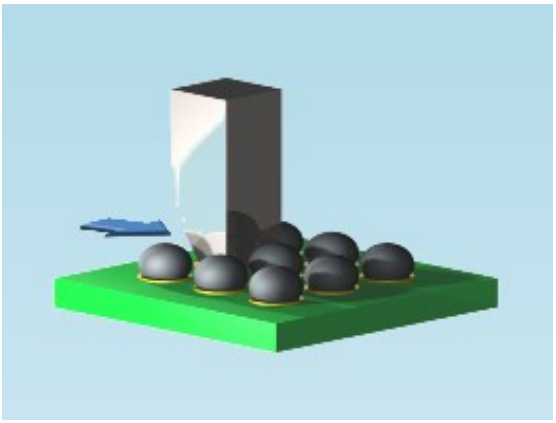
CREEP TESTING

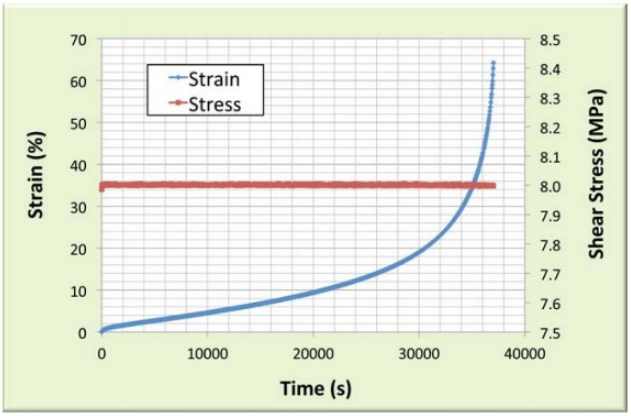
ADVANCED TECHNOLOGY FOR RESEARCH & INDUSTRY

KNOWLEDGE BASE FACT SHEET

- SCOPE: What is Creep Testing?

Creep testing addresses the measurement of the dimensional changes that occur with time when materials are statically loaded. Creep measurements are important for solders, polymers and adhesives where large strains can develop over time and strain rates are very temperature sensitive.





The left image shows creep testing on solder balls, the right image shows creep data for a 60/40 SnPb solder.

Software can be used to perform a shear creep test using shear cartridges. Although these cartridges can be used to perform elevated temperature shear testing, it is not recommended for a long period of time.

Creep testing can be performed on individual solder balls, test structures or components that are soldered or glued to a substrate. Without a defined test structure this measurement is largely comparative, but never the less provides valuable feedback on the impact of material changes.

The main parameters are the test load and end point condition.

Test Load: The load that will be applied to the shear tool during the test; active feedback ensures this load is maintained as the sample deforms.

End Point Condition: The completion of the test can be time-based or depend on sample deformation. The end point conditions are as follows:

- ***Stop after duration:*** The system will hold the test load against the sample for the specified duration
- ***Stop after displacement:*** If the XY table moves the specified displacement value the test will finish
- ***Stop after load detection:*** If the load cell measurement is met, by using an internal sensor (external is also possible) the test will stop. This is measured in %.

Displacement can be measured using the stage encoder (Internal Sensor) or by an external transducer (External Sensor). If an external transducer is used it should be positioned to measure the relative movement between the tool tip and sample or work holder.

WHY USE ELEVATED TEMPERATURES FOR CREEP TESTING?

Creep in metals is governed by thermally activated movement of dislocations. At very low temperatures, where creep does not occur, metals work-harden as increasing numbers of dislocations are blocked by other dislocations, grain boundaries and precipitates. At higher temperatures, dislocations are able to work around these barriers by climbing onto new glide planes and so the material can continue to deform.

WHAT TEMPERATURES SHOULD I BE CREEP TESTING AT?

As a rule of thumb, creep is important for temperatures above half the materials absolute melting point in Kelvin. For solder, room temperature (20°C = 293°K) is greater than half the melting point (188°C = 461°K for 60/40 Sn/Pb). It is usual to express temperature (Homologous temperature) as a fraction of the materials absolute melting point. 60/40 solder at room temperature has a homologous temperature of 0.64.

Reference Material: Nordson Dage