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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 20688.5-2014

Rubber bearings - Part 5: Elastic sliding seismic-protection isolator for buildings

橡胶支座 第5部分：建筑隔震弹性滑板支座

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Table of Contents

Foreword

SAC/TC 35/SC 7 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

The GB/T 20688 rubber bearings consists of the following 5 parts under the general title: Part 1: Seismic-protection isolators test methods; Part 2: Elastomeric seismic-protection isolators for bridges; Part 3: Elastomeric seismic-protection isolators for buildings; Part 4: Normal rubber bearings; Part 5: Elastic sliding seismic-protection isolator for buildings.

This part is the fifth part of GB/T 20688. This part is drafted in accordance with the rules given in the GB/T 1.1-2009.

This standard was proposed by China Petroleum and Chemical Industry Federation. This standard was prepared by SAC/TC 35/SC 7 Subcommittee on Rubber Miscellaneous of China National Standardization Technical Committee on Rubber and Rubber Products.

1 Scope

China's national standard for the elastic sliding seismic-protection isolator, the fifth part of the GB/T 20688 family on rubber bearings. Base isolation works by putting a soft, dissipative layer between a building and the ground, so that the shaking arrives filtered

rather than whole; but a building supported only on laminated rubber bearings puts too much load on some columns and not enough on others, and lightly loaded points need a bearing that carries vertical load without adding much horizontal stiffness. The elastic sliding bearing is that companion device: a rubber bearing component with a sliding material - PTFE or modified ultra-high molecular weight polyethylene - riding on a stainless steel sliding plate, so the isolator supports its share of the weight and then slips, adding friction damping while the isolation period is set by the elastomeric bearings around it. This part specifies the terms and definitions, symbols, classifications, requirements, test methods, test rules, and marking and labelling of such isolators, and applies to elastic sliding seismic-protection isolators used to protect building structures from earthquake damage. It classifies them by shape, circular or square, and by sliding friction coefficient into low-friction (below 0.03), middle-friction (0.03 to 0.06) and large-friction (above 0.06) types, and fixes the physical properties required of the rubber, the sliding material, the sliding surface and the connecting plates, together with the compressive and shear performance of the assembled bearing. Three normative annexes give the test methods for the linear abrasion coefficient and the compressive elasticity modulus of the sliding material and for the shear performance of the sliding bearing.

This part specifies terms and definitions, symbols, classifications, requirments, test methods, test rules, and marking and labelling of elastic sliding seismic-protection isolators for buildings.

It is applicable to elastic sliding seismic-protection isolators used to provide building structures with protection from earthquake damage.

2 Normative references

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.

GB/T 528 Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties; GB/T 1033.1 Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method; GB/T 1040.2 Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics.

GB/T 3280 Cold rolled stainless steel plate, sheet and strip; GB/T 3398.1 Plastic hardness measurement - Part 1: the ball indentation method; GB/T 6031 Rubber, vulcanized or thermoplastic - Determination of hardness (hardness between 10 IRHD and 100 IRHD).

GB/T 7759 Rubber, vulcanized or thermoplastic - Determination of compression set at ambient elevated or low temperatures; GB/T 7760 Rubber, vulcanized - Determination of adhesion to metal - one-plate method; GB/T 7762 Rubber, vulcanized or thermoplastic -

Resistance to ozone cracking - static strain testing; GB/T 15256 Rubber, vulcanized - Determination of low-temperature brittleness (multiple test piece method).

GB/T 20688.1-2007 Rubber bearings - Part 1: Seismic-protection isolators test methods; GB/T 20688.3-2006 Rubber bearings - Part 3: Elastomeric seismic-protection isolators for buildings.

3 Terms and definitions

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

3.1 elastic sliding bearing, ESB: bearing, for seismic isolation, which consists of sliding material, sliding plate, upper and lower connecting plates.

3.2 rubber bearing component: bearing component, consists of inner vulcanized rubber sheets and reinforcing steel plates.

3.3 sliding material: material which provides sliding functionality, used to compose friction pair with sliding plate. 3.4 sliding plate: plate which provides sliding functionality.

3.5 sliding friction coefficient: ratio of friction force to normal compression force of sliding friction pair.

3.6 failure: either rupture failure caused by compression-shear, distortion of sliding material or sliding plate, or sliding displacement overrun.

3.7 compressive-shear testing machine: machine used to test elastic sliding bearings, which has the capability of shear loading under constant compressive load.

3.8 cover rubber: rubber wrapped around the outside of inner rubber and reinforcing steel plates 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.

3.9 design compressive stress: long-term compressive stress on the elastic sliding bearing and the rubber bearing imposed by the structure.

3.10 effective loaded area: area sustaining vertical load in rubber bearing component, which corresponds to the area of reinforcing steel plates.

3.11 effective width: (square rubber bearing component) the side lengths of inner rubber to which direction shear displacement is not restricted. 3.12 effective diameter: (circular rubber bearing component) the diameter of the inner rubber.

3.13 1st shape factor: ratio of effective loaded area to side area of each inner rubber layer in rubber bearing component.

3.14 2nd shape factor: (circular rubber bearing component) ratio of the diameter of the inner rubber to the total thickness of the inner rubber; (square rubber bearing component) ratio of the effective width of the inner rubber to the total thickness of the inner rubber.

3.15 inner rubber: rubber between multi-layered steel plates inside an elastomeric isolator.

3.16 maximum compressive stress: peak compressive stress in elastic sliding bearings during an earthquake.

3.17 shear properties of elastic sliding bearing: sliding friction coefficient (mu) and initial stiffness (K1) of elastic sliding bearings.

3.18 ultimate properties of elastic sliding bearing: properties at failure of elastic sliding bearing.

4 Symbols

For the purposes of this document, the following symbols applied. A is bearing area of sliding material; As is bearing area of elastic sliding bearing; c is chamfer length of the sliding surface of sliding plate; Dd is outer diameter of circular connecting plate of rubber bearing component; Ds is diameter of circular sliding material or side length of square sliding material; Dr is inner diameter of reinforcing steel plate of circular rubber bearing component; D' is outer diameter of circular rubber bearing component, or outer side length of square rubber bearing component, including cover rubber.

E1 is compression elastic modulus of sliding material; F is compressive failure load of sliding material; Fv is compressive failure load of elastic sliding bearing; fsv is compressive capacity of elastic sliding bearing; fv is compressive capacity of sliding material.

H1 is total height of upper connecting plate and rubber bearing component (excluding sliding material thickness); H2 is thickness of upper connecting plate; H3 is thickness of upper cover plate of rubber bearing component; H4 is thickness of sliding plate; H5 is thickness of lower cover plate of rubber bearing component; H6 is thickness of lower connecting plate.

K1 is initial stiffness of elastic sliding bearing; Kv is vertical compressive stiffness of elastic rubber bearing; L1 is side length of square sliding plate; Lf is side length of square lower connecting plate; Ps is reference diameter of connecting bolt holes of circular rubber bearing component and embedded part; Sd is side length of connecting plate of square rubber bearing component; Sr is effective side length of rubber layer in square rubber bearing component; Ss is center to center distance of bolt holes located near opposite edges of square connecting plate.

The Greek symbols are: horizontal offset of rubber bearing component; difference in rubber bearing component height measured between two points at opposite extremes of 180 degrees angular distance; accumulated compressive strain of sliding material under 0.7 times and under 1.3 times of design compressive load; sliding friction coefficient of elastic sliding bearing; design compressive stress of sliding material and its 0.7 and 1.3 multiples; and flatness of rubber bearing component.