
International Standard



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**Rubber, raw styrene-butadiene, emulsion polymerized —
Test recipe and method of evaluation**

Caoutchouc butadiène-styrène brut, polymérisé en émulsion — Formule d'essai et méthode d'évaluation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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 2322 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*.

The first edition (ISO 2322-1975) had been approved by the member bodies of the following countries :

Australia	France	Romania
Belgium	Germany, F. R.	Spain
Brazil	Hungary	Sweden
Bulgaria	India	Turkey
Canada	Italy	United Kingdom
Chile	Netherlands	USA
Czechoslovakia	New Zealand	Yugoslavia
Egypt, Arab Rep. of	Poland	

No member body had expressed disapproval of the document.

This second edition, which supersedes ISO 2322-1975 and Amendment 1-1976, which had been submitted directly to ISO Council for acceptance under the abbreviated procedure, incorporates draft Amendment 2, which was circulated to the member bodies in January 1980, and which has been approved by the member bodies of the following countries :

Belgium	India	Spain
Brazil	Italy	Sri Lanka
China	Korea, Rep. of	Sweden
Czechoslovakia	Mexico	Switzerland
Egypt, Arab Rep. of	Netherlands	Thailand
France	Poland	Turkey
Germany, F. R.	Romania	United Kingdom
Hungary	South Africa, Rep. of	USSR

The member body of the following country expressed disapproval of the document on technical grounds :

USA

Rubber, raw styrene-butadiene, emulsion polymerized — Test recipe and method of evaluation

1 Scope and field of application

This International Standard specifies standard materials, equipment and processing methods for evaluating vulcanization characteristics of emulsion-polymerized general purpose styrene-butadiene rubbers (SBR), including oil-extended rubbers.

2 References

ISO 37, *Rubber, vulcanized — Determination of tensile stress-strain properties.*

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

ISO 2393, *Rubber test mixes — Preparation, mixing and vulcanization — Equipment and procedures.*

ISO 3417, *Raw rubber — Measurement of vulcanization characteristics with the oscillating disc curemeter.*

3 Standard test recipe

3.1 Standard test formula

The standard test formula is given in the table.

The materials shall be NBS¹⁾ standard reference materials as indicated in the table, or shall be in accordance with equivalent national standards.

Table

Material	NBS standard reference material number	Parts by mass
Non-pigmented SBR (including oil in oil-extended SBR)	—	100,00
Sulphur	371	1,75
Stearic acid	372	1,00
Oil furnace black (HAF)*	378	50,00
Zinc oxide	370	3,00
TBBS**	384	1,00
		Total 156,75

* The current Industry Reference Black may be used in place of NBS 378, but this may give slightly different results.

** *N-tert-butyl-2-benzothiazole sulphenamide*. This shall be supplied in powder form having an initial ether- or ethanol-insoluble matter content of less than 0,3 %. The material shall be stored at room temperature in a closed container and the ether- or ethanol-insoluble matter shall be checked every 6 months. If this is found to exceed 0,75 %, the materials shall be discarded or recrystallized.

3.2 Procedure

3.2.1 Equipment and procedure

Equipment and procedure for the preparation, mixing and vulcanization shall be in accordance with ISO 2393.

3.2.2 Mill mixing procedure

The standard laboratory mill batch mass, in grams, shall be based on four times the formula mass. The surface

1) National Bureau of Standards of the USA.

temperatures of the rolls shall be maintained at 50 ± 5 °C throughout the mixing.

NOTE — All mill openings should be adjusted to maintain a good rolling bank at the nip of the rolls during mixing.

	Duration (min)
3.2.2.1 Band the rubber with the mill opening set at 1,1 mm and make 3/4 cuts every 30 s from alternate sides	7
3.2.2.2 Add the sulphur slowly and evenly across the rubber	2
3.2.2.3 Add the stearic acid. Make one 3/4 cut from each side	2
3.2.2.4 Add the carbon black evenly across the mill at a uniform rate. When about half the black has been incorporated, open the mill to 1,4 mm and make one 3/4 cut from each side. Then add the remainder of the carbon black, including the black that has dropped into the mill pan. When all the black has been incorporated, open the mill to 1,8 mm and make one 3/4 cut from each side	12
3.2.2.5 Add the zinc oxide and TBBS with the mill opening at 1,8 mm	3
3.2.2.6 Make three 3/4 cuts from each side	3
3.2.2.7 Cut the batch from the mill. Set the mill opening to 0,8 mm and pass the rolled batch endwise through the rolls six times	2
Total time	31
3.2.2.8 Sheet the batch to an approximate thickness of 6 mm and check weigh. Remove sufficient sample for viscometer testing.	
3.2.2.9 Sheet the batch to approximately 2,2 mm for preparing test slabs or to the appropriate thickness for preparing ISO ring specimens.	
3.2.2.10 Condition the batch for 2 to 24 h after mixing and prior to vulcanizing at a standard laboratory temperature (see ISO 471).	

4 Evaluation of vulcanization characteristics

4.1 Evaluation according to stress-strain properties

Vulcanize sheets at 145 °C for three periods selected from a cure series of 15, 25, 35, 50 and 75 min.

NOTES

1 Alternatively, vulcanize the sheets at 150 °C for three periods selected from a cure series of 15, 20, 25, 30, 35 and 50 min. These conditions will give results different from those obtained with the standard vulcanization conditions.

2 The three periods of cure selected should cover the undercure, optimum cure and overcure of the polymer under test.

Condition the vulcanized test slabs for 16 to 72 h at a standard laboratory temperature (see ISO 471).

Measure the stress-strain properties in accordance with ISO 37.

4.2 Evaluation according to oscillating disc curemeter test

Measure the following standard test parameters :

M_L , M_H , t_{50} , $t'_c(50)$ et $t'_c(90)$

in accordance with ISO 3417, using the following test conditions :

oscillation frequency :	1,7 Hz (100 cycles per minute)
amplitude of oscillation :	1° arc
selectivity :	to be chosen to give at least 75 % full scale deflection at M_H
die temperature :	160 °C
pre-heat time :	none

NOTE — If macro-dies are used, a pre-heat time of 1 min is necessary.

5 Precision

To be added later.