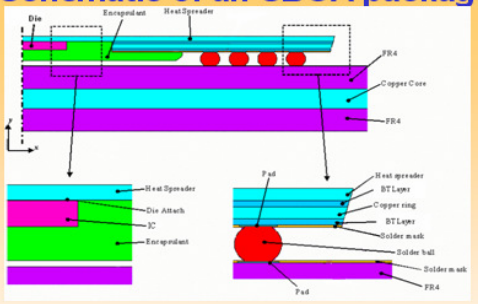
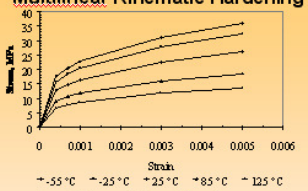
Reliability Assessment of a PBGA package

Schematic of an SBGA package



Solder Material Modeling (62Sn/36Pb/2Ag)

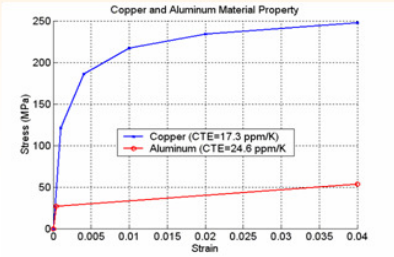
Multilinear Kinematic Hardening

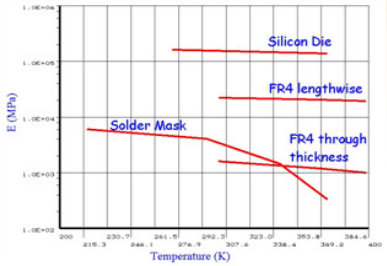


Secondary Creep Equation:

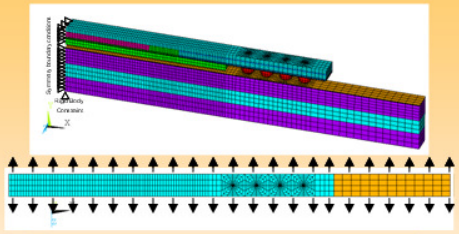
$$\dot{\varepsilon}_s = 9.10\times10^{-3}\,\sigma^{7.67} e^{-\left(\frac{79.4}{(8.314\times10^{-3})\times T}\right)}$$

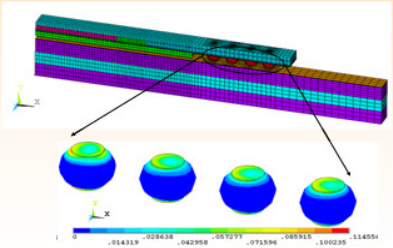
Silicon, Metal, and Polymer Models





Results From Numerical Simulation





Accumulated inelastic strain energy density contours for the SBGA 352 package

Number of cycles to failure = N_f

Number of cycles for crack initiation = N_0

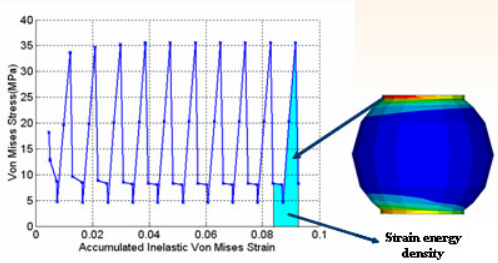
Number of cycles for crack Propagation = N_p

Diameter of the solder ball along the copper pad = a

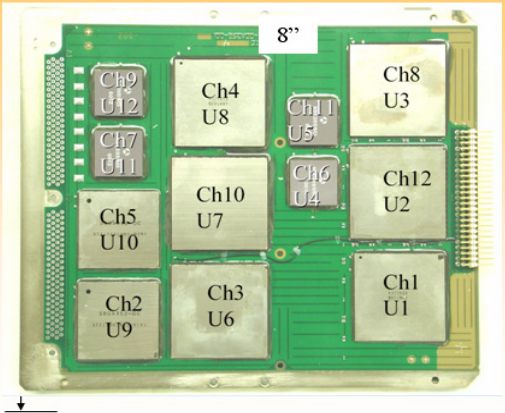
$$N_o = C_3 \Delta W_{ave}^{\ C_4}$$

$$N_p = \frac{a}{da/dN} \quad where \frac{da}{dN} = C_5 \Delta W_{ave}^{\ C_6}$$

$$N_f = N_o + N_p$$



Test Vehicle Description

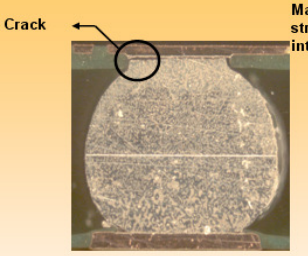


- **Intended to be used in Military Applications**
- **Underfilled to prevent moisture condensation**
- **Subjected to MIL-STD 883E condition B temperatures; -55°C to 125°C**

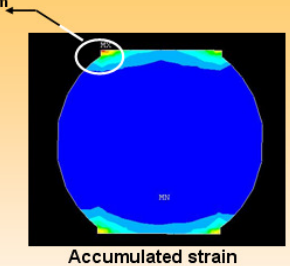
Locator	Type	Package size, mm
U1	432 SBGA	40X40
U2	560 SBGA	42.5X42.5
U3	560 SBGA	42.5X42.5
U4	255 CI-CGA	21X21
U5	255 CI-CGA	21X21
U6	560 SBGA	42.5X42.5
U7	560 SBGA	42.5X42.5
U8	432 SBGA	40X40
U9	352 SBGA	35X35
U10	352 SBGA	35X35
U11	255 CI-CGA	21X21
U12	255 CI-CGA	21X21

- SBGA - AMKOR
- CI-CGA - Thomson-CSF

FE Validation



Cross-section of the solder



Accumulated strain contours in the solder by modeling

The location of the observed crack in the outermost solder ball after the ATC matches well with the predicted location

Predicted Results (N50%)	Experimental Data (ITRI) (N50%)	Experimental Data (GT) (N50%)
3630 cycles	3300 cycles	3462 cycles