INTERNATIONAL STANDARD

ISO 899-1

Second edition
2003-06-01

AMENDMENT 1
2015-03-15

Plastics — Determination of creep behaviour —

Part 1:
Tensile creep

AMENDMENT 1

Plastiques — Détermination du comportement au fluage —

Partie 1: Fluage en traction

AMENDEMENT 1

Reference number
ISO 899-1:2003/Amd.1:2015(E)

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The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

Plastics — Determination of creep behaviour —

Part 1:
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Page 11, Annex A

Change A.2 with the following:

A.2 Creep at elevated temperatures

The influence of physical ageing on creep behaviour is more complicated when measurements are made at elevated temperatures following a storage period at a lower temperature. It is well known that an increase in temperature leads to an increase in molecular mobility and thus a higher rate of creep deformation. In addition to this, changes in molecular structure take place on heating that are associated with a reduction in the physical age of the polymer and lead to a further increase in mobility. Creep deformation at the higher temperature is, therefore, more rapid than expected from the temperature increase alone. With increasing time, physical ageing is reactivated, and the associated progressive decrease in mobility thus leads to a shift in creep behaviour to longer time, as described in A.1, and thus to a dependence of creep behaviour on dwell time at the high temperature prior to load application. The timescales associated with the changes in physical age depend on the age of the polymer prior to the temperature increase and the magnitudes of the temperature increase and the glass-transition temperature.

Illustrations of the transient changes in creep behaviour that can occur with dwell time at the elevated temperature are shown in Figures A.2 and A.3. In Figure A.2, PVC specimens were stored at 23 °C for 200 h prior to heating to the test temperature of 44 °C. Creep curves were then measured after different dwell times, t_{e2}, at 44 °C prior to load application. The shift in creep behaviour to longer times is interpreted as the reactivation of physical ageing at 44 °C before loading following the reduction in age state from that at 23 °C resulting from the increase in temperature. In Figure A.3, creep tests were carried out under the same conditions but following a storage period of greater than 1 year at 23 °C prior to heating to the test temperature. The progressive reduction in the structural age of the specimens is observed here as a shift in the curves to shorter creep times and arises because of the more extensive structural changes that have taken place through physical ageing at 23 °C before heating that are not fully overcome by the relatively short times, t_e, at the temperature prior to loading.

A further issue needs to be considered in the analysis of creep data at elevated temperatures. The shape of a creep curve at the elevated temperature will change, if during the reactivation of physical ageing, significant changes in age take place in the duration of the creep test. Any attempt to construct creep master curves using procedures based on time-temperature equivalence must take account of these transient changes in molecular mobility linked to physical ageing for predictions of long-term behaviour to have any validity.

The changes in creep behaviour with time shown in these figures following cooling or heating are associated with changes in the non-equilibrium structure of the amorphous phase established when the polymer is cooled below its glass-transition temperature. Similar effects are observed in the creep behaviour of semi-crystalline polymers even if the glass transition temperature is below ambient. These effects are believed to be caused by physical ageing in the amorphous phase associated with a relaxation process (the α-process) involving coupled motions of molecules spanning both the crystal and amorphous phases.

ICS 83.080.01
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