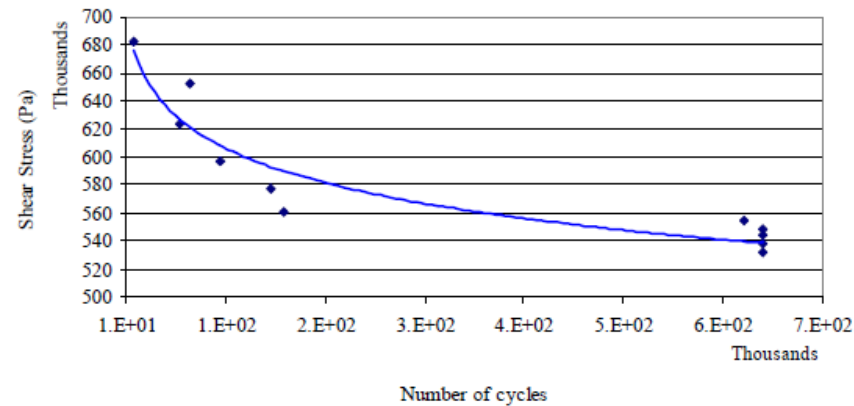
## Hertzian Stress Analysis



## HALT Tests



## Fatigue Stress Testing



## Design Documentation

