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Plastics — Determination of linear dimensions of test specimens

Plastiques — Détermination des dimensions linéaires des éprouvettes

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16012 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 2, *Mechanical properties*.

Plastics — Determination of linear dimensions of test specimens

1 Scope

This International Standard specifies measuring equipment and procedures for the determination of the linear dimensions of solid plastics test specimens.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 3599, *Vernier callipers reading to 0,1 and 0,05 mm*

ISO 3611:1978, *Micrometer callipers for external measurement*

ISO 6906, *Vernier callipers reading to 0,02 mm*

3 Terms and definitions

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

3.1
linear dimension
shortest distance, measured with the equipment described in Clause 4, between any two points selected on the plastics specimen

3.2
error of measurement
numerical difference between the indicated value and the true value of the dimension measured

4 Measuring equipment

4.1 General

The choice of measuring equipment for the measurement of dimensions is influenced by the characteristics of the specimen being measured. Each material will differ in its response to test method parameters, which include, but may not be limited to, the rate of loading, the ultimate load, the dwell time and the dimensions of the presser foot and anvil. For a specific plastics material, these responses may cause measurements made using one method to differ significantly from measurements made using another method. The compressibility of the material will have greater influence when comparing measurements taken with non-contact apparatus and spring-loaded micrometers.

Care shall be taken to ensure that the measuring equipment used does not leave on the measured surface any marks, scratches or cracks which could influence the results of the measurement.

4.2 Micrometers

Micrometers shall conform to the requirements of ISO 3611:1978 where appropriate.

Micrometers that are equipped with a system which ensures that a preset load is applied during measurement shall exert a force at the measurement faces of between 5 N and 15 N.

Micrometers shall meet the error-measurement requirements listed in Annex A of ISO 3611:1978. Digital-reading micrometers can be used provided they comply with the relevant requirements of ISO 3611:1978.

4.3 Vernier callipers

Vernier callipers shall conform to the requirements of ISO 3599 or ISO 6906. Digital-reading callipers can be used provided they comply with the relevant requirements of these standards.

4.4 Dead-weight dial gauge micrometers

4.4.1 Dead-weight dial gauge micrometers shall have the following features:

a) a presser foot that moves in an axis perpendicular to the anvil face;

b) presser foot and anvil surfaces (those which contact the specimen) that are parallel to within 5 µm;

c) a vertical dial spindle;

d) a dial indicator that is essentially friction-free and capable of repeatable readings within ± 10 µm at zero setting or on a steel gauge block;

e) a frame, housing the indicator, of such rigidity that a load of 15 N applied to the dial housing will produce a deflection of the frame not greater than the smallest scale division on the indicator dial.

The contact pressure exerted on the specimens during measurement shall be approximately 10 kPa to 30 kPa.

The diameter of the presser foot or spindle may vary from 3,2 mm to 12,7 mm. The shape of the presser foot may be either spherical or flat, depending upon the nature of the specimen surface.

The lower (fixed) anvil shall be wide enough to extend out beyond the contact foot in all directions and shall be parallel to the contact foot to within 5 µm over the entire foot area.

The dial diameter shall be at least 50 mm and the dial shall be graduated continuously to read directly to the nearest 2,5 µm. If necessary, equip the dial with a revolution counter that displays the number of complete revolutions of the large hand.

Possible types of contact face for dead-weight gauge micrometres are shown in Annex A.

4.4.2 The preferred design of manually operated dead-weight dial gauge micrometer is one which calls for a limit on the force applied to the presser foot. The limit is related to the compressive characteristics of the material of which the specimen being measured is made. The force applied to the presser foot spindle and the weight necessary to move the pointer upwards from the zero position shall be less than the force that would cause permanent deformation of the specimen.

4.4.3 An electronic instrument having a digital readout in place of the dial indicator is permitted, provided the instrument meets the error-measurement requirements listed in Annex A of ISO 3611:1978.

4.5 Non-contact devices and other alternative devices

Non-contact measuring devices (optical and laser) and other alternative devices may be used provided the device meets the error-measurement requirements listed in Annex A of ISO 3611:1978.

5 Procedure

5.1 Test specimens

Test specimens may be prepared from plastics sheet, plate or moulded shapes that have been machined in accordance with ISO 2818 to the required dimensions or moulded to the desired finished dimensions for the particular test. For each specimen, take precautions to prevent damage or contamination that may adversely affect the measurements.

Unless otherwise specified, all measurements shall be made after the specimens have been conditioned at one of the standard laboratory atmospheres defined in ISO 291.

5.2 Accuracy requirements

The accuracy requirements for the dimension measurements shall be as specified in Table 1.

Table 1 — Accuracy requirements

Dimensions in millimetres

Range of dimensions	Required accuracy
< 10	$\pm$ 0,02
$\geqslant 10$	$\pm$ 0,1

5.3 Number and location of measurement points

The number of measurement points depends on the size and shape of the specimen, but shall be at least three for each dimension. The measurement points shall be as widely separated as possible, in order to give a good average. The arithmetic mean of all the measured values is taken as the value of the dimension of the specimen.

For multipurpose test specimens, the thickness shall be measured in the middle of the specimen between the two edges. The measurement points shall be within the gauge region for the specific test procedure.

5.4 Calibration of equipment

Calibrate micrometers and callipers under the appropriate standard laboratory test conditions in accordance with the test method applicable to the specific material under test. Use several standard gauge blocks or other metallic objects of known dimensions covering the measurement range of the micrometer. The known dimensional accuracy of such blocks shall be within $\pm$ 10 % of the smallest scale division on the micrometer dial or scale. Thus, if an instrument's smallest scale division is 2 µm, the standard gauge block dimension shall be known to within $\pm$ 0,2 µm. Perform calibration procedures only after the instrument has been checked and found to meet the requirements of the pertinent ISO standard or the manufacturer’s specifications.

From the calibration measurements, construct a calibration correction curve that will provide corrections to the measured dimension of the specimens. To obtain the correction curve, plot the true dimension of the gauge block against the measured value.

Perform calibration procedures at least once every year. For heavily used equipment or for equipment subjected to a harsh environment, the recommended calibration interval is once every 30 days.

5.5 Measuring with a micrometer

Close the micrometer on an area of the specimen near a measurement point. Observe the reading, then open the micrometer approximately 100 µm beyond this reading and move the specimen so that the micrometer is over the first measurement point.

Using the ratchet, or the friction thimble, close the micrometer at such a rate that the change in the reading on the scale or digital display can be followed easily. Continue the closing motion until the ratchet clicks three times, the friction thimble slips, or the two contact surfaces can be felt to be in full contact with the specimen. Record the reading indicated. Move the specimen so that the micrometer is over another measurement position, and repeat the procedure given above.

5.6 Measuring with vernier callipers

Progressively close the sliding jaw of the callipers onto the specimen until the contact faces of the callipers just touch the surfaces of the specimen without compressing or damaging it. Move the specimen slightly back and forth, simultaneously continuing to bring the contact surfaces of the calliper together slowly until resistance to the back-and-forth movement is felt. Record the reading indicated.

Move the callipers to another measurement point, and repeat the procedure given above.

5.7 Measuring with a dead-weight dial gauge micrometer

Place the dial gauge micrometer on a solid, level, clean table or bench that will not vibrate excessively during the measurements. Confirm that the anvil and presser foot surfaces are clean. Zero the instrument.

Raise the presser foot slightly. Move the specimen so that the micrometer is at the first measurement point, and lower the presser foot to a dial reading approximately 7 µm to 10 µm higher than the expected reading.

Drop the foot onto the specimen. This procedure minimizes small errors caused by lowering the pressure foot slowly onto the specimen. Record the dial reading. Move the specimen to another measurement position and repeat the procedure given above. Recheck the instrument zero setting after measuring each specimen. Any change in the setting is usually the result of contaminating particles being transferred from the specimen to the contact surfaces of the presser foot and anvil. This condition necessitates the cleaning of these surfaces.

5.8 Measuring with non-contact devices

Calibrate the equipment following the manufacturer's instructions. Measure the specimen dimensions at the locations specified in 5.3. In the case of injection-moulded specimens, each thickness measurement shall be the average of three values obtained at locations as widely separated as possible.

6 Test report

The test report shall contain the following information:

a) a reference to this International Standard;

b) the type and designation of the plastics material;

c) the type of test piece;

d) the conditioning used;

e) the measuring equipment used;

f) for each specimen:

- the number of measurements made for each dimension,
- the arithmetic mean of the measurements made for each dimension;

g) any deviations from the specified procedure;

h) the date of measurement.

Annex A
(informative)

Possible types of contact face for dead-weight gauge micrometers

Dimensions in millimetres

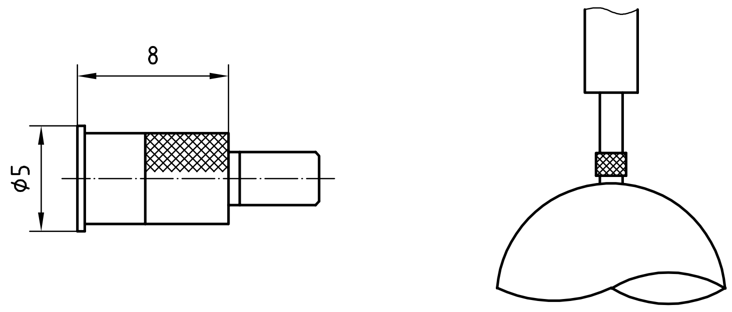

Figure A.1 — Flat

Dimensions in millimetres

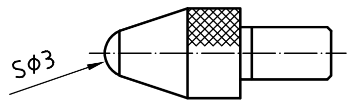

Figure A.2 — Spherical

Dimensions in millimetres

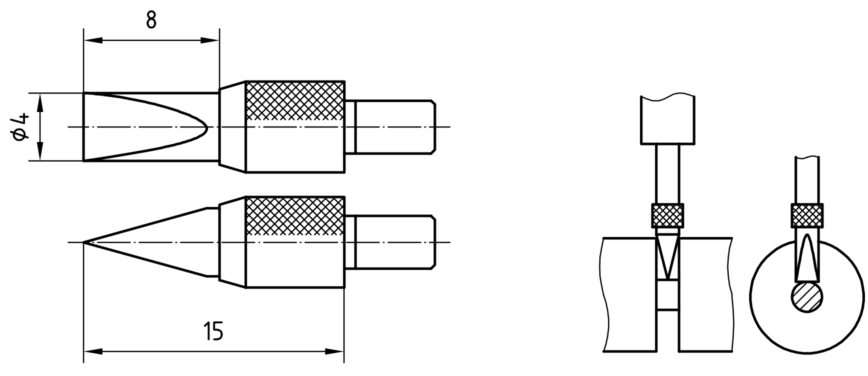

Figure A.3 — Knife-edge (carbide)

Dimensions in millimetres

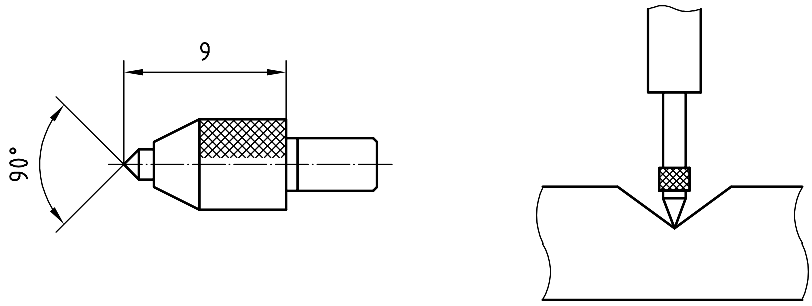

Figure A.4 — Conical (90°)

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