International Standard 5999

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Polymeric materials, cellular flexible — Polyurethane foam for load-bearing applications excluding carpet underlay — Specification

Matériaux polymères alvéolaires souples — Mousse de polyuréthanne pour utilisations soumises à des charges, à l'exclusion des revers de tapis — Spécifications

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5999 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*, and was circulated to the member bodies in September 1979.

It has been approved by the member bodies of the following countries :

Brazil	Libyan Arab Jamahiriya	Thailand
Canada	Poland	Turkey
Czechoslovakia	Romania	United Kingdom
Denmark	South Africa, Rep. of	USA
Egypt, Arab Rep. of	Spain	USSR
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Belgium
France
Germany, F. R.
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Polymeric materials, cellular flexible — Polyurethane foam for load-bearing applications excluding carpet underlay — Specification

1 Scope and field of application

This International Standard specifies requirements for flexible load-bearing polyurethane foam of the polyether type.

It is applicable to flexible polyurethane cellular materials manufactured in block, sheet and strip form, in moulded and fabricated shapes, and as reconstituted material, used for load-bearing applications in general, but excluding carpet backing and underlay. It thus primarily relates to the quality of polyurethane foam used for comfort cushioning purposes.

The foam is classified according to performance during a fatigue test, indentation hardness being used as a secondary means of grading material.

This International Standard is not applicable to polyurethane foams foamed in place or to foams for use in heat-welded systems unless for load-bearing purposes.

Recommended applications for the range of flexible polyurethane foams covered by this International Standard are listed in annex B.

2 References

ISO 1798, *Flexible cellular materials — Determination of tensile strength and elongation at break.*

ISO 1856, *Polymeric materials, cellular flexible — Determination of compression set.*

ISO 2439, *Polymeric materials, cellular flexible — Determination of hardness (indentation technique).*

ISO 2440, *Flexible cellular materials — Accelerated ageing tests.*

ISO 3385, *Flexible cellular materials — Test for dynamic fatigue by constant load pounding.*

ISO 3582, *Cellular plastic and cellular rubber materials — Laboratory assessment of horizontal burning characteristics of small specimens subjected to a small flame.*

ISO 3795, *Road vehicles — Determination of burning behaviour of interior materials for motor vehicles.*

3 Classification

3.1 Type

For the purpose of this International Standard, flexible polyurethane foams are classified according to type as follows :

— type B : Block foam, slabstock or contour cut (conventional);

— type CB : Block foam [high resilience (previously known as "cold cure")];

— type M : Moulded (conventional);

— type CM : Moulded [high resilience (previously known as "cold cure")];

— type RE : Reconstituted or bonded.

3.2 Class

Materials of the above types (except type RE) are sub-divided into five classes based on performance in the constant load pounding test described in ISO 3385. The five classes and their intended types of service are given in table 1.

Table 1 — Classes and intended types of service

Class	Type of service
X	Exceptionally severe
V	Very severe
S	Severe
A	Average
L	Light

NOTE — Further details of recommended applications are given in annex B.

Classes X, V, S, A and L are defined by the maximum indentation hardness loss over the range of hardness index values from 0 to 650 N, as shown in figures 1 and 2, provided that the requirements for physical properties specified in table 6 are met.

The classification is based on the lowest level achieved in any of the tests.

NOTE — Reconstituted foam (type RE), because of its good fatigue properties combined with poorer compression set, tensile strength and elongation at break properties, is specified separately in table 7. It is generally used as thin, firm padding or to provide reinforcement for the other foams.

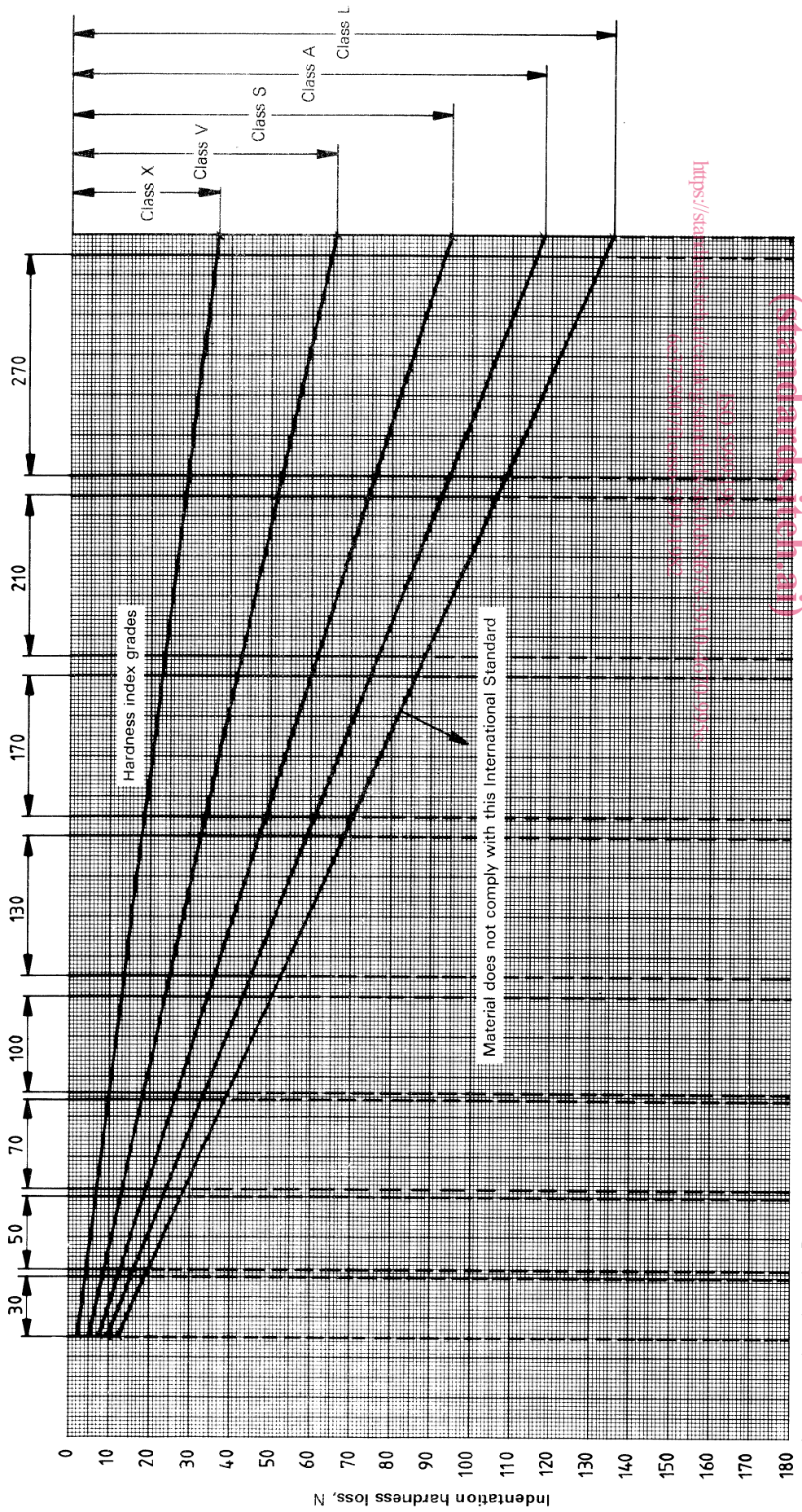

Figure 1 — Fatigue classes and indentation hardness index grades — Low hardness values

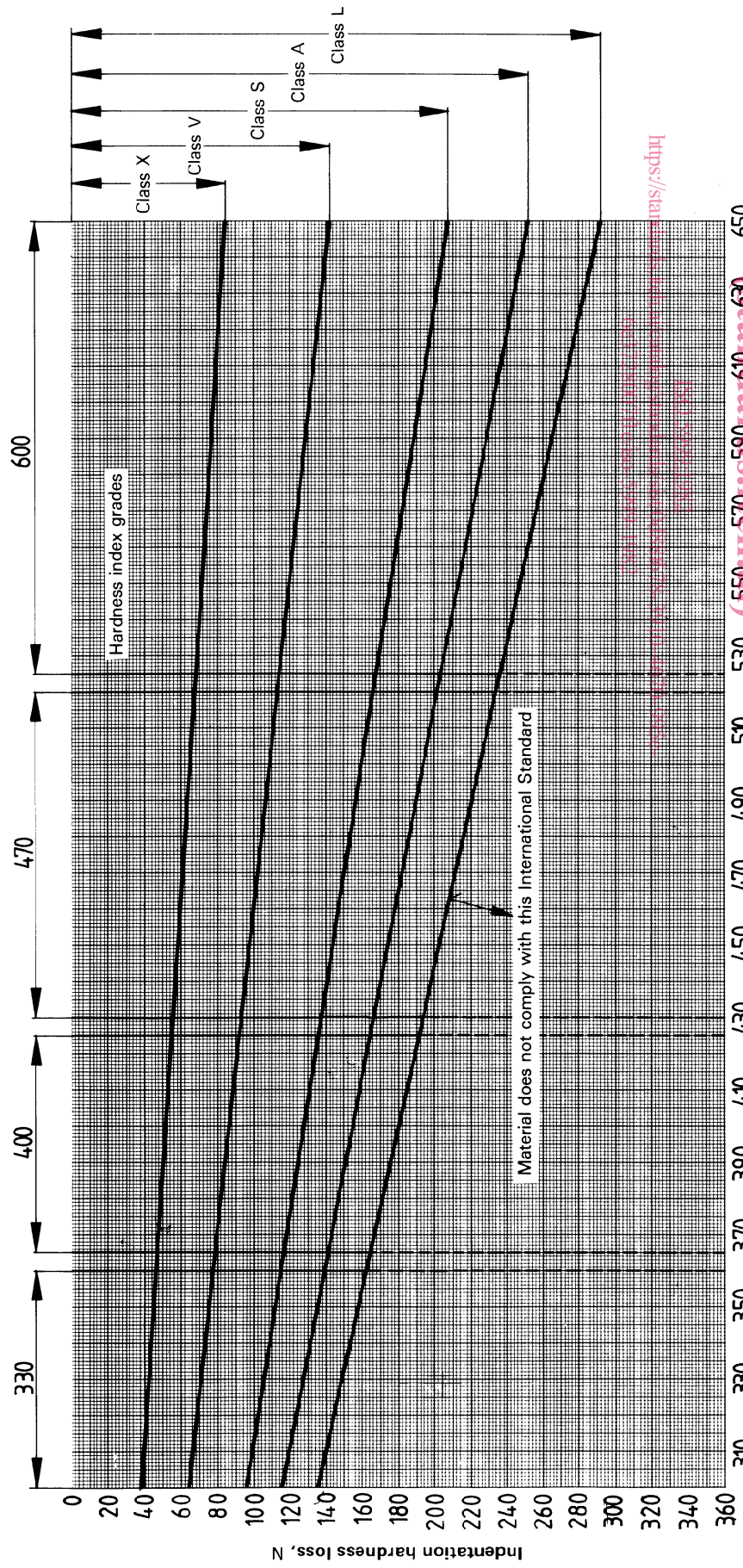

Figure 2 — Fatigue classes and indentation hardness index grades — High hardness values

NOTE — Class A and class L materials may not be available at all high hardness levels.

As an example, a material of initial indentation index 140 N, with an indentation hardness loss between 0 and 17 N is a class X material, with a hardness loss between 0 and 31 N is a class V material, with a hardness loss between 0 and 44 N is a class S material, with a hardness loss between 0 and 55 N is a class A material, and with a hardness loss between 0 and 63 N is a class L material, provided, in all cases, that the other property levels are achieved. Any material having an indentation hardness index of 140 N and a hardness loss greater than 63 N does not comply with the requirements of this International Standard.

3.3 Grade

Polyurethane foams are further graded by indentation hardness index, as determined by the method described in ISO 2439, according to table 2.

Table 2 — Grading by indentation hardness index

Grade	Indentation hardness index, N
30	25 to 40
50	41 to 60
70	61 to 85
100	86 to 110
130	115 to 150
170	155 to 190
210	195 to 235
270	240 to 295
330	300 to 360
400	365 to 425
470	430 to 520
600	525 to 650

NOTE — It may not be possible to manufacture foam falling into all these grades in each of the material classes. To control the hardness of foam to within the above grades, selection of material may be necessary, since the typical variation of the hardness of foam within and between production runs can be of the order of ± 16 %.

4 Material

Flexible polyurethane foam shall consist of a network of cells which are essentially open and interconnecting. It shall be free from abnormalities that are likely to affect adversely its performance.

5 Construction

Flexible polyurethane foams may be supplied in block, sheet or strip form, or in moulded or fabricated shapes, which may be cavitied or profiled.

Depending on the manufacturing conditions, the material may have to be corrected or repaired. Repaired or corrected material shall be considered to comply with this International Standard if the foam used in such repairs or corrections is of the same composition and quality as the original product and provided that such corrections do not adversely affect performance, or alter the size and shape beyond the tolerances agreed upon between the purchaser and the supplier.

When components are repaired, corrected or fabricated, any adhesives used shall be such as to be non-injurious to the foam and the resulting bonds shall be at least as strong as the foam itself.

NOTE — The area of the bond should be sufficient to withstand the service conditions, and a thin overlay should be bonded over a large enough area to prevent rucking or wrinkling in service.

6 Surface condition

There shall be no loose skin on agreed significant surfaces. Mould parting marks and other surface blemishes shall be no worse than those on standard initial samples agreed upon between the purchaser and the supplier.

7 Odour

The odour of the foam shall not be objectionable.[1)]

8 Colour

The colour shall be as agreed upon between the purchaser and the supplier.

9 Component mass

The mass of a component, when required, shall be as agreed upon between the purchaser and the supplier, with a tolerance of ± 15 %, unless otherwise stated.

10 Dimensions

The dimensions of flexible polyurethane foam components shall be as specified by the purchaser, subject to the tolerances given in tables 3 and 4, unless otherwise agreed between the purchaser and the supplier.

NOTE — The trimming allowances are the sole responsibility of the designer. The actual dimensions of a flexible polyurethane foam article used in upholstering should normally be greater than the nominal dimensions by a small amount in order to allow the foam to be compressed slightly by a cover made to the nominal dimensions.

11 Physical and chemical requirements

11.1 When tested in accordance with the method described in ISO 3385, the median value of indentation hardness loss of the three test pieces shall be no greater than the maximum specified in figures 1 or 2 for the class and indentation hardness index of the material supplied. If this requirement is not met, the fatigue test may be repeated with a further four test pieces.

1) Tests for odour have been investigated but none has yet been found to be of practical use in this context.

In this case the median indentation hardness loss of all seven test pieces shall be used for the classification.

Table 3 — Tolerances on length and width

Dimensions in millimetres

Length and/or width	Tolerance
Up to and including 250[1]	+ 5 0
Up to and including 250[2]	+ 10 0
Over 250 up to and including 500	+ 10 0
Over 500 up to and including 1 000	+ 20 0
Over 1 000	+ 30 0

1) Excluding fabricated components.

2) Fabricated components only.

Table 4 — Tolerances on thickness

Dimensions in millimetres

Thickness	Tolerance
Up to and including 25	+ 3 0
Over 25 up to and including 100	+ 4 0
Over 100	+ 6 0

11.2 Flexible polyurethane foam shall comply with the requirements given in tables 5 and 6 or 5 and 7, as appropriate, when tested by the methods indicated.

11.3 The standard test pieces required for the tests listed in table 6 shall not include the surface skin, the adjacent layer of denser material or any portion where there is an obvious defect.

The depth of skin to be removed during test piece preparation may vary considerably, depending on the general configuration of the moulded shape. A minimum of 5 mm shall be removed.

It is permissible, however, to use test pieces of moulded materials with skin if the thickness of the moulding is too low to yield specimens of appropriate size after removal of 5 mm of surface material, or if surface effects are of particular interest. In all such cases, the surface condition of the test pieces shall be stated in the test report.

11.4 Reconstituted or bonded foam shall conform to cleanliness requirements agreed upon between the purchaser and the supplier.

Table 5 — Requirements for all types

Property	Method of test	Requirement
Organic material staining	(A suitable method of test will form the subject of a future International Standard.)	Shall have no deleterious effect
Low temperature flexibility		Shall not tear or crack
Change in tensile strength, % of original value, max., after humidity ageing in accordance with ISO 2440[1]	ISO 1798	30
Change in tensile strength, % of original value, max., after heat ageing in accordance with ISO 2440[2]	ISO 1798	30

1) Maintaining the test pieces at 105 °C and 100 % relative humidity for 3 h.

2) Maintaining the test pieces at 140 °C for 16 h.

Table 6 — Requirements for types B, CB, M and CM (slabstock and moulded foam)

Property	Method of test	Class and type									
		X		V		S		A		L	
		B and M	CB and CM	B and M	CB and CM	B and M	CB and CM	B and M	CB and CM	B and M	CB and CM
Compression set[1], % max.	ISO 1856	Not yet specified	8	6	8	10	12	10	15	10	15
Elongation at break, % min.	ISO 1798	Not yet specified	100	150	90	150	90	150	90	150	90
Tensile strength, kPa min.	ISO 1798	Not yet specified	50	70	50	70	50	70	50	60	50
Tensile strength after heat ageing, kPa min.[2]	ISO 2440, ISO 1798	Not yet specified	35	55	35	55	35	55	35	50	35
Tensile strength after humidity ageing, kPa min.[3]	ISO 2440, ISO 1798	Not yet specified	35	55	35	55	35	55	35	50	35

1) At 75 % compression for 22 h at 70 °C.

2) Maintaining the test pieces at 140°C for 16 h.

3) Maintaining the test pieces at 105 °C and 100 % relative humidity for 3 h.

Table 7 — Requirements for type RE (reconstituted or bonded foam)

Property	Method of test	Requirement
Indentation hardness loss, max.	ISO 3385	As specified in figures 1 and 2 for class V material
Compression set[1], % max.	ISO 1856	20
Elongation at break, % min.	ISO 1798	70
Tensile strength[2], kPa min.	ISO 1798	50

1) At 75 % compression for 22 h at 70 °C.

2) 1 kPa = 1 kN/m^2.

12 Burning characteristics

Flexible polyurethane foam, in common with many other materials, is combustible. The material specified in this International Standard may, however, by agreement between the purchaser and the supplier, be suitably formulated so that, under certain well-defined conditions, its tendency to burn is reduced.

Suitable tests to be the basis of such agreement are specified in ISO 3582 and ISO 3795. Other tests may be chosen depending on the application for which the foam is intended.

NOTE — These test methods are used primarily for the purpose of monitoring the consistency of production of the flexible polyurethane foam. Their use gives an indication of a suitable formulation which influences burning as measured by these test methods. In no circumstances should the test results thus obtained be considered as an overall indication of the potential fire hazard presented by the foam under actual conditions of use (see also annex C).

13 Marking

When so specified by the purchaser, components shall be clearly and permanently marked, by means which are non-staining and non-injurious to the foam, with the following information :

a) manufacturer's identification;

b) manufacturer's date code;

c) type, class and indentation hardness grade;

d) where applicable, indentor location;

e) where applicable, burning characteristics;

f) the number of this International Standard, i.e. ISO 5999.

Annex A

Calculation of specification limits

To facilitate accurate reconstruction of figures 1 and 2, the equations for the curves shown in these figures are as given in table 8.

It is important that similar calculations are not performed on actual experimental results. By doing so, errors would be reintroduced that are eliminated by expressing the losses in absolute units.

This occurs because the hardness measurements are subject to a degree of interlaboratory experimental error. Thus, for absolute results

$$L = (H + \delta) - (F + \delta) = H - F$$

where

F is the final hardness index;

δ is the experimental error of hardness measurement.

But

$$P = \frac{(H + \delta) - (F + \delta)}{(H + \delta)}$$

$$= \frac{H - F}{(H + \delta)}$$

where P is the hardness loss, expressed as a fraction of the initial hardness.

Table 8 — Equations for calculation of specification limits

Class lower boundary	Equation[1)]
X	$L - 0{,}13\,H = 0$
V	$L - 0{,}22\,H = 0$
S	$L - 0{,}32\,H = 0$
A	$L - 0{,}39\,H = 0$
L	$L - 0{,}45\,H = 0$

1) L is the hardness loss on pounding, in newtons; H is the initial hardness index, in newtons.