3.2 Test instruments

3.2.1 Depending on the circumstances, measurements shall be made using one or more of the following types of instrument.

3.2.1.1 For solid products, a **micrometre dial gauge**, the foot of which shall exert a pressure of 22 kPa ± 5 kPa for rubber of hardness equal to or greater than 35 IRHD or of 10 kPa ± 2 kPa for rubber of hardness less than 35 IRHD as specified in ISO 23529 and ISO 48.

3.2.1.2 A **suitable optical measuring instrument**.

3.2.1.3 **Fixed gauges**, for upper and lower limits appropriate to the dimensions being measured.

3.2.1.4 **Other devices**, including tape measures (with or without vernier), sliding calipers, and micrometre calipers.

3.2.2 All instruments shall be capable of measuring the dimension with an error within the tolerances specified.

3.2.3 In all measurements intended to be comparative, the same measuring device shall be used.

4 Tolerances

For the purposes of this part of ISO 3302, nominal dimensions and tolerances are based on the R 5 and R 10 series of preferred numbers, respectively, in accordance with ISO 3.

The dimensions of certain parameters of a particular product may not all require the application of the same class of tolerance. Dimensions of different parameters of the product on the same drawing can have different class tolerances applied to them. When drawings do not indicate a class tolerance, the largest tolerance given in the related table shall be applied.

NOTE 1 Tolerances that are specified in this part of ISO 3302 in terms of a positive value and an equal negative value (e.g. ± 0,35) can also be expressed in terms of unequal positive and negative values, providing the difference between the two values remains the same. For example, ± 0,35 may also be expressed as $^{+0,2}_{-0,5}$ or $^{+0,7}_{0}$ or $^{0}_{-0,7}$ etc.

NOTE 2 Special consideration of tolerances will be necessary for a vulcanizate with a low hardness and a high tensile strength (e.g. natural rubber gum vulcanizate).

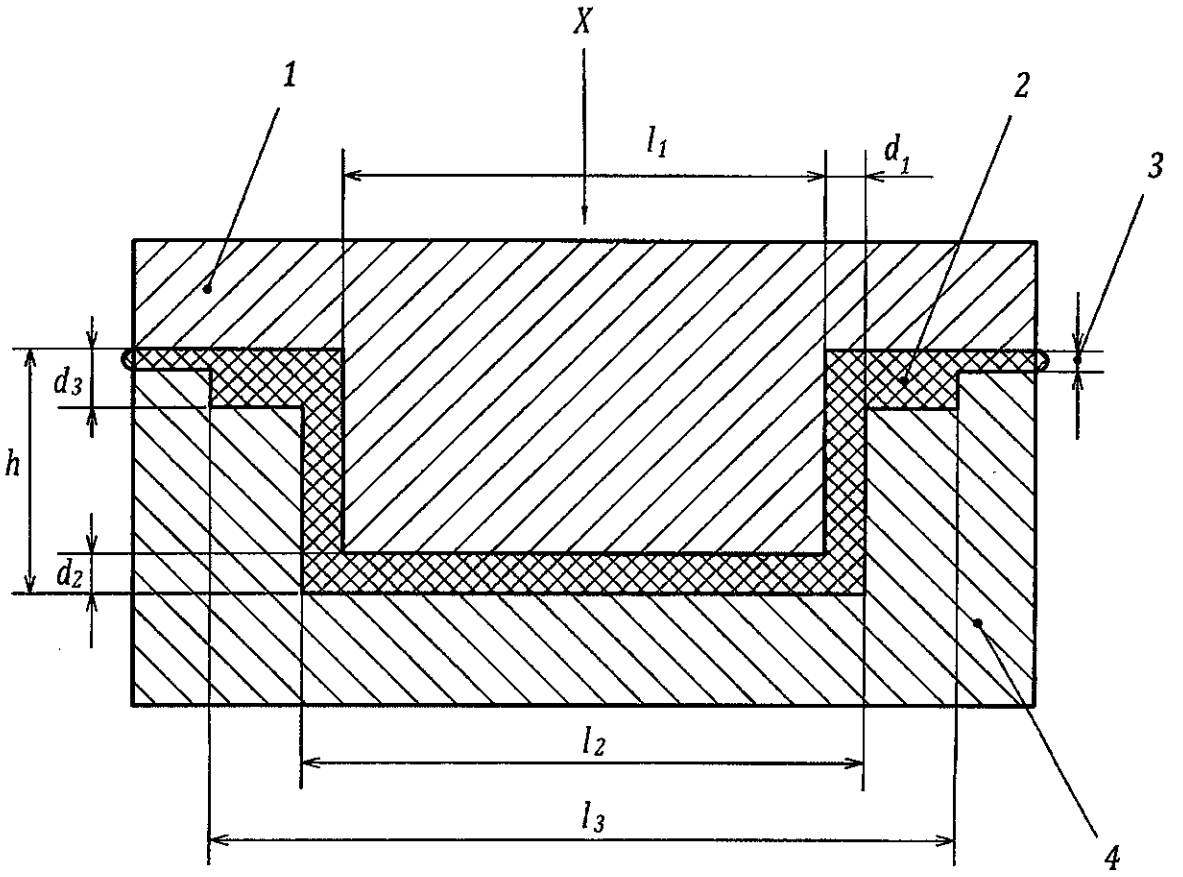
5 Mouldings

5.1 General

The dimensional tolerances stated in this part of ISO 3302 may be wider than those used in some other engineering practice. The following considerations apply.

a) All rubber shows some shrinkage when cooled after moulding, and for this is made in the mould design. The amount of shrinkage is dependent on the rubber type and the mix used, but also varies from batch to batch of the same mix. Products made from some silicone rubbers, fluorocarbon elastomers, and other special-purpose elastomers are subject to larger shrinkages; therefore, tolerance classes M1 and M2 (see 5.2) are very difficult to obtain with these rubbers.

b) Non-rubber parts bonded to the rubber will affect the shrinkage and, therefore, the practicable tolerances.



Key

X direction of pressure
1 upper half of mould
2 moulded part
3 flash
4 lower half of mould

Figure 1 — Compression mould and moulded part (diagrammatic)

Table 1 — Tolerances for mouldings

Dimensions in millimetres (unless indicated otherwise)

Nominal dimension		Class M1		Class M2		Class M3		Class M4
Above	up to and including	F ±	C ±	F ±	C ±	F ±	C ±	F and C ±
0	4,0	0,08	0,10	0,10	0,15	0,25	0,40	0,50
4,0	6,3	0,10	0,12	0,15	0,20			
6,3	10	0,10	0,15	0,20	0,20	0,30	0,50	0,70
10	16	0,15	0,20	0,20	0,25	0.40	0,60	0,80
16	25	0,20	0,20	0,25	0,35	0,50	0,80	1,00
25	40	0,20	0,25	0,35	0,40	0,60	1,00	1,30
40	63	0,25	0,35	0.40	0,50	0,80	1,30	1,60
63	100	0,35	0,40	0,50	0,70	1,00	1,60	2,00
100	160	0,40	0,50	0,70	0,80	1,30	2,00	2,50
160	—	0,3 %	0,4 %	0,5 %	0,7 %	0,8 %	1,3 %	1,5 %

5.5 Flash

This subclause establishes six classes of flash, as listed in Table 2.

Table 2 — Classes of flash

Class	Maximum height of flash mm	Description
X0	0	No flash[a]
X1	0,1	Precision flash
X2	0,5	Accurate flash
X3	1,0	Normal flash
X4	2,0	Rough flash
X5	No limit	Non-critical

[a] Class X0 can only apply to those surfaces of an article which do not have parting lines.

6 Extrusions

6.1 General

Extruded rubber products require greater tolerances in manufacture than those produced by moulding since the rubber undergoes die swell and, during subsequent vulcanization, shrinkage and deformation usually occur.

Deformation can be reduced by the use of supports during vulcanization, the nature of the support depending on the section being produced, and the degree of control required. Such features determine the class of tolerance applicable to given dimensions.

In the case of certain synthetic rubbers, extrusion class E1 tolerances are not directly obtainable.

c) Moulds are made in various ways depending on the type of product and accuracy demanded. In general, product can be no more accurate than the mould, and the greater the degree of accuracy demanded, the more expensive the moulds and their maintenance become.

d) Care shall be taken in applying the standard tolerances to products having wide sectional variations.

e) In cases where the rubber product is unavoidably distorted during removal from the mould, the dimensions of the products can be affected, and special allowance might be needed.

5.2 Classification

This subclause establishes four classes of tolerance for fixed and closure dimensions (see 5.3) for products moulded in solid rubber.

a) Class M1 for precision mouldings. Such mouldings require precision moulds, fewer cavities per mould, close mix controls, etc., which results in high cost. Optical comparators or other, similar, measuring devices might be required to minimize distortion of the rubber by the measuring instrument. This type of part requires expensive control and inspection procedures.

b) Class M2 for high-quality mouldings involving much of the close control required for class M1.

c) Class M3 for good-quality mouldings.

d) Class M4 for mouldings where dimensional control is non-critical.

A classification system for flash is given in 5.5.

5.3 Fixed dimensions and closure dimensions

In moulding a rubber product, more rubber is used than is required to fill the cavity, and the excess is flashed. This flash tends to prevent the mould sections from fully closing and, thus, affects the finished part dimensions.

NOTE For products moulded by transfer or injection, it is possible to regard all dimensions as fixed.

Two sets of tolerances, F and C, are given and are defined below.

5.3.1 Fixed dimensions (F): Dimensions which are not affected by deforming influences like flash thickness or lateral displacement of different mould parts (upper and lower parts or cores). See Figure 1, dimensions l_1, l_2, and l_3.

5.3.2 Closure dimensions (C): Dimensions which can be altered by variation in the flash thickness or lateral displacement of different mould parts. See Figure 1, dimensions d_1, d_2, d_3, and h.

NOTE The dimensions for F and C can only be tolerance insofar as they are independent of each other.

5.4 Tolerances

The tolerances to be applied shall be chosen, by agreement between the interested parties, from the classes of tolerance described in 5.2.

Standard tolerances are given in Table 1. Fixed tolerances (F) are related by size to each dimension, but all closure tolerances (C) are determined by the largest closure dimension (h, see Figure 1).