

# Steel, concrete and composite bridges —

## Part 9: Bridge bearings —

### Section 9.2 Specification for materials, manufacture and installation of bridge bearings

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- Constructional Steel Research and Development Organization
- Greater London Council
- Institution of Highway Engineers
- London Transport Executive
- Ministry of Defence
- Sand and Gravel Association Limited
- Welding Institute

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## Foreword

BS 5400 is a document combining codes of practice to cover the design and construction of steel, concrete and composite bridges and specifications for loads, materials, and workmanship. It comprises the following Parts and Sections:

- *Part 1: General statement;*
- *Part 2: Specification for loads;*
- *Part 3: Code of practice for design of steel bridges;*
- *Part 4: Code of practice for design of concrete bridges;*
- *Part 5: Code of practice for design of composite bridges;*
- *Part 6: Specification for materials and workmanship, steel;*
- *Part 7: Specification for materials and workmanship, concrete, reinforcement and prestressing tendons;*
- *Part 8: Recommendations for materials and workmanship, concrete, reinforcement and prestressing tendons;*
- *Part 9: Bridge bearings;*
- *Section 9.1: Code of practice for design of bridge bearings;*
- *Section 9.2: Specification for materials, manufacture and installation of bridge bearings;*
- *Part 10: Code of practice for fatigue.*

This Section of Part 9, together with Section 9.1, supersede appendix F of BS 5400-2:1978, which is to be withdrawn by an amendment.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This Section of Part 9 of BS 5400 specifies requirements for the materials and workmanship commonly used in the manufacture and installation of bridge bearings.

NOTE The requirements specified herein are suitable for inclusion in contract documents.

## 2 References

The titles of the publications referred to in this Section of Part 9 are listed on the page 16.

## 3 Materials

**3.1 General.** Where more than one quality of material is specified in the relevant British Standard or more than one British Standard is referred to herein, the quality required shall be that specified or approved by the Engineer.

### 3.2 Steel

**3.2.1 General.** Steel products shall comply with the appropriate standard given in Table 1.

#### 3.2.2 Hardened steel for rollers and rockers.

Rollers and rockers shall be through hardened and not case hardened.

**Table 1 — Steel products**

| Steel product                                                         | Standard                                                                        |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Steel plates and flats                                                | BS 1449, BS 4360                                                                |
| Steel sheet and strip                                                 | BS 1449                                                                         |
| Steel bars                                                            | BS 970, BS 1407, BS 4360                                                        |
| Steel sections                                                        | for material: BS 1775, BS 4360<br>for sizes: BS 4-1, BS 4848                    |
| Wrought steel                                                         | BS 970                                                                          |
| Forged steel                                                          | BS 29, BS 970, BS 4670                                                          |
| Cast steel                                                            | BS 3100                                                                         |
| Stainless steel                                                       | BS 970, BS 1449<br>(the grade of material for sliding surfaces shall be 316S16) |
| Hot-dip zinc coated and iron-zinc alloy coated steel, plate and strip | BS 2989                                                                         |

**3.3 Cast iron.** Cast iron shall comply with BS 2789.

**3.4 Cast aluminium.** Aluminium alloy castings shall comply with BS 1490 and shall be of grade LM5, LM6 or LM25. Aluminium alloy castings shall not be used for roller, rocker, knuckle pin or leaf bearings.

**3.5 Copper alloy castings.** Copper alloy castings shall comply with BS 1400. For knuckle and leaf bearings, phosphor-bronze inserts shall be of grade PB1, PB2 or PB4 material and leaded-bronze inserts shall be of grade LB4 material.

### 3.6 Polytetrafluoroethylene (PTFE)

**3.6.1 General.** Unfilled PTFE shall be pure virgin PTFE without any addition of regenerated materials or fillers. It shall be free sintered and not pressure cooled. The mechanical properties of unfilled PTFE shall comply with grade A of BS 3784:1973.

The composition of filled PTFE shall be such that its coefficient of friction is not more than twice the coefficient of friction of pure PTFE when measured under the same conditions.

**3.6.2 Lubrication cavities.** Lubricant retention cavities in PTFE shall comply with the following requirements.

- The plan area of the cavities shall be between 10 % and 30 % of the total PTFE bearing surface including the area of the dimples or grooves.
- The volume of the cavities shall not be less than 3 % nor more than 20 % of the volume of PTFE including the volume of cavities. Only the volume above the top of the recess shall be considered if the PTFE is confined.
- the depth of the cavities shall not exceed half the thickness of the PTFE sheet, or in the case of confined PTFE, the height of its projection from the top of the recess.

The temperature for hot pressing of cavities shall not exceed 200 °C.

**3.6.3 Lubricants.** Lubricants for use with PTFE sliding surfaces shall be compounded for long life and to retain their properties within the temperature range to which the bridge is subject and shall not affect the constituent parts of the bearings.

**3.6.4 Adhesives.** Adhesives for bonding PTFE to backing plates shall produce a bond with a minimum peel strength of 4 N/mm width when tested in accordance with BS 5350-C9. They shall be resistant to the action of lubricants, atmospheric and biological agents and temperatures to which the bearing may be subject.

### 3.7 Elastomer

**3.7.1 General.** The elastomer used in the manufacture of bridge bearings shall contain either natural rubber or chloroprene rubber as the raw polymer, and shall have a hardness in the range of 45 IRHD to 75 IRHD (see 3.7.3.1). No reclaimed or ground vulcanizate rubber shall be used.

The elastomer shall have adequate weathering resistance, as assessed by the test given in 3.7.3.8, and shall be suitable for use up to 6 weeks at subzero temperatures with occasional periods of up to 3 days below  $-25^{\circ}\text{C}$ , as assessed by the tests given in 3.7.3.5 to 3.7.3.7. The shear modulus of the elastomer, measured by the method given in 3.7.3.9, shall not vary by more than 15 % from the value assumed in the design of the bearing.

**3.7.2 Mechanical properties.** The mechanical properties of the elastomer shall comply with the relevant requirements given in Table 2, depending upon the raw polymer used.

**Table 2 — Elastomer properties**

| Property                                   | Rubber                 |                        |
|--------------------------------------------|------------------------|------------------------|
|                                            | Natural                | Chloroprene            |
| Tensile strength, minimum (see 3.7.3.2)    | 15.5 N/mm <sup>2</sup> | 15.5 N/mm <sup>2</sup> |
| Elongation at break, minimum (see 3.7.3.2) |                        |                        |
| 45 IRHD to 55 IRHD                         | 450 %                  | 400 %                  |
| 56 IRHD to 65 IRHD                         | 400 %                  | 350 %                  |
| 66 IRHD to 75 IRHD                         | 300 %                  | 300 %                  |
| Ageing resistance (see 3.7.3.3)            |                        |                        |
| Maximum change from initial values:        |                        |                        |
| Hardness                                   | 10 IRHD                | 15 IRHD                |
| Tensile strength                           | 15 %                   | 15 %                   |
| Elongation at break                        | 20 %                   | 40 %                   |
| Compression set maximum (see 3.7.3.4)      | 30 %                   | 35 %                   |

### 3.7.3 Methods of test

**3.7.3.1 Hardness.** Hardness shall be determined in accordance with method N of BS 903-A26.

**3.7.3.2 Tensile strength and elongation at break.** Tensile strength and elongation at break shall be determined in accordance with BS 903-A2 using dumb-bell test pieces.

**3.7.3.3 Ageing.** Accelerated ageing in air shall be conducted in accordance with either method A or method B of BS 903-A19. Natural rubber shall be aged for 7 days at  $70 \pm 1^{\circ}\text{C}$  and chloroprene rubber for 3 days at  $100 \pm 1^{\circ}\text{C}$ .

**3.7.3.4 Compression set.** Compression set shall be determined in accordance with method A of BS 903-A6. The temperature during the compression period shall be  $70 \pm 1^{\circ}\text{C}$  for natural rubber and  $100 \pm 1^{\circ}\text{C}$  for chloroprene rubber.

**3.7.3.5 Low temperature brittleness.** A low temperature brittleness test shall be carried out in accordance with BS 903-A25 to demonstrate that the impact brittleness temperature lies below  $-25^{\circ}\text{C}$ .

**3.7.3.6 Low temperature stiffening.** Low temperature stiffening shall be assessed by measuring increases in hardness. Three test pieces shall be initially conditioned for 3 h at  $23 \pm 2^{\circ}\text{C}$  and then their hardness measured. These test pieces shall then be conditioned for 24 h at  $-25 \pm 2^{\circ}\text{C}$  and then their hardness shall be remeasured. For any of the test pieces the difference between the above two measurements shall not exceed 15 IRHD. (See 3.7.3.1.)

**3.7.3.7 Low temperature crystallization.** The low temperature crystallization resistance of the elastomer shall be assessed from low temperature compression set measurements conducted in accordance with BS 903-A39. Two tests shall be made; one with the test pieces maintained at  $-10 \pm 2^{\circ}\text{C}$  for 10 days, and the other with test pieces held at  $-25 \pm 2^{\circ}\text{C}$  for 3 days. At the end of the chilling period the low temperature compression set shall be measured after a recovery period of 1 800 s. For acceptance, the set in neither test shall exceed 65 %.

**3.7.3.8 Ozone resistance.** Ozone resistance shall be determined in accordance with BS 903-A43, using an ozone concentration of 25 parts per hundred million by volume (p.p.h.m.) unless otherwise specified by the Engineer, a temperature of  $30 \pm 1^{\circ}\text{C}$ , and a duration of 96 h, with the test piece at an elongation of 20 %. At the end of the test there shall be no visible cracks.

**3.7.3.9 Shear modulus.** The shear modulus shall be determined in accordance with BS 903-A14 at a shear strain of 0.25.

### 3.7.4 Test pieces

**3.7.4.1 General.** The tests required by 3.7.1 and 3.7.2 shall be performed on specially moulded test pieces. When, additionally, the Engineer directs tests to be made on samples cut from a finished bearing, these samples shall be obtained as specified in 3.7.4.2 and 3.7.4.3 and prepared in accordance with BS 903-A36.

NOTE 1 Test pieces taken from finished bearings will exhibit mechanical properties different from those of specially moulded pieces. Nevertheless, they have to satisfy fully the requirements of 3.7.

NOTE 2 Samples for shear tests conducted in accordance with BS 903-A14 cannot be obtained from a bearing. Appendix A gives a method for determining the shear stiffness of a completed bearing, from which the shear modulus can be inferred.