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Plastics — Determination of specific volume as a function of temperature and pressure, *pvT* diagram — Piston apparatus method

Plastiques — Détermination du volume spécifique en fonction de la température et de la pression, diagramme pvT *— Méthode utilisant un appareil à piston*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

This second edition cancels and replaces the first edition (ISO 17744:2004), which has been technically revised.

The main changes are as follows:

— procedure for measuring amourphous samples with a lower height of the sample once melted has been added;

— a specification for the balance to determine specific volume or density has been added;

— a specification for temperature calibration and position of measurement has been added;

— a specification for further measurement of density in the melt has been added;

— the presentation of results has been revised.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The characterization of changes in specific volume of plastics, as a function of temperature and pressure, is necessary for the purpose of simulation studies and for optimizing polymer processing.

These thermophysical data can be used as they are or modelled in the form of suitable mathematical laws (see References [7] to [12]).

In injection moulding, during the packing phase, most of the flow results from solidification. During solidification, if the plastic is semi-crystalline, the shrinkage is primarily due to crystallization. For materials with high shrinkage and fast cooling rates, material can lose wall contact especially at low holding pressures. *pvT* data are used to model the volumetric shrinkage, which is translated into dimensional changes in the moulding. Also, critical stress areas are detectable with a loss of wall contact.

All the techniques described hereafter are equivalent in their ability to characterize the melt state *pvT* behaviour, the isobaric cooling measurement is the only one which allows characterization of both the supercooling behaviour and the pressure dependency of the transition.

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Plastics — Determination of specific volume as a function of temperature and pressure, *pvT* diagram — Piston apparatus method

1 Scope

This document describes procedures for determining the specific volume of plastics as a function of temperature and pressure in both the molten and solid states.

This document specifies the use of a piston-equipped apparatus in which the test sample, held in a measurement cell, is pressurized by means of the piston. Measurements under conditions of constant pressure or constant temperature can be made.

NOTE For the acquisition of data needed for processing design, the isobaric cooling method is found to be more useful, see ISO 17282. The result of this measurement cannot be used directly for injection-moulding simulation.

This document is used to obtain:

— *pvT* diagrams that represent the relationship which exists between pressure, specific volume and temperature for a given material;

— volumetric compressibility and volumetric thermal-expansion coefficients;

— information on first-order and glass transitions as a function of temperature and pressure.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
specific volume
v
volume per unit mass of a material at a given temperature, *T*, and pressure, *p*

Note 1 to entry: Specific volume is expressed in cm^3/g.

3.2
density
ρ
mass per unit volume of a material at a given temperature, *T*, and pressure, *p*

Note 1 to entry: Density is expressed in g/cm^3.

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