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**NATIONAL STANDARD OF THE  
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**Plastics - Determination of drawing characteristics of  
thermoplastics in the molten state  
(English Translation)**

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## Table of Contents

|                              |    |
|------------------------------|----|
| Foreword...                  | 3  |
| Introduction...              | 5  |
| 1 Scope...                   | 6  |
| 2 Normative references...    | 6  |
| 3 Terms and definitions...   | 6  |
| 4 Principle...               | 8  |
| 5 Equipment...               | 9  |
| 6 Calibration...             | 13 |
| 7 Sample and conditioning... | 14 |
| 8 Test procedure...          | 14 |
| 9 Results representation...  | 23 |
| 10 Precision...              | 25 |
| 11 Test report...            | 25 |

### Foreword

This document was drafted in accordance with the provisions of GB/T 1.1-2020

Directives for standardization - Part 1.Rules for the structure and drafting of  
standardizing documents.

This document is modified in relation to ISO 16790.2021 Plastics - Determination of  
drawing characteristics of thermoplastics in the molten state.

Compared with ISO 16790.2021, this document has many structural adjustments. See  
Appendix A for a comparison list of the structural number changes between the two  
documents.

The technical differences between this document and ISO 16790.2021 and their reasons  
are as follows.

- ISO 11443 (see 5.1.2, 5.1.3.3, and 6.1) is replaced by the normative reference  
GB/T 25278 to adapt to Chinese technical conditions and increase operability;
- ISO 291 is replaced by the normative reference GB/T 2918 (see Chapter 7) to

adapt to Chinese technical conditions and increase operability;

-- The "Measurement of mean velocity" has been optimized and supplemented to adapt to Chinese technical conditions and increase operability (see 8.5.1);

-- It is divided into two parts. extruder (8.5.1.1) and capillary rheometer (8.5.1.2) to make the calculation methods of the two extrusion methods clearer;

-- "Weigh the amount of the specimen extruded from the die within 1 minute as the mass flow  $Q$ , with an accuracy better than  $\pm 1$  g" is changed to "Weigh the amount of the specimen extruded from the die within 1 minute as the mass flow  $Q$ , with an accuracy better than  $\pm 0.01$  g" (see 8.5.1.1) to adapt to Chinese technical conditions and improve accuracy;

-- The content "rhoT shall be calculated according to GB/T 3682.1 or other appropriate methods" is added (see 8.5.1.1) to provide the calculation method;

-- The calculation formula for the mean velocity of the capillary rheometer is added (see 8.5.1.2) to provide the calculation method;

-- The normative references to GB/T 3682.1 are added (see 8.5.1.1 and 8.5.1.2) to adapt to Chinese technical conditions and increase operability;

-- The content "Important note -- Melt strength shall not be reported alone. Test results shall always be reported together with the actual test conditions" is deleted from Chapter 11.

The following editorial changes were made to this document.

-- A foreword is added, the content of which corresponds to part of the scope of ISO 16790.2021;

-- Note 2 and Note 3 of "initial diameter" in the definitions are transferred to Note

## 1 Scope

This document describes a method for determining the drawing and fracture properties of thermoplastics in the molten state by measuring the melt forces developed when the melt strand is deformed under specified extrusion temperature and traction conditions.

This document applies to thermoplastic molding and extrusion materials that have

sufficient melt strength to be extruded using a capillary rheometer or an extruder equipped with a die or another extrusion device.

This document also applies to chemically stable thermoplastics that can be formed into extrudates free of foreign bodies, bubbles, unmelted impurities, etc.

## 2 Normative references

The provisions of the following documents constitute the essential clauses of this document through normative references in this text. Among them, for referenced documents with dates, only the versions corresponding to the dates are applicable to this document; for referenced documents without dates, the latest versions (including all amendments) are applicable to this document.

GB/T 2918 Plastics - Standard atmospheres for conditioning and testing (GB/T 2918-2018, ISO 291.2008, MOD)

GB/T 3682.1 Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1. Standard method

GB/T 25278 Plastics - Determination of the fluidity of plastics using capillary and slit-die rheometers (GB/T 25278-2010, ISO 11443.2005, MOD)

## 3 Terms and definitions

The following terms and definitions apply to this document.

### 3.1 drawing

The process of drawing a filament of polymer melt when it is continuously extruded by Record and measure the drawing force  $F_t$  and drawing velocity  $v_t$  in the first stage.

#### 8.5.2.7 Measure the drawing force at different melt drawing velocities by continuously

increasing the pulling velocity. Wait at least 30 seconds at each measuring point to allow the force value to stabilize.

#### **8.5.2.8 Continue to increase the drawing velocity until the melt breaks. The increase in**

the drawing velocity shall ensure that at least 6 values of the drawing force at different drawing velocities can be measured before the melt breaks.

#### **8.5.3.1 Insert the melt strand between the drive rollers, then close the rollers to tightly**

clamp the melt strand, and then stretch the melt at a certain pulling velocity. Set the pulling velocity of the pulling rollers to be slightly lower than the minimum melt pulling velocity value obtained in 8.5.2.3. This velocity will vary depending on the material and temperature. The initial melt pulling velocity should be 0.0125 m/s.

Insert the melt strand between the drive rollers, then close the rollers to tightly clamp the melt strand, and then stretch the melt at a velocity slightly lower than the minimum drawing velocity obtained in 8.5.2.3. The initial drawing velocity will vary depending on the material and temperature. 0.0125 m/s is recommended.

**NOTE:** Too low a mean velocity and drawing velocity will cause the extrudate to solidify. Therefore, it is necessary to select appropriate extrusion and drawing velocities to prevent local solidification of the

extrudate (forming a hard skin), which will distort the melt strength results.

#### **8.5.3.4 After the extrudate has stabilized and a baseline signal has been recorded for**

these conditions, start accelerating constantly. Record the time at which acceleration is initiated.

The starting value of acceleration should be 0.0006 m/s<sup>2</sup>, but this value varies with material and temperature.

In the case of extrusion using a capillary rheometer, the combination of a high melt mean velocity  $V_m$  and a low melt drawing acceleration  $a$  may result in the material in the barrel being used up before the final value of the melt strength is measured. In addition, the selection of the melt drawing acceleration shall take into account both the time interval between melt strand breaks so that appropriate data can be collected and