



# Technical Report

**ISO/TR 22762-7**

## Elastomeric seismic-protection isolators —

### Part 7: Relationship of the ISO 22762 series to the design and testing of seismic isolation systems

*Isolateurs en élastomère pour la protection sismique —*

*Partie 7: Relation entre la série ISO 22762 et la conception et les  
essais des systèmes de protection sismique*

**First edition  
2024-07**

iTeh Standards  
(<https://standards.iteh.ai>)  
Document Preview

[ISO/TR 22762-7:2024](https://standards.iteh.ai/catalog/standards/iso/1036faec-c7af-4e12-a9a5-33b7256781b7/iso-tr-22762-7-2024)

<https://standards.iteh.ai/catalog/standards/iso/1036faec-c7af-4e12-a9a5-33b7256781b7/iso-tr-22762-7-2024>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2024

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</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 Structure of ISO 22762 from perspective of relationship with this document</b> .....	<b>4</b>
<b>6 Application of ISO 22762 to the testing and design requirements of elastomeric isolators given in building codes</b> .....	<b>5</b>
6.1 General.....	5
6.2 Correspondence between seismic codes and ISO 22762: Key design terms and definitions.....	5
6.3 Correspondence between seismic codes and ISO 22762: Testing.....	6
6.3.1 Qualification tests.....	6
6.3.2 Prototype tests.....	6
6.3.3 Production tests.....	7
6.4 Determination of property modification factors.....	8
6.5 Differences in property definitions between seismic codes and ISO 22762.....	9
<b>Annex A (informative) Comparison table of requirements for isolators in ISO 22762-6 and EN 15129</b> .....	<b>10</b>
<b>Annex B (informative) Examples of test data by ISO 22762 corresponding to typical prototype tests specified in seismic codes</b> .....	<b>14</b>
<b>Annex C (informative) Examples of test data by ISO 22762 for determination of property modification factors specified in seismic codes</b> .....	<b>32</b>
<b>Annex D (informative) An example of differences in measured value of properties for HDR due to differences in definition formulae of seismic code (ASCE/SEI 7-22) and ISO 22762</b> .....	<b>39</b>
<b>Bibliography</b> .....	<b>40</b>

## 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 document 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.

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)*.

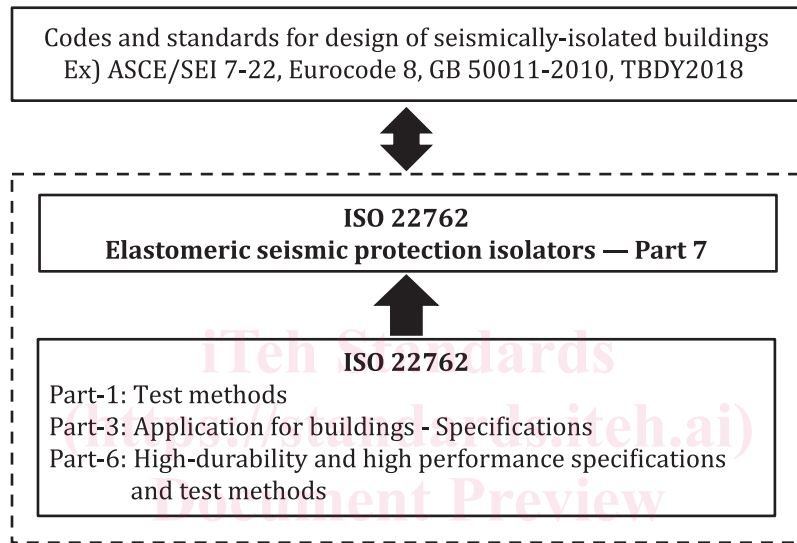
A list of all parts in the ISO 22762 series can be found on the ISO website.

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).

<https://standards.iteh.ai/catalog/standards/iso/1036faec-c7af-4e12-a9a5-33b7256781b7/iso-tr-22762-7-2024>

## Introduction

Elastomeric isolators are one of the most popular types of seismic isolation systems for buildings worldwide. Structural engineers must comply with national building code requirements, or guidelines if detailed code provisions for isolation do not exist, and generally that means designing in accordance with a standard, such as ASCE/SEI 7-22. In these codes and guidelines, the requirements for isolators must satisfy design demands determined by structural seismic response analysis. The ISO 22762 series provides detailed requirements for testing and design of elastomeric isolators and gives different requirements (grades) according to the target performance level for the isolation system. This document is intended to explain the relationship between the requirements in national seismic codes with ASCE/SEI 7-22 used by way of example throughout, and ISO 22762 series, with the goal of allowing structural engineers to more effectively, and more widely, make use of ISO 22762 series when designing seismically-isolated buildings. ASCE/SEI 7-22 is used throughout this document as an example building code for seismically-isolated buildings, and any reference to “seismic code” may be understood to refer to that document. The concept of this document is given in [Figure 1](#).



**Figure 1 — Conceptual diagram showing the role of ISO/TR 22762-7**

<https://standards.iteh.ai/catalog/standards/iso/1036faec-c7af-4e12-a9a5-33b7256781b7/iso-tr-22762-7-2024>



# Elastomeric seismic-protection isolators —

## Part 7:

# Relationship of the ISO 22762 series to the design and testing of seismic isolation systems

## 1 Scope

This document explains the relationship of the ISO 22762 series to the design and testing of seismic isolation systems, including the relationship to national seismic codes.

## 2 Normative references

There are no normative references in this document.

## 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* (3.6) due to compression- (or tension-) shear loading

### 3.2

#### **buckling**

state when *elastomeric isolators* (3.6) lose their stability under compression-shear loading

### 3.3

#### **compressive properties of elastomeric isolator**

$K_v$

compressive stiffness for all types of rubber bearings

### 3.4

#### **design compressive stress**

long-term compressive force on the *elastomeric isolator* (3.6) imposed by the structure

### 3.5

#### **design shear strain**

shear strain of elastomeric isolator (3.6) at design shear displacement

### 3.6

#### **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.

**3.7**

**first shape factor**

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

**3.8**

**high-damping rubber bearing**

**HDR**

*elastomeric isolator* (3.6) with relatively high damping properties obtained by special compounding of the rubber and the use of additives

**3.9**

**inner rubber**

rubber between multi-layered steel plates inside an *elastomeric isolator* (3.6)

**3.10**

**lead rubber bearing**

**LRB**

*elastomeric isolator* (3.6) whose *inner rubber* (3.9) has a lead plug or lead plugs press fitted into a hole or holes of the isolator body to achieve damping properties

**3.11**

**linear natural rubber bearing**

**LNR**

*elastomeric isolator* (3.6) 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.

**3.12**

**maximum compressive stress**

peak stress acting briefly on *elastomeric isolators* (3.6) in compressive direction during an earthquake

**3.13**

**maximum shear strain**

shear strain of *elastomeric isolator* (3.6) at maximum shear displacement

**3.14**

**property modification factor**

factor to account for a variation in physical property from a standard value, due to effects such as temperature, rate of loading, manufacturing variations, ageing and environmental exposure

**3.15**

**compressive stress**

**nominal compressive stress**

long-term stress acting on *elastomeric isolators* (3.6) in compressive direction as recommended by the manufacturer for the isolator, including the safety margin

**3.16**

**production test**

project specific test to verify that the isolator manufactured has the required performance prior to shipping

**3.17**

**prototype test**

project specific test to verify that the designed isolator has the required performance

**3.18**

**qualification test**

test to demonstrate the isolator performance in various test items, which is conducted by manufacturer and whose data is submitted for approval of structural engineer as one of bidding documents



**3.19**

**routine test**

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

**3.20**

**second shape factor**

<circular elastomeric isolator> ratio of the diameter of the *inner rubber* (3.9) to the total thickness of the inner rubber

**3.21**

**second shape factor**

<rectangular or square elastomeric isolator> ratio of the effective width of the *inner rubber* (3.9) to the total thickness of the inner rubber

**3.22**

**seismic code**

building code that defines regulatory requirements for the earthquake design of buildings, and which may include provisions for seismic isolation

**3.23**

**shear properties**

**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

**3.24**

**standard value**

value of isolator property defined by manufacturer based on the results of type test

**3.25**

**structural engineer**

engineer responsible for the design of the seismically-isolated building and for specifying the requirements for *elastomeric isolators* (3.6)

**3.26**

**type test**

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

**3.27**

**ultimate property**

property at either buckling, breaking, or roll-out of an isolator under compression-shear loading

## 4 Symbols

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

Table 1 — Symbols and descriptions

Symbol	Description
$D_L$	dead load of building-superstructure
$D_D$	displacement at the centre of stiffness of the isolation system under the Design Earthquake <sup>a</sup> (from seismic code)
$D_M$	maximum displacement at the center of stiffness of the isolation system under the Maximum Earthquake <sup>a</sup> (from seismic code)
$D_{TM}$	maximum displacement of an element of the isolation system under the Maximum Earthquake <sup>a</sup> , including torsional effects (from seismic code)
$E_L$	load of building-superstructure in vertical direction generated during earthquake
$h_{eq}$	equivalent damping ratio
$K_d$	post-yield stiffness (tangential stiffness after yielding of lead plug) of lead rubber bearing
$K_{eff}$	effective stiffness of an isolator unit in the horizontal direction at either the Design Earthquake or the Maximum Earthquake level (from seismic code)
$K_h$	shear stiffness
$L_L$	live load of building-superstructure
$P_0$	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
$Q_1(X_1)$	shear force at maximum positive shear displacement
$Q_2(X_2)$	shear force at minimum negative shear displacement
$Q_d$	characteristic strength
$S_1$	first shape factor
$S_2$	second shape factor
$T_r$	total rubber thickness, given by $T_r = n \times t_r$
$X_0$	design shear displacement
$X_1$	maximum positive shear displacement
$X_2$	minimum negative shear displacement
$\beta_{eff}$	effective damping (equivalent viscous damping ratio) of an isolator unit in the horizontal direction at either the Design Earthquake or the Maximum Earthquake level (from seismic code)
$\gamma_0$	design shear strain
$\gamma_{max}$	maximum design shear strain during earthquake
$\gamma_u$	ultimate shear strain under horizontal uniaxial loading
$\sigma_0$	design compressive stress
$\sigma_{max}$	maximum compressive stress
$\sigma_{min}$	minimum compressive stress
<sup>a</sup> The terms “Design Earthquake” and “Maximum Earthquake” are used for simplicity herein to facilitate explanation of concepts and relationships for two earthquake hazard levels. It is recognized that these terms are not directly used by ASCE 7-22 or other building codes. The test parameters presented in subsequent tables (give table numbers) assume that the Design Earthquake demand is 2/3 of the Maximum Earthquake Demand.	

## 5 Structure of ISO 22762 from perspective of relationship with this document

The relationship between the different parts of ISO 22762 is shown schematically in [Figure 2](#). ISO 22762-7 intends to help structural engineers whereas ISO 22762-4 to help manufacturers of elastomeric isolators for buildings.

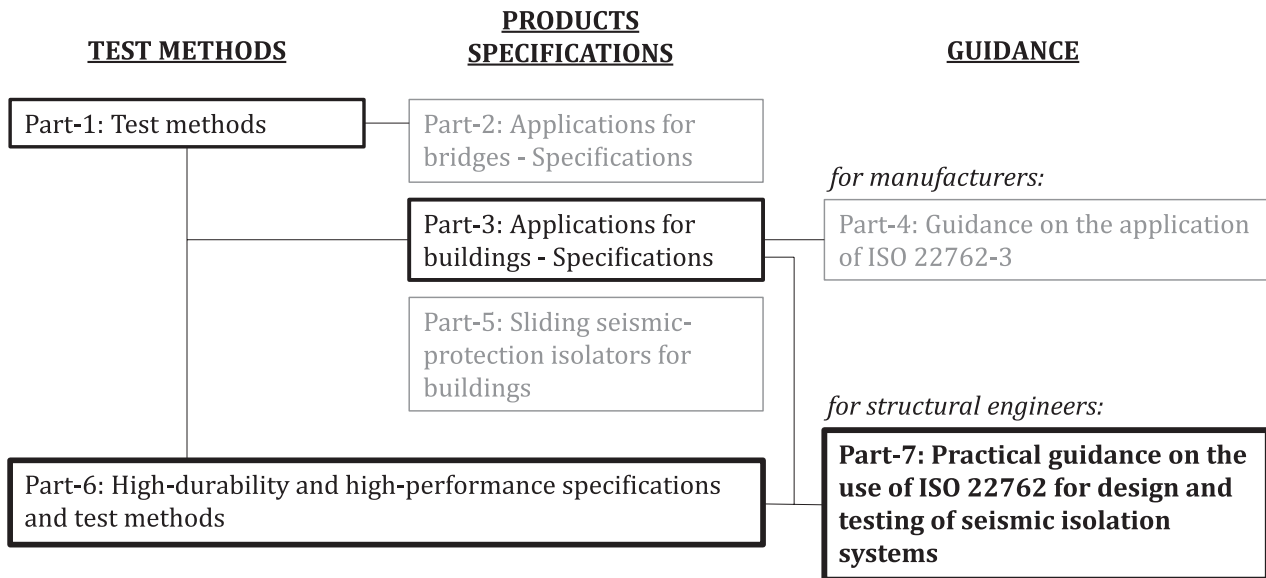


Figure 2 — Relationship of this document and other parts of the ISO 22762 series

## 6 Application of ISO 22762 to the testing and design requirements of elastomeric isolators given in building codes

### 6.1 General

When applying the ISO 22762 series for the design of elastomeric seismic isolation bearings it is necessary for the user to relate various design terms and symbols in the seismic code or guideline being followed with the applicable terms and symbols in ISO 22762 series. It is expected that the main users of ISO 22762 series will be structural engineers and that their primary interest will be the testing requirements for the seismic isolators. The types of tests typically required are qualification tests, prototype tests and production tests.

### 6.2 Correspondence between seismic codes and ISO 22762: Key design terms and definitions

The correspondence between key design terms and definitions commonly used in seismic codes and those used in the ISO 22762 series is shown in [Table 2](#).

Table 2 — Correspondence between seismic codes and ISO 22762: Key design terms and definitions

Seismic code term		ISO 22762 term	Remarks
Qualification test		Type test	All tests and requirements specified in ISO 22762-3 or ISO 22762-6 are applicable.
Prototype test		Type test	There are minor differences in some definitions of isolator properties between seismic codes and ISO 22762. In such case, similar definition in ISO 22762 is applied.
Production test		Routine test	Some minor differences exist in definition of the properties. In such case, similar definition in ISO 22762 is applied.
Vertical load	$1,0 D_L + 0,5 L_L$	Design compressive force $P_0$	Design compressive stress $\sigma_0 = P_0 / A$
	$1,2 D_L + L_L + E_L$	Maximum compressive force $P_{max}$	Maximum compressive stress $\sigma_{max} = P_{max} / A$

Table 2 (continued)

Seismic code term	ISO 22762 term	Remarks
	$0,9 D_L - E_L$ Minimum compressive force $P_{min}$ (if negative) Tensile force $P_t = P_{min}$	Minimum compressive stress $\sigma_{min} = P_{min} / A$
Horizontal displacement	$D_D$ Design displacement $X_0$	Design shear strain $\gamma_0 = X_0 / T_r$
	$D_M, D_{TM}$ Maximum displacement $X_{max}$	Maximum shear strain $\gamma_{max} = X_{max} / T_r$

6.3 Correspondence between seismic codes and ISO 22762: Testing

6.3.1 Qualification tests

Although most seismic codes do not provide specific details for qualification tests, manufacturers generally must provide structural engineers with various properties of isolators, including dependencies on effects such as temperature and frequency, repeated loading, creep, and ageing. Tests for these properties are specified as type tests of ISO 22762-3 and ISO 22762-6 using test methods defined in ISO 22762-1. These tests and methods are directly applicable for manufacturers to provide qualification test data for elastomeric isolators. ISO 22762 provisions that can be referred to for qualification test of elastomeric isolators are shown in Table 3. Comparison of the test items and requirements in EN 15129 and ISO 22762-6 are given in Annex A.

Table 3 — ISO 22762 provisions for qualification tests of elastomeric isolators

Properties	Test item	Test method
Compressive properties	Compressive stiffness	ISO 22762-1:2018, 6.2.1, method 2
Shear properties	Shear stiffness Equivalent damping ratio Post-yield stiffness (for LRB) Characteristic strength (for LRB)	ISO 22762-1:2018, 6.2.2
Tensile properties	Tensile fracture strength Tensile yield strength	ISO 22762-1:2018, 6.5
Dependencies of shear properties	Shear strain dependency	ISO 22762-1:2018, 6.3.1
	Compressive stress dependency	ISO 22762-1:2018, 6.3.2
	Frequency dependency	ISO 22762-1:2018, 6.3.3
	Repeated loading dependency	ISO 22762-1:2018, 6.3.4
	Temperature dependency	ISO 22762-1:2018, 6.3.5
Dependencies of compressive properties	Shear strain dependency	ISO 22762-1:2018, 6.3.6
	Compressive stress dependency	ISO 22762-1:2018, 6.3.7
Shear strain and displacement capacity	Breaking strain, buckling strain Roll-out strain	ISO 22762-1:2018, 6.4
	Ultimate property diagram	ISO 22762-3:2018, Annex B
Durability	Shear property change	ISO 22762-1:2018, 6.6.1
	Creep	ISO 22762-1:2018, 6.6.2

6.3.2 Prototype tests

The correspondence between isolator prototype tests typically defined by seismic codes and the elastomeric isolator test methods of ISO 22762-1 is shown in Table 4. In the table, the seismic code prototype