INTERNATIONAL STANDARD

ISO 4661-1

Second edition
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Rubber, vulcanized or thermoplastic — Preparation of samples and test pieces —

Part 1: Physical tests

Caoutchouc vulcanisé ou thermoplastique — Préparation des échantillons et éprouvettes —

Partie 1: Essais physiques

INTERNATIONAL ISO

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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.

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.

International Standard ISO 4661-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Sub-Committee SC 2, *Physical and degradation tests*.

This second edition cancels and replaces the first edition (ISO 4661-1:1986), of which it constitutes a minor editorial revision.

ISO 4661 consists of the following parts, under the general title *Rubber, vulcanized or thermoplastic — Preparation of samples and test pieces*:

— *Part 1: Physical tests*

— *Part 2: Chemical tests*

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Introduction

This part of ISO 4661 includes a number of factors of importance in the preparation of test pieces for physical testing, in order to ensure the best use of the relevant ISO methods of test.

The procedure for adjusting the thickness of the test piece, if necessary, is described. If it is not feasible to obtain suitable test pieces from the finished product, or if required for determining the properties of a rubber compound, test pieces may be prepared from specially moulded sheets. For assessing the properties of a product by means of specially moulded sheets, it is important that both product and sheet be made from the same batch of material and have equivalent cure, as demonstrated by the determination of such properties as can be obtained on the product.

Cutters for preparing test pieces from moulded sheets or from products are described.

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Rubber, vulcanized or thermoplastic — Preparation of samples and test pieces —

Part 1:
Physical tests

1 Scope

This part of ISO 4661 specifies methods of preparing test pieces from vulcanized and thermoplastic rubber for use in physical tests on rubber specified in other International Standards.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4661. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 4661 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1983, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 525:1986, *Bonded abrasive products — General — Designation, marking, range of outside diameters and tolerances.*

ISO 4648:1991, *Rubber, vulcanized or thermoplastic — Determination of dimensions of test pieces and products for test purposes.*

3 Test piece thickness

The test piece thickness shall be as specified in the relevant test method. However, it is recommended that the following test piece thicknesses be used for specially moulded test sheets for all tests unless other thicknesses are technically necessary:

1 mm ± 0,1 mm
2 mm ± 0,2 mm
4 mm ± 0,2 mm
6,3 mm ± 0,3 mm
12,5 mm ± 0,5 mm

The thickness shall be measured in accordance with ISO 4648.

4 Thickness adjustment

Material requiring testing, particularly products, may not be available in the required thicknesses specified in clause 3, so that procedures are required to adjust the thickness to within the prescribed limits. Recommended procedures are given below. In most cases, the thickness adjustments should be made on the material before the cutting of the test pieces.

4.1 Removal of textiles combined with the rubber

The separation should preferably avoid the use of a liquid which causes swelling. If this is not possible, a non-toxic liquid of low boiling point, such as iso-octane, may be used to wet the contacting surfaces. Care shall be taken to avoid excessive stretching of the rubber during the separation by separating a little at a time while the rubber is gripped near the point of separation.

If a liquid is used, the rubber shall be placed so as to permit free evaporation of the liquid, and time shall be allowed for the complete evaporation of the liquid,

preferably at least 16 h, before the test pieces are cut and tested.

4.2 Cutting techniques

When it is necessary to remove considerable thicknesses of rubber or to produce a number of slices from a thick piece of rubber, cutting techniques shall be used such as those described in 4.2.1 and 4.2.2.

4.2.1 Rotating-blade equipment

This equipment is based on commercial slicing machines. The machine consists of a motor- or hand-driven disc cutter of suitable diameter with a movable cutting table which transports the sample to the cutting edge. An adjustable slow-feed mechanism fitted to the cutting table feeds the rubber forward to the line of cut and controls the thickness of the slice. Clamping devices shall be available to secure the rubber. The blade should preferably be lubricated with a dilute aqueous detergent solution to ease the cutting operation.

4.2.2 Skiving machines

This equipment is based on commercial leather-slitting machinery, and convenient types are available for cutting strips about 50 mm wide with thicknesses up to about 12 mm. Adjustments shall be available to vary the thickness of cut, and feed rollers shall be provided to transport the material past the knife. Provision shall be made for maintaining the cutting edge in a sharp condition. Attachments are available for splitting and cutting sections from cable sheathing.

4.3 Abrading techniques

When it is necessary to remove unevenness of surface, such as fabric impressions or corrugations caused by contact with fabric components or cloth wrappings used for vulcanization or as a result of cutting techniques, this shall be done using the equipment described in 4.3.1 or that described in 4.3.2.

4.3.1 Abrasive wheels

The abrading apparatus consists of a grinder with a motor-driven abrasive wheel. It is important that the wheel run true, without vibration, and that the abrasive surface, of aluminium oxide or silicon carbide, be true and sharp. The grinder may be equipped with a slow-feed mechanism so that very light cuts may be made to avoid over-heating of the rubber. Suitable means shall be provided for securing the rubber to prevent excessive deformation and for controlled traversing of the rubber against the abrasive wheel.

NOTE 1 Wheels of 150 mm diameter operating at a surface speed in the range 10 m/s to 12 m/s, designated C-30-P-4-V for roughing and designated C-60-P-4-V for finishing (see ISO 525), have been found suitable.

The depth of cut produced in the first pass shall not exceed about 0,2 mm. Successive cuts shall be progressively thinner to avoid over-heating. Grinding shall not be carried out beyond the point where unevenness of thickness has been eliminated. For removal of greater thicknesses of rubber, cutting techniques as indicated in 4.2 shall be used.

4.3.2 Flexible abrasive belts

The apparatus consists either of a motor-driven drum on which a helical strip of the abrasive belt is secured or of two pulleys, one motor-driven and the other adjustable to tension and align the belt. The abrasive belt shall be of textile or paper or a combination of the two with the abrasive, of aluminium oxide or silicon carbide, bonded to the surface with a resin unaffected by water. Equipment shall be provided for slow feeding of the material to the abrasive belt and for securing the material without excessive deformation.

NOTE 2 A surface speed of the band in the range of 20 m/s ± 5 m/s has been found suitable.

In operation, cuts removing several tenths of a millimetre of rubber are practicable as much less heat is produced than with the method of 4.3.1. The grinding may be carried out against the drum, against one of the pulleys or against the taut belt between the pulleys.

5 Conditioning of test pieces

After carrying out any of the procedures recommended in clause 4, test pieces shall be conditioned for at least 16 h at a standard temperature as specified in ISO 471.

6 Test piece cutters

6.1 Design of cutters

The design and type of cutter employed will vary with the thickness and hardness of the material under test. In the case of thin materials, punching or rotary cutting techniques shall be used as described in 6.1.1, 6.1.2 or 6.1.3. For thicker materials, usually above 4 mm, a rotary cutting technique as described in 6.1.3 is desirable, to reduce the degree of dishing of the cut edge resulting from compression of the rubber during cutting. These techniques are not suitable for ebonite, which shall be prepared using metal-machining techniques.

For cutters which do not have replaceable blades, a suitable design of cutting edge is shown in figure 1.

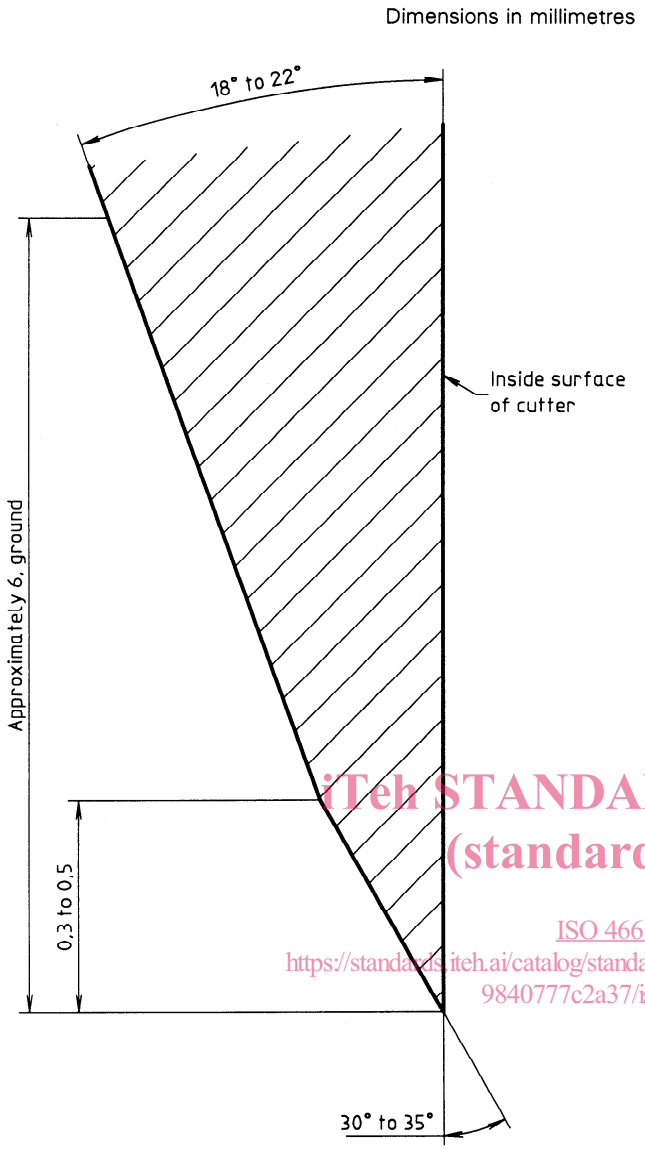

Figure 1 — Suitable cutting edge

6.1.1 Fixed-blade cutters

These shall be constructed from high-quality tool steel and may either be constructed from solid metal or be of split construction. Cutters may be designed to punch out single or multiple test pieces. It is essential that the design ensure sufficient rigidity to prevent distortion of the cutting shape, and the cutter should preferably be fitted with an ejection system to release the test piece. Such ejectors shall be designed to accommodate material up to the maximum thickness to be cut, normally 4,2 mm. If ejectors are not fitted, access shall be available from the rear to permit release of the test piece by the operator without damaging the cutting edge.

The cutting edge shall be kept sharp and free from nicks, as described in 6.2, to prevent the formation of ragged edges on the test piece.

6.1.2 Replaceable-blade cutters

These use sharpened, high-carbon-steel strips, such as single-edged razor blades, which are sufficiently flexible to conform to the shape of cutter required. The cutting edge shall be securely clamped between shaped metal spacers and shaped blocks which conform to the specified cutter shape.

The spacers and shaped blocks shall be of sufficient thickness to support the cutting blade so that normally not more than 2,5 mm of the blade protrudes from the surface. The back of the cutting blade shall bed firmly on a solid metal base. The cutter should preferably be fitted with an ejector system to release the test piece. If fitted, such ejectors shall be designed to accommodate material up to the maximum thickness to be cut, normally 2,2 mm. If ejectors are not fitted, access shall be available from the rear to permit release of the test piece by the operator without damaging the cutting edge. Checks shall be made to ensure that the blade is not significantly deformed during the cutting operation, particularly with vulcanizates of high hardness.

6.1.3 Rotary cutters

Either annular or arc-shaped cutting knives or razor blades held in suitable adapters permitting them to be fitted in the drilling machine shall be used. Means shall be provided for securing the rubber during the cutting operation. This can be a combination of a plunger with presser foot incorporated in the adapter for securing the central portion of the rubber, with a metal pressure plate having a central hole larger than the size to be cut or a vacuum holder applying suction to the lower surface of the rubber. Means may be provided for lubricating the surface of the rubber during the cutting operation. To assist in obtaining a perpendicular cut, a second annular knife of a larger diameter, working at the same time as the test piece cutting knife, has been found effective. The cutting knives and the movement of the drilling head shall be sufficient to accommodate the thickness of rubber to be cut. The leading edge of an arc-shaped cutter shall be angled and sharpened to facilitate entry into the rubber. It is important that the cutting area be adequately guarded with a transparent shield permitting examination of the cutting operation. Other techniques in which the rubber is rotated against a stationary knife or razor blade may also be used.

6.2 Maintenance of cutters

Care shall be exercised at all times to protect and maintain the cutting edges of cutting equipment, as any dulling, nicking or bending of the cutting edge can lead to defective test pieces which will give atypical results. During storage, cutters shall be either placed in such a way that the cutting edge is resting on a soft

surface such as foamed rubber or, preferably, placed so that the cutting edge does not contact any surface.

The metal of the cutter shall be protected from corrosion by the application of a thin layer of a suitable protective oil, and the cutter shall be stored in a dry atmosphere.

When in use, the cutting edge shall be protected from damage due to contact with the base plate of the cutting apparatus after passing through the rubber sheet. Such damage can be avoided by covering the base plate with a moderately soft material such as rubber-coated conveyor belt or good-quality cardboard. The cutting edge shall be regularly honed to maintain a sharp edge.

When major resharpening is required, shaped 12,5-mm-diameter silicon carbide dressing stones fitted in a universal grinding machine may be employed.

Prepare four types of dressing stone:

— type A, with a trued face perpendicular to the axis of the stone to grind the cutting edge parallel to the base of the cutter;

— type B, with a trued reduced diameter sufficient to fit inside the cutting edge of the cutter to make the inside surface perpendicular to the plane defined by the end points of the cutting edge;

— type C, with a trued conical end of angle 36° to 44° to produce the 18° to 22° angle on the cutting edge;

— type D, with a trued conical end of angle 60° to 70° to produce the 30° to 35° angle at the end of the cutting edge;

Shape the dressing stones by mounting each in the machine and dressing it with a grinding wheel.

Carry out the resharpening operation by traversing the cutter along the work-table of the machine against each of the rotating dressing stones in turn.

Use the type A stone until a small flat can be seen over the entire cutting edge of the cutter.

Subsequently use the type B stone to true the inside, vertical surface of the cutter (see figure 1), taking care to ensure that the width and other features of the outline are not ground to outside the tolerances.

Then use the type C stone until a very narrow flat of uniform width can be seen over the entire length of the cutting edge.

Finally, use the type D stone, again ensuring that the cutting edge is of uniform width.

On completion of these operations, hone the cutting edge by hand to remove any feathering along the edge.

The critical dimensions of the cutter shall be measured after sharpening, preferably using a travelling microscope.

NOTE 3 Careful maintenance of the cutting edge is extremely important and can be carried out by frequent light honing and touching up of the cutting edge with a honing stone. The condition of the cutting edge may be assessed by examining the rupture point of any series of test pieces after testing. When ruptured test pieces are removed from the clamps of the test machine, it is useful to examine them and note if there is any tendency to rupture consistently at or near the same point. If so, this may mean that the cutting edge is blunt, nicked or bent at that particular position.

6.3 Lubrication for cutting

The cutting of a test piece is facilitated by the use of a lubricant either on the cutting knife or on the surface of the rubber. For this purpose, a weak solution of a detergent in water has been found suitable. After using lubricants, care should be exercised to dry any metal surfaces, particularly cutting edges, to prevent corrosion. When lubricants are used in conjunction with rotating cutters, protective clothing is desirable as liquid will spray out from the cutter.

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