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Elastomeric seismic-protection isolators —

Part 3: Applications for buildings — Specifications

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Partie 3: Applications pour bâtiments — Spécifications ISO 22762-3:2005 https://standards.iteh.ai/catalog/standards/sist/ba2cc427-6b93-4b39-8622-30e4d507c131/iso-22762-3-2005



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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 22762-3 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

ISO 22762 consists of the following parts, under the general title *Elastomeric seismic-protection isolators*: (standards.iteh.ai)

- Part 1: Test methods
- Part 2: Applications for bridges Specifications https://standards.iteh.av/catalog/standards/sist/ba2cc427-6b93-4b39-8622-
- Part 3: Applications for buildings Specifications

Introduction

This International Standard contains two parts related to specifications for isolators — one for bridges and the other for buildings — since the requirements for isolators for bridges and for buildings are quite different, although the basic concept of the two products is similar. Therefore, when this International Standard is applied to the design of bridge isolators, Part 2 and the relevant clauses in Part 1 are used and, when it is applied to building isolators, Part 3 and the relevant clauses in Part 1 are used.

The main differences to be noted between isolators for bridges and isolators for buildings are as below:

- a) Isolators for bridges are mainly rectangular in shape and those for buildings 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 that are neither buildings nor bridges (e.g. tanks), the structural engineer may use either Part 2 or Part 3 of this International Standard, depending on the requirements of the structure.

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Elastomeric seismic-protection isolators —

Part 3: Applications for buildings — Specifications

1 Scope

ISO 22762 applies to elastomeric seismic isolators used to provide buildings or bridges with protection from earthquake damage. The isolators covered consist of alternate elastomer layers and reinforcing steel plates. They 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.

This part of ISO 22762 specifies the requirements for elastomeric seismic isolators used for buildings and the requirements for the rubber material used in the manufacture of such isolators. The specification covers requirements, design rules, manufacturing tolerances, marking and labelling and test methods for elastomeric isolators.

Some items of classification and some requirements need to be confirmed before production and these should be reviewed using the list given in Annex B.

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2 Normative references ^{30e4d507c1}

The following referenced documents are indispensable for the application 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, Structural steels — Plates, wide flats, bars, sections and profiles

ISO 1052, Steels for general engineering purposes

ISO 1629, Rubber and latices — Nomenclature

ISO 3302-1, Rubber — Tolerances for products — Part 1: Dimensional tolerances

ISO 22762-1:2005, Elastomeric seismic-protection isolators — Part 1: Test methods

3 Terms and definitions

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

3.1

breaking

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

3.2

buckling

state when elastomeric isolators lose their stability under compressive-shear loading

3.3

compressive properties of elastomeric isolator

compressive stiffness (K_v) for all types of rubber bearings

3.4

compressive-shear testing machine

machine used to test elastomeric isolators, which has the capability of shear loading under constant compressive load

3.5

cover rubber

rubber wrapped around the outside of inner rubber and reinforcing steel plates before or after curing of elastomeric isolators for the purpose of protecting the inner rubber from deterioration due to oxygen, ultraviolet rays and other natural elements and protecting the reinforcing plates from corrosion

3.6

3.7

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design compressive stress

long-term compressive force on the elastomeric isolator imposed by the structure

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30e4d507c131/iso-22762-3-2005

effective loaded area

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

3.8

effective width

 $\langle rectangular \ elastomeric \ isolator \rangle$ the smaller of the two side lengths of inner rubber to which direction shear displacement is not restricted

3.9

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

NOTE Types of such isolators include high-damping rubber bearings, linear natural rubber bearings and lead rubber bearings.

3.10

first shape factor

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

3.11

high-damping rubber bearing

HDR

elastomeric isolator with relatively high-damping properties obtained by special compounding of the rubber and the use of additives

3.12

inner rubber

rubber between multi-layered steel plates inside an elastomeric isolator

3.13

lead rubber bearing

LRB

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

3.14

linear natural rubber bearing

LNR

elastomeric isolator with linear shear force-deflection characteristics and relatively low-damping properties and fabricated using natural rubber

NOTE Any bearing with relatively low damping may be treated as an LNR bearing for the purposes of isolator testing.

3.15

maximum compressive stress

maximum compressive stress acting briefly on elastomeric isolators during an earthquake

3.16

nominal compressive stress

long-term compressive stress recommended by the manufacturer for the isolator, including the safety margin iTeh STANDARD PREVIEW

3.17 roll-out

(standards.iteh.ai)

ISO 22762-3:2005

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

3.18

not the set https://standards.iteh.ai/catalog/standards/sist/ba2cc427-6b93-4b39-8622-30e4d507c131/iso-22762-3-2005

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

3.19

second shape factor

(circular elastomeric isolator) ratio of the diameter of the inner rubber to the total thickness of the inner rubber

 $\langle rectangular \ or \ square \ elastomeric \ isolator \rangle$ ratio of the effective width of the inner rubber to the total thickness of the inner rubber

3.20

shear properties of elastomeric isolators

a 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 of structure for base-isolated bridges or buildings and is responsible for specifying the requirements for elastomeric isolators

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 compressive-shear loading

3.24

ultimate property diagram

UPD

diagram giving the interaction curve of compressive stress and buckling strain or breaking strain of an elastomeric isolator

4 Symbols and abbreviated terms

For the purposes of all three parts of ISO 22762, the symbols given in Table 1 apply.

Table 1 — Symbols and definitions

Symbol	Definition		
A	effective plan area; plan area of elastomeric isolator excluding cover rubber portion		
A_{b}	effective area of bolt (standards.iteh.ai)		
A_{e}	overlap area between the top and bottom elastomer area of isolator sheared under non-seismic displacement ISO 22762-3:2005		
A_{free}	https://standards.iteh.ai/catalog/standards/sist/ba2cc427-6b93-4b39-8622- load-free area of isolator 30e4d507c131/iso-22762-3-2005		
A_{load}	loaded area of isolator		
A_{p}	area of the lead plug for a lead rubber bearing		
а	side length of square elastomeric isolator excluding cover rubber thickness, or length in longitudinal direction of rectangular isolator excluding cover rubber thickness		
a _e	length of the shorter side of the rectangular isolator including cover rubber thickness		
<i>a</i> '	length in longitudinal direction of the rectangular isolator, including cover rubber thickness		
В	effective width for bending of flange		
b	length in transverse direction of the rectangular isolator, excluding cover rubber thickness		
<i>b</i> '	length in transverse direction of the rectangular isolator, including cover rubber thickness		
С	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*_o 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 the shape factor (S_1)
- E_{∞} bulk modulus of rubber
- *E*₀ Young's modulus of rubber
- $F_{\rm u}$ tensile force on isolator by uplift
- G shear modulus
- $G_{eq}(\gamma)$ equivalent linear shear modulus at shear strain γ
 - *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 **EVIEW**
 - K_d post-yield stiffness (tangential stiffness after yielding of lead plug) of lead rubber bearing
 - K_h
 shear stiffness
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 - K_i initial shear stiffness 30e4d507c131/iso-22762-3-2005
 - K_{p} shear stiffness of lead plug inserted in lead rubber bearing
 - $K_{\rm r}$ shear stiffness of lead rubber bearing before inserting lead plug
 - K_{t} tangential shear stiffness
 - K_v compressive stiffness
 - $L_{\rm f}$ length of one side of a square flange
 - *M* resistance to rotation
 - M_{f} moment acting on bolt
 - $M_{\rm r}$ moment acting on isolator
 - *n* number of rubber layers
 - *n*_b number of fixing bolts
 - *P* compressive force
 - *P*₀ design compressive force
 - *P*_{max} maximum design compressive force

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$P_{\sf min}$	minimum design compressive force		
P_{Tb}	tensile force at break of isolator		
P_{Ty}	tensile force at yield of isolator		
Q	shear force		
Q_{b}	shear force at break		
\mathcal{Q}_{buk}	shear force at buckling		
Q_{d}	characteristic strength		
<i>S</i> ₁	first shape factor		
<i>S</i> ₂	second shape factor		
Т	temperature		
T _r	total rubber thickness, given by $T_r = n \times t_r$		
t _r	thickness of one rubber layer		
<i>t</i> _{r1} , <i>t</i> _{r2}	thickness of rubber layer laminated on each side of plate ${f REVIEW}$		
t _s	thickness of one reinforcing steel plate dards.iteh.ai)		
t _o	thickness of outside cover rubber ISO 22762-3:2005		
$U(\gamma)$	https://standards.iteh.ai/catalog/standards/sist/ba2cc427-6b93-4b39-8622- 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		
Х	shear displacement		
X ₀	design shear displacement		
X_{b}	shear displacement at break		
\boldsymbol{X}_{buk}	shear displacement at buckling		
Xs	shear displacement due to quasi-static shear movement		
X_{max}	maximum design shear displacement		
X_{d}	shear displacement due to dynamic shear movement		
Y	compressive displacement		
Ζ	section modulus of flange		
α	coefficient of linear thermal expansion		
γ	shear strain		

- γ_0 design shear strain
- γ_a upper limit of the total of design strains on elastomeric isolators
- γ_{b} shear strain at break
- *Y*_c local shear strain due to compressive force
- γ_d shear strain due to dynamic shear movement
- % maximum shear strain during earthquake
- γ_r local shear strain due to rotation
- γ_{s} shear strain due to quasi-static shear movement
- γ_{u} ultimate shear strain
- δ_{H} horizontal offset of isolator
- $\delta_{\rm V}$ difference in isolator height measured between two points at opposite extremes of the isolator
- ε compressive strain of isolator
- *c*reep strain iTeh STANDARD PREVIEW
- ε_T tensile strain of isolato (standards.iteh.ai)
- ε_{Tb} tensile strain at break of isolator ISO 22762-3:2005
- ετy tensile strain/at yield of solator log/standards/sist/ba2cc427-6b93-4b39-8622-
 - 30e4d507c131/iso-22762-3-2005
- ζ ratio of total rubber height to total height of rubber and steel layers
- θ rotation angle of isolator about the diameter of a circular bearing or about an axis through a rectangular bearing
- θ_a rotation angle of isolator in the longitudinal direction (a)
- $\theta_{\rm b}$ rotation angle of isolator in the transverse direction (b)
- λ correction factor for calculation of stress in reinforcing steel plates
- η correction factor for calculation of critical stress
- *κ* correction factor for apparent Young's modulus according to hardness
- $\Sigma \gamma$ total local shear strain
- ρ_{R} safety factor for roll-out
- $\rho_{\rm T}$ safety factor for tensile force
- σ compressive stress in isolator
- σ_0 design compressive stress
- $\sigma_{\rm B}$ tensile stress in bolt

- $\sigma_{\rm b}$ bending stress in flange
- σ_{bf} allowable bending stress in steel
- $\sigma_{
 m cr}$ critical stress in isolator
- $\sigma_{\rm f}$ allowable tensile stress in steel
- σ_{max} maximum design compressive stress
- σ_{min} minimum design compressive stress
- σ_{nom} for building: nominal long term compressive stress recommended by manufacturer
- σ_{s} tensile stress in reinforcing steel plate
- σ_{sa} allowable tensile stress in steel plate
- σ_{sy} yield stress of steel for flanges and reinforcing steel plates
- σ_{su} tensile strength of steel for flanges and reinforcing steel plates
- $\sigma_{\rm t}$ tensile stress
- σ_{te} allowable tensile stress in isolator ANDARD PREVIEW
- $\sigma_{\rm yi}$ yield stress in steel plate
- *τ*_B shear stress in bolt <u>ISO 22762-3:2005</u> https://standards.iteh.ai/catalog/standards/sist/ba2cc427-6b93-4b39-8622-
- $\tau_{\rm f}$ allowable shear stress in steel <u>30e4d507c131/iso-22762-3-2005</u>
- ϕ factor for computation of buckling stability
- Ψ factor for computation of buckling check
- ξ 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.

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5.2 Classification by construction

Elastomeric isolators are classified by construction as shown in Table 2.

Other methods not listed in Table 2 may be used to fix flanges to the laminated rubber if the resulting construction has adequate strength to resist the shear forces and bending moments due to shear deflection. Furthermore, such constructions shall be capable of resisting tension if the elastomeric isolator is designed for uplift.

Туре І	Mounting flanges are bolted to connecting flanges, which are bonded to the laminated rubber. Cover rubber is added before curing of isolator.	
турет	Mounting flanges are bolted to connecting flanges, which are bonded to the laminated rubber. Cover rubber is added after curing of isolator.	
Type II	Mounting flanges are directly bonded to the Laminated rubber.	ANDARI PREVI andar d
Type III	30 Isolators without mounting flanges, connected to base by	Iso 22/02-32005 Icatalog/standards/sist/ba2cc427-6b93-4b39-8622- e4d507
	either recess rings or dowell pins.	Dowell connection

Table 2 — Classification by construction