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**Elastomeric seismic-protection  
isolators —**

**Part 2:  
Applications for bridges —  
Specifications**

**iTeh STANDARD PREVIEW**  
*Appareils d'appuis structuraux en élastomère pour protection  
sismique —  
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Partie 2: Applications pour ponts — Spécifications*

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# Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols</b> .....	<b>3</b>
<b>5 Classification</b> .....	<b>6</b>
5.1 General.....	6
5.2 Classification by construction.....	6
5.3 Classification by tolerances on shear stiffness.....	7
<b>6 Requirements</b> .....	<b>7</b>
6.1 General.....	7
6.2 Type tests and routine tests.....	7
6.3 Functional requirements.....	10
6.4 Design compressive force and design shear displacement.....	10
6.5 Performance requirements.....	10
6.5.1 General.....	10
6.5.2 Compressive properties.....	11
6.5.3 Rotation properties.....	11
6.5.4 Shear properties.....	11
6.5.5 Tensile properties.....	12
6.5.6 Dependencies of shear properties.....	13
6.5.7 Shear displacement capacity.....	14
6.5.8 Durability.....	14
6.5.9 Cyclic compressive fatigue properties.....	15
6.5.10 Reaction force characteristics at low-rate deformation.....	15
6.6 Rubber material requirements.....	15
6.6.1 General.....	15
6.6.2 Tensile properties.....	15
6.6.3 Properties after ageing in air.....	16
6.6.4 Hardness.....	17
6.6.5 Adhesion properties.....	17
6.6.6 Compression set.....	17
6.6.7 Ozone resistance.....	18
6.6.8 Other properties.....	18
6.7 Dimensional requirements.....	18
6.8 Requirements on steel used for flanges and reinforcing plates.....	18
<b>7 Design rules</b> .....	<b>18</b>
7.1 General.....	18
7.2 Shape factor.....	20
7.2.1 First shape factor.....	20
7.2.2 Second shape factor.....	20
7.3 Compressive and shear properties.....	21
7.3.1 Compressive stiffness.....	21
7.3.2 Shear stiffness and equivalent damping ratio.....	21
7.4 Shear strain due to horizontal displacements.....	22
7.5 Total local shear strain.....	22
7.5.1 Local shear strain due to compressive force.....	22
7.5.2 Local shear strain due to compressive force.....	22
7.5.3 Total local shear strain.....	23
7.6 Tensile stress on reinforcing steel plates.....	23
7.7 Stability.....	23

7.7.1	Maximum compressive stress in non-seismic condition .....	23
7.7.2	Rotation performance check .....	23
7.7.3	Buckling check .....	24
7.7.4	Tensile stress on isolator .....	24
7.8	Force, moment and deformation affecting structures .....	24
7.8.1	Shear force affecting structures due to movement .....	24
7.8.2	Resistance to rotation .....	24
7.8.3	Compressive displacement due to compressive force .....	25
7.9	Design of fixings .....	25
7.9.1	External forces affecting joint members .....	25
7.9.2	Fixings and stresses to be checked .....	25
7.9.3	Allowable stress .....	26
<b>8</b>	<b>Manufacturing tolerances .....</b>	<b>26</b>
8.1	General .....	26
8.2	Measuring instruments .....	26
8.3	Plan dimensions of isolator body .....	27
8.3.1	Measurement method (see <a href="#">Figure 1</a> ) .....	27
8.3.2	Tolerances .....	27
8.4	Product height .....	28
8.4.1	Measurement method .....	28
8.4.2	Tolerances .....	29
8.5	Flatness of products .....	30
8.5.1	Measurement method .....	30
8.5.2	Tolerances .....	30
8.6	Horizontal offset .....	30
8.6.1	Measurement method .....	30
8.6.2	Tolerances .....	30
8.7	Plan dimensions of flanges .....	30
8.8	Flange thickness .....	31
8.9	Tolerances on positions of flange bolt holes .....	31
<b>9</b>	<b>Marking and labelling .....</b>	<b>32</b>
9.1	Information to be provided .....	32
9.2	Additional requirements .....	32
9.3	Marking and labelling examples .....	33
<b>10</b>	<b>Test methods .....</b>	<b>33</b>
<b>11</b>	<b>Quality assurance .....</b>	<b>33</b>
<b>Annex A</b>	<b>(normative) Tensile stress in reinforcing steel plate .....</b>	<b>34</b>
<b>Annex B</b>	<b>(normative) Buckling stability .....</b>	<b>36</b>
<b>Annex C</b>	<b>(normative) Allowable tensile stress in isolator .....</b>	<b>37</b>
<b>Annex D</b>	<b>(informative) Dependency of ultimate properties on shape factor .....</b>	<b>38</b>
<b>Annex E</b>	<b>(informative) Minimum recommended tensile properties for rubber materials .....</b>	<b>42</b>
<b>Annex F</b>	<b>(informative) Compressive stiffness .....</b>	<b>43</b>
<b>Annex G</b>	<b>(informative) Determination of shear properties of elastomeric isolators .....</b>	<b>47</b>
<b>Annex H</b>	<b>(informative) Determination of local shear strain due to compression .....</b>	<b>52</b>
<b>Annex I</b>	<b>(informative) Maximum compressive stress .....</b>	<b>55</b>
<b>Bibliography</b>	<b>.....</b>	<b>56</b>

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ISO 22762-2:2018  
<https://standards.iteh.ai/catalog/standards/sist/e94e141-585d-494f-9988-b72a67907711/iso-22762-2-2018>

## 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)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 4, *Products (other than hoses)*.

This third edition cancels and replaces the second edition (ISO 22762-2:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the definitions of some symbols in [Clause 4](#) have been changed.

A list of all parts in the ISO 22762 series can be found on the ISO website.

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).

## Introduction

ISO 22762 series includes two parts related to specifications for isolators, i.e. ISO 22762-2 for bridges and ISO 22762-3 for buildings. This is because the isolator requirements for bridges and buildings are quite different, although the basic concept of the two products is similar. Therefore, ISO 22762-2 and the relevant clauses in ISO 22762-1 are used when ISO 22762 (all parts) is applied to the design of bridge isolators whereas ISO 22762-3 and the relevant clauses of ISO 22762-1 are used when it is applied to building isolators.

The main differences to be noted between isolators for bridges and isolators for buildings are the following.

- a) Isolators for bridges are mainly rectangular in shape and those for buildings are circular in shape.
- b) Isolators for bridges are designed to be used for both rotation and horizontal displacement, while isolators for buildings are designed for horizontal displacement only.
- c) Isolators for bridges are designed to perform on a daily basis to accommodate length changes of bridges caused by temperature changes as well as during earthquakes, while isolators for buildings are designed to perform only during earthquakes.
- d) Isolators for bridges are designed to withstand dynamic loads caused by vehicles on a daily basis as well as earthquakes, while isolators for buildings are mainly designed to withstand dynamic loads caused by earthquakes only.

For structures other than buildings and bridges (e.g. tanks), the structural engineer uses either ISO 22762-2 or ISO 22762-3, depending on the requirements of the structure.

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# Elastomeric seismic-protection isolators —

## Part 2: Applications for bridges — Specifications

### 1 Scope

This document specifies minimum requirements and test methods for elastomeric seismic isolators used for bridges, as well as rubber material used in the manufacture of such isolators.

It is applicable to elastomeric seismic isolators used to provide bridges with protection from earthquake damage. The isolators covered consist of alternate elastomeric layers and reinforcing steel plates, which are placed between a superstructure and its substructure to provide both flexibility for decoupling structural systems from ground motion and damping capability to reduce displacement at the isolation interface and the transmission of energy from the ground into the structure at the isolation frequency.

### 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 630 (all parts), *Structural steels*

ISO 22762-2:2018

ISO 22762-1:2018, *Elastomeric seismic-protection isolators — Part 1: Test methods*

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### 3 Terms and definitions

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

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

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

#### 3.1

##### **breaking**

rupture of *elastomeric isolator* (3.9) due to compression- (or tension-) shear loading

#### 3.2

##### **buckling**

state when *elastomeric isolators* (3.9) lose their stability under compression-shear loading

#### 3.3

##### **compressive stiffness**

$K_v$

compressive stiffness for all types of rubber bearings

#### 3.4

##### **cover rubber**

rubber wrapped around the outside of inner rubber and reinforcing steel plates before or after curing of *elastomeric isolators* (3.8) for the purposes of protecting the inner rubber from deterioration due to oxygen, ozone and other natural elements and protecting the reinforcing plates from corrosion

**3.5**  
**design compressive stress**

long-term compressive force on the *elastomeric isolators* (3.8) imposed by the structure

**3.6**  
**effective loaded area**

area sustaining vertical load in *elastomeric isolators* (3.8), which corresponds to the area of reinforcing steel plates

**3.7**  
**effective width**

<rectangular elastomeric isolator> the smaller of the two side lengths of inner rubber to which direction shear displacement is not restricted

**3.8**  
**elastomeric isolator**

rubber bearing, for seismic isolation of buildings, bridges and other structures, which consists of multi-layered vulcanized rubber sheets and reinforcing steel plates

EXAMPLE High-damping rubber bearings, linear natural rubber bearings and lead rubber bearings.

**3.9**  
**first shape factor**

ratio of effectively loaded area to free deformation area of one inner rubber layer between steel plates

**3.10**  
**high-damping rubber bearing**  
**HDR**

*elastomeric isolator* (3.8) with relatively high damping properties obtained by special compounding of the rubber and the use of additives

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**3.11**  
**inner rubber**

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rubber between multi-layered steel plates inside an *elastomeric isolator* (3.8)

**3.12**  
**lead rubber bearing**  
**LRB**

*elastomeric isolator* (3.8) whose *inner rubber* (3.11) with a lead plug or lead plugs press fitted into a hole or holes of the isolator body to achieve damping properties

**3.13**  
**linear natural rubber bearing**  
**LNR**

*elastomeric isolator* (3.8) with linear shear force-deflection characteristics and relatively low damping properties, fabricated using natural rubber

Note 1 to entry: Any bearing with relatively low damping can be treated as an LNR bearing for the purposes of isolator testing.

**3.14**  
**maximum compressive stress**

peak stress acting briefly on *elastomeric isolators* (3.8) in compressive direction during an earthquake

**3.15**  
**nominal compressive stress**

long-term stress acting on *elastomeric isolators* (3.8) in compressive direction as recommended by the manufacturer for the isolator, including the safety margin



**3.16****roll-out**

instability of an isolator with either dowelled or recessed connection under shear displacement

**3.17****routine test**

test for quality control of the production isolators during and after manufacturing

**3.18****second shape factor**

<circular elastomeric isolator> ratio of the diameter of the inner rubber to the total thickness of the inner rubber

**3.19****second shape factor**

<rectangular or square elastomeric isolator> ratio of the effective width of the inner rubber to the total thickness of the inner rubber

**3.20****shear properties of elastomeric isolators**

comprehensive term that covers characteristics determined from isolator tests:

- shear stiffness,  $K_h$ , for LNR;
- shear stiffness,  $K_h$ , and equivalent damping ratio,  $h_{eq}$ , for HDR and LRB;
- post-yield stiffness,  $K_d$ , and characteristic strength,  $Q_d$ , for LRB

**3.21****structural engineer**

engineer who is in charge of designing the structure for base-isolated bridges or buildings and is responsible for specifying the requirements for *elastomeric isolators* (3.8)

**3.22****type test**

test for verification either of material properties and isolator performances during development of the product or that project design parameters are achieved

**3.23****ultimate properties**

properties at either buckling, breaking, or roll-out of an isolator under compression-shear loading (see Annex D).

**4 Symbols**

For the purposes of this document, the symbols given in [Table 1](#) apply.

**Table 1 — Symbols and descriptions**

Symbol	Description
$A$	effective plan area; plan area of elastomeric isolator, excluding cover rubber portion
$A_b$	effective area of bolt
$A_e$	overlap area between the top and bottom elastomer area of isolator
$A_{free}$	load-free area of isolator
$A_{load}$	loaded area of isolator
$A_p$	area of the lead plug for a lead rubber bearing
$a$	side length of square elastomeric isolator, excluding cover rubber thickness, or length in longitudinal direction of rectangular isolator, excluding cover rubber thickness

Table 1 (continued)

Symbol	Description
$a_e$	length of the shorter side of the rectangular isolator, including cover rubber thickness
$a'$	length in longitudinal direction of the rectangular isolator, including cover rubber thickness
$B$	effective width for bending of flange
$b$	length in transverse direction of the rectangular isolator, excluding cover rubber thickness
$b'$	length in transverse direction of the rectangular isolator, including cover rubber thickness
$c$	distance from centre of bolt hole to effective flange section
$D'$	outer diameter of circular isolator, including cover rubber
$D_f$	diameter of flange
$d_i$	inner diameter of reinforcing steel plate
$d_k$	diameter of bolt hole
$d_0$	outer diameter of reinforcing steel plate
$E_{ap}$	apparent Young's modulus of bonded rubber layer
$E_c$	apparent Young's modulus corrected, if necessary, by allowing for compressibility
$E_c^s$	apparent Young's modulus corrected for bulk compressibility depending on its shape factor ( $S_1$ )
$E_\infty$	bulk modulus of rubber
$E_0$	Young's modulus of rubber
$F_u$	tensile force on isolator by uplift
$G$	shear modulus
$G_{eq}(\gamma)$	equivalent linear shear modulus at shear strain $\gamma$
$H$	height of elastomeric isolator, including mounting flange
$H_n$	height of elastomeric isolator, excluding mounting flange
$h_{eq}$	equivalent damping ratio
$h_{eq}(\gamma)$	equivalent damping ratio as a function of shear strain $\gamma$
$K_d$	post-yield stiffness (tangential stiffness after yielding of lead plug) of lead rubber bearing
$K_h$	shear stiffness
$K_i$	initial shear stiffness
$K_p$	shear stiffness of lead plug inserted in lead rubber bearing
$K_r$	shear stiffness of lead rubber bearing before inserting lead plug
$K_t$	tangential shear stiffness
$K_v$	compressive stiffness
$L_f$	length of one side of a rectangular flange
$M$	resistance to rotation
$M_f$	moment acting on bolt
$M_r$	moment acting on isolator
$n$	number of rubber layers
$n_b$	number of fixing bolts
$P$	compressive force
$P_0$	design compressive force in absence of seismic action effects
$P_{max}$	maximum compressive force including seismic action effects
$P_{min}$	minimum compressive force including seismic actions effects (the minimum may be negative; ie the minimum force may be tensile)
$Q$	shear force
$Q_b$	shear force at break
$Q_{buk}$	shear force at buckling

Table 1 (continued)

Symbol	Description
$Q_d$	characteristic strength
$S_1$	first shape factor
$S_2$	second shape factor
$T$	temperature
$T_0$	standard temperature, 23 °C or 27 °C; where specified tolerance is $\pm 2$ °C, $T_0$ is standard laboratory temperature
$T_r$	total rubber thickness, given by $T_r = n \times t_r$
$t_r$	thickness of one rubber layer
$t_{r1}, t_{r2}$	thickness of rubber layer laminated on each side of plate
$t_s$	thickness of one reinforcing steel plate
$t_0$	thickness of outside cover rubber
$U(\gamma)$	function giving ratio of characteristic strength to maximum shear force of a loop
$V$	uplift force
$v$	loading velocity
$W_d$	energy dissipated per cycle
$X$	shear displacement
$X_0$	design shear displacement
$X_b$	shear displacement at break
$X_{buk}$	shear displacement at buckling
$X_s$	shear displacement due to quasi-static shear movement
$X_{max}$	maximum shear displacement
$X_d$	shear displacement due to dynamic shear movement
$Y$	compressive displacement
$Z$	section modulus of flange
$\alpha$	coefficient of linear thermal expansion
$\gamma$	shear strain
$\gamma_0$	design shear strain
$\gamma_a$	upper limit of the total of design strains on elastomeric isolators
$\gamma_b$	shear strain at break
$\gamma_c$	local shear strain due to compressive force
$\gamma_d$	shear strain due to dynamic shear movement
$\gamma_{max}$	maximum design shear strain during earthquake
$\gamma_r$	local shear strain due to rotation
$\gamma_s$	shear strain due to quasi-static shear movement
$\gamma_u$	ultimate shear strain
$\delta_H$	horizontal offset of isolator
$\delta_v$	difference in isolator height measured between two points at opposite extremes of the isolator
$\epsilon$	compressive strain of rubber
$\epsilon_{cr}$	creep strain
$\epsilon_T$	tensile strain of isolator
$\epsilon_{Tb}$	tensile-break strain of isolator
$\epsilon_{Ty}$	tensile-yield strain of isolator
$\zeta$	ratio of total height of rubber and steel layers to total rubber height

**Table 1** (continued)

Symbol	Description
$\theta$	rotation angle of isolator about the diameter of a circular bearing or about an axis through a rectangular bearing
$\theta_a$	rotation angle of isolator in the longitudinal direction (a)
$\theta_b$	rotation angle of isolator in the transverse direction (b)
$\lambda$	correction factor for calculation of stress in reinforcing steel plates
$\eta$	correction factor for calculation of critical stress
$\kappa$	correction factor for apparent Young's modulus according to hardness
$\Sigma\gamma$	total local shear strain
$\sigma$	compressive stress in isolator
$\sigma_0$	design compressive stress
$\sigma_B$	tensile stress in bolt
$\sigma_b$	bending stress in flange
$\sigma_{bf}$	allowable bending stress in steel
$\sigma_{cr}$	critical stress in isolator
$\sigma_f$	allowable tensile stress in steel
$\sigma_{max}$	maximum design compressive stress
$\sigma_{min}$	minimum design compressive stress
$\sigma_{nom}$	for building: nominal compressive stress recommended by manufacturer
$\sigma_s$	tensile stress in reinforcing steel plate
$\sigma_{sa}$	allowable tensile stress in steel plate
$\sigma_{sy}$	yield stress of steel for flanges and reinforcing steel plates
$\sigma_{su}$	tensile strength of steel for flanges and reinforcing steel plates
$\sigma_t$	tensile stress
$\sigma_{te}$	allowable tensile stress in isolator
$\tau_B$	shear stress in bolt
$\tau_f$	allowable shear stress in steel
$\phi$	factor for computation of buckling stability
$\xi$	factor for computation of critical stress

## 5 Classification

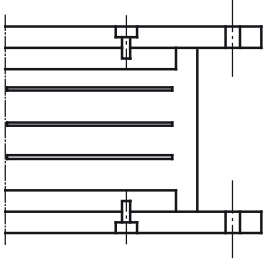
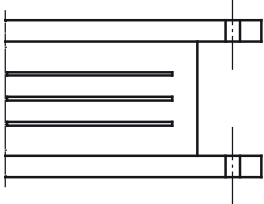
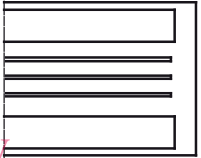
### 5.1 General

Elastomeric isolators are classified by construction, their ultimate properties and tolerances on their performance.

### 5.2 Classification by construction

Elastomeric isolators are classified by construction, as shown in [Table 2](#). The structural engineer shall specify which construction is to be used.

**Table 2 — Classification by construction**

Type	Construction	Illustration
<b>Type I</b>	Mounting flanges are bolted to connecting flanges, which are bonded to the laminated rubber.	
<b>Type II</b>	Mounting flanges are directly bonded to the laminated rubber.	
<b>Type III</b>	Isolators without mounting flanges	

### 5.3 Classification by tolerances on shear stiffness

Elastomeric isolators may be classified by their tolerance on shear stiffness, as shown in [Table 3](#). The structural engineer shall specify the tolerance required.

**Table 3 — Classification by tolerance on shear stiffness**

Class	Tolerance %
S-A	±10
S-B	±20

## 6 Requirements

### 6.1 General

Elastomeric isolators for bridges and the materials used in their manufacture shall meet the requirements specified in this clause. For test items (see [Table 4](#)) that have no specific required values, the manufacturer shall define the values and inform the purchaser prior to production.

The standard temperature for determining the properties of elastomeric isolators is 23 °C or 27 °C in accordance with prevailing International Standards. However, it is advisable to establish a range of working temperatures, taking into consideration actual environmental temperatures and possible changes in temperature at the work site where the elastomeric isolators are installed.

### 6.2 Type tests and routine tests

**6.2.1** Testing to be carried out on elastomeric isolators is classified into

- a) type tests, and

b) routine tests.

**6.2.2** Type tests shall be conducted either to ensure that project design parameters have been achieved (in which case the test results shall be submitted to the structural engineer for review prior to production) or to verify isolator performance and material properties during development of an isolator. The test piece for each type test shall be full-scale or one of the options specified in [Table 4](#). The test piece shall not have been subjected to any previous test programme. The tests shall be performed on test pieces not subjected to any scragging, unless the production isolators are to be supplied after scragging. In that case, the test pieces shall be subjected to the same scragging procedure as the production isolators

**6.2.3** Previous type test results may be substituted, provided the following conditions are met.

- a) Isolators are fabricated in a similar manner and from the same compound and adhesive.
- b) All corresponding external and internal dimensions are within 10 % of each other.
- c) The second shape factors are within  $\pm 10$  %.
- d) The test conditions such as maximum and minimum vertical load applied in the ultimate property test, as described in [6.5.7](#), are more severe.

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Table 4 — Tests on products

Properties	Test item	Test method in ISO 22762-1:2018	Routine test	Type test	Test piece <sup>a</sup>
Compressive properties Rotation performance	Compressive stiffness Compressive deflection	6.2.1, method 1	X	X	Full-scale only
Shear properties	Shear stiffness Equivalent damping ratio Post-yield stiffness (for LRB) Characteristic strength (for LRB)	6.2.2	X	X	Full-scale only
Tensile properties	Tensile fracture strength Shear strain	6.5	N/A	Opt.	Scale B
Dependency of shear properties	Shear strain dependency	6.3.1	N/A	X	Scale B
	Compressive stress dependency	6.3.2	N/A	Opt.	Scale B
	Frequency dependency	6.3.3 5.8	N/A	X(m)	Scale A, STD, SBS
	Repeated loading dependency	6.3.4 ISO 22762-2:2018	N/A	X	Scale B
	Temperature dependency	6.3.5 5.8 <a href="https://standards.iteh.ai/catalog/standards/sist/e94e141-585d-494f-9988-b72a679077b1/iso-22762-2-2018">https://standards.iteh.ai/catalog/standards/sist/e94e141-585d-494f-9988-b72a679077b1/iso-22762-2-2018</a>	N/A	X(m)	Scale A, STD, SBS
Shear displacement capacity	Breaking strain Buckling strain Roll-out strain	6.4	N/A	X	Scale B
Durability	Ageing	6.6.1 5.8	N/A	X(m)	Scale A, STD, SBS
	Creep	6.6.2	N/A	X	Scale A
Cyclic compressive fatigue	Shear stiffness	6.6.3	N/A	X	Scale B
Reaction force characteristics at low-rate deformation	Shear stiffness or shear force	6.7	N/A	Opt.	Scale A

X: Test to be conducted with isolators.

X(m): Test can be conducted either with isolators or with shear-block test pieces.

N/A: Not applicable.

Opt.: Optional.

Scale A: Scaling such that, for a circular bearing, diameter  $\geq 150$  mm, for a rectangular bearing, side length  $\geq 100$  mm and, for both types, rubber layer thickness  $\geq 1,5$  mm and thickness of reinforcing steel plates  $\geq 0,5$  mm.

Scale B: Scaling such that, for a circular bearing, diameter  $\geq 450$  mm, for a rectangular bearing, side length  $\geq 400$  mm and, for both types, rubber layer thickness  $\geq 1,5$  mm and thickness of reinforcing steel plates  $\geq 0,5$  mm.

STD: Standard test piece (see Tables 12 and 13 of ISO 22762-1:2018).

SBS: Shear-block test piece specified in ISO 22762-1:2018, 5.8.3. With LRB, SBS shall only be used for ageing tests.

<sup>a</sup> Test piece may in all cases be a full-scale isolator. This column indicates other options, where these exist.