

THERMOPLASTIC ELASTOMERS (TPE)

Position paper

Preamble

The official definition of thermoplastic elastomers – TPE for short – is as clear as it is brief. The terms and abbreviations of the individual TPE families are specified in the nomenclature standard DIN EN ISO 18064.

Definition from DIN EN ISO 18064:

TPE is a material consisting of polymer or polymer blend which, at its service temperature, has properties similar to those of vulcanised rubber but which can be processed and reprocessed like a thermoplastic at higher temperatures.

As simple as this definition may sound, the market-relevant TPEs are very different in their chemical structure and morphology. It is not possible to make a clear distinction between them and classic rubber elastomers or thermoplastics, as their property profiles always overlap at the interface. In order to satisfy both existing and future standards, it seems desirable to create a framework definition for TPEs in which certain material properties are specified.

The framework is designed so that all elastic, thermoplastically processable polymers that fit into it are classified as TPEs. However, it does not go so far as to imply that materials outside this framework cannot in any case be TPEs.

Therefore there can be only one possible approach to classification, and that is a classification by manufacturer.

Description

Thermoplastic elastomers combine the mechanical properties of vulcanised elastomers (rubber) at room temperature with the processability of thermoplastics. Elastomeric properties are obtained either by copolymerising hard and soft segments or by blending a thermoplastic matrix with a (partially) crosslinked or non-crosslinked rubber. In the case of copolymerisation, the hard segments form so-called domains (which may also be crystallites) which act as physical cross-linking points. As the material can be processed as a thermoplastic, it is possible to (re)granulate existing manufactured parts made of TPE and remould them into new components, i.e. to recycle them. For a more detailed study, see the technical literature listed on the TPE forum website: www.tpe-forum.de

Key property profiles

Typically, a conventional elastomer is characterised by its ability to recovery after deformation has taken place. A description of this elasticity forms the general framework of the following criteria, which usually play a role in TPEs. The criteria ensure that at the very least all elastic, thermoplastically processable polymers included within this framework are counted as TPEs.

► Tensile stress or tensile strength:

A test specimen is tested to destruction in a tensile testing machine. The characteristic stress-strain curve reflects the elongation properties of the material.

Tensile testing of a TPE is carried out according to recognised test standards (such as ISO 37, DIN 53504 or DIN EN ISO 527). The elongation at break of a TPE should be at least 100 %.

► Compression set:

A test specimen is deformed by a certain amount depending on the requirement and maintained under this load for a specified time at a specified temperature. At the end of this period, the test specimen is released and the difference between the initial and final state is measured

The measurement according to DIN ISO 815 is a creep test to determine the compression set after compressive loading. After a normalisation period of 72 h at room temperature, deformation of the TPE should be less than 70 %.

► Hysteresis:

A test specimen is stretched by a certain amount and the force immediately released. This procedure is then repeated a number of times. At the end of the process, the difference between the initial and final state is measured.

Hysteresis measurements can be carried out under many different measuring conditions. One suggestion is to stretch the specimen by 100 % and then release it, similar to DIN EN ISO 527, and then measure the remaining elongation after the third cycle. The permanent deformation of the TPE should not exceed 50 %.

► Recycling:

Thermoplastic processing is considered a prerequisite for a TPE, and is thus also the precondition for thermoplastic recycling of TPEs.



This position paper is the result of a team work of the TPE Forum members coordinated by the TPE Forum speakers

Dr.-Ing. Ines Kühnert, Vice director, Institute of Polymer Materials and Head of department

Processing Technology, Leibniz-Institut für Polymerforschung Dresden e.V., Dresden, Germany and Dr.-Ing. Stefan Zepnik, Director Technical Service Center, Mocom Compounds GmbH & Co. KG, Hamburg, Germany

www.tpe-forum.com