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**Rubber compounding ingredients —  
Sulfenamide accelerators — Test  
methods**

*Ingrédients de mélange du caoutchouc — Accélérateurs de type  
sulfénamide — Méthodes d'essai*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 3, *Raw materials (including latex) for use in the rubber industry*.

This third edition cancels and replaces the second edition (ISO 11235:2016), which has been technically revised.

The main changes are as follows:

- errors in [Formula \(1\)](#) and [Formula \(2\)](#) have been corrected;
- the CAS Registry Number<sup>®1)</sup> has been added for each chemical;
- the usage of auto titrator with electrode has been added in [Clause 5](#);
- [Annex A](#) has been changed from “normative” to “informative”.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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# Rubber compounding ingredients — Sulfenamide accelerators — Test methods

**WARNING** — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of any other restrictions.

## 1 Scope

This document specifies the methods to be used for the evaluation of sulfenamide accelerators:

- MBTS: benzothiazyl disulphide;
- CBS: *N*-cyclohexylbenzothiazole-2-sulfenamide;
- TBBS: *N*-*tert*-butylbenzothiazole-2-sulfenamide;
- DIBS: *N,N'*-diisopropylbenzothiazole-2-sulfenamide;
- DCBS: *N,N'*-dicyclohexylbenzothiazole-2-sulfenamide;
- MBS: *N*-oxydiethylenebenzothiazole-2-sulfenamide.

NOTE 1 Although MBTS is not a sulfenamide, it is the primary decomposition product of these accelerators and quantitatively determined by the method specified in [5.2](#).

The analytical methods are applicable for most commercial sulfenamide accelerators:

- sulfenamides of primary amines (type I);
- sulfenamides of unhindered secondary amines (type II);
- sulfenamides of hindered secondary amines (type III).

NOTE 2 Classification and key properties of sulfenamide accelerators are described in [Annex A](#).

The method ([5.2](#)) to determine purity by high performance liquid chromatography (HPLC) is the preferred method.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 385, *Laboratory glassware — Burettes*

ISO 648, *Laboratory glassware — Single-volume pipettes*

ISO 1772, *Laboratory crucibles in porcelain and silica*

ISO 3819, *Laboratory glassware — Beakers*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

ISO 4793, *Laboratory sintered (fritted) filters — Porosity grading, classification and designation*

ISO 6556, *Laboratory glassware — Filter flasks*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

### 3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

**3.1**  
**lot sample**  
sample from production representative of a standard production unit, normally referred to as “the sample”

**3.2**  
**test portion**  
actual material, representative of the lot sample, used for a particular determination

### 4 Determination of physical and chemical properties

#### 4.1 Sampling

The sampling of the product shall be performed in accordance with ISO 15528.

To ensure homogeneity, thoroughly blend at least 250 g of the lot sample before removing the test portion.

#### 4.2 Test methods

The test methods list of sulfenamide accelerators is shown in [Table 1](#).

**Table 1 — List of the test methods**

Property	Clause or subclause of this document
Purity by reduction with MBT and titration	<a href="#">5.1</a>
Purity by high performance liquid chromatography (HPLC)	<a href="#">5.2</a>
Insoluble material	<a href="#">6</a>
Melting range by capillary tube	<a href="#">7.1</a>
Melting range by differential scanning calorimetry (DSC)	<a href="#">7.2</a>
Volatile material	<a href="#">8</a>
Wet sieve analysis	<a href="#">9</a>
Ash	<a href="#">10</a>

#### 4.3 Limit of acceptance

The difference between the results of duplicate determinations shall not exceed the repeatability of the test, if it is defined. Otherwise, it is necessary to repeat the test. When the repeatability is not defined, the results of both determinations shall be reported.