

Master Specification

Part ST-BF-C1

Bearings

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ST-BF-C1 Bearings

1 General

- a) This Master Specification Part specifies the requirements for the supply, delivery, and installation of bearings, including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the material property requirements, as set out in section 3;
 - iii) the requirements for the protective treatment of bearings, fixing plates and shim plates, as set out in section 4;
 - iv) the requirements for the inspection of bearings, as set out in section 5;
 - v) the requirements for the testing of bearings, as set out in section 6;
 - vi) the marking and delivery requirements, as set out in section 7;
 - vii) the installation requirements, as set out in section 8; and
 - viii) the Hold Point requirements, as set out in section 9.
- b) Bearings must comply with the Reference Documents, including:
 - i) AS 1554 Structural steel welding;
 - ii) AS/NZS 3678 Structural steel - Hot-rolled plates, floorplates and slabs;
 - iii) AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;
 - iv) AS 5100.4 Bridge design, Part 4: Bearings and deck joints;
 - v) AS/NZS 3679 Structural steel;
 - vi) ASTM A240/A240M-03b Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; and
 - vii) TfNSW QA Bridgeworks Specifications.
- c) Where a bearing, or part of a bearing, is required that is not covered by this Master Specification Part, the Contractor must comply with the relevant requirements set out in the TfNSW QA Bridgework Specifications.
- d) Pot bearings must not be used and spherical bearings must be used in lieu of pot bearings.

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include:

- a) details of the proposed approved sliding material (ASM), required by section 3.3b);
- b) details of the method of bearing installation, required by section 6.1g); and
- c) details of the method of bearing testing, which must comply with the requirements of section 6.

2.2 Pre-installation Quality Management Records

- a) In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:
 - i) NATA endorsed test reports of the bearings tested, which must include:
 - A. copies of the test certificates showing details of each bearing tested and whether any tolerances have been exceeded or any faults have been observed; and
 - B. the test results of each sample of elastomer.
 - b) The records required in section 2.2a) must be submitted at least 5 Business Days prior to delivery of the bearings and will constitute a **Hold Point**. Installation of the relevant bearings must not commence until the Hold Point has been released.

2.3 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include records of the bearing installation date, temperature and setting dimension as required in section 8.2c).

3 Material properties

3.1 General

- a) Elastomeric and spherical bearings must meet the requirements of AS 5100.4 Bridge design, Part 4: Bearings and deck joints.
- b) Sliding contact surfaces must be manufactured in accordance with AS 5100.4 Bridge design, Part 4: Bearings and deck joints.
- c) Neoprene strip bearings must comply with the material requirements of AS 5100.4 Bridge design, Part 4: Bearings and deck joints, including Appendix B, with a durometer hardness of 53.
- d) The materials used in plane sliding contact surfaces must consist of polytetrafluoroethylene (PTFE) or an approved sliding material (ASM) sliding on stainless steel.
- e) The materials used in curved sliding contact surfaces must be an ASM and stainless steel.

3.2 Polytetrafluoroethylene (PTFE)

- a) PTFE sliding pads must consist of unfilled PTFE sheets.
- b) PTFE sheets must be permanently lubricated in accordance with AS 5100.4 Bridge design, Part 4: Bearings and deck joints.
- c) The resin used in the manufacture of PTFE sliding pads must be:
 - i) 100% virgin material complying with AS 5100.4 Bridge design, Part 4: Bearings and deck joints (ISO 13000-1 Grade 1); and
 - ii) Grade A with a relative density of 2.13 to 2.23 and durometer hardness of 50 to 65.

3.3 Approved sliding material (ASM)

- a) The approved sliding material (ASM) and lubrication must comply with the requirements of AS 5100.4 Bridge design, Part 4: Bearings and deck joints.
- b) Details of the proposed ASM must be submitted as part of the Construction Documentation demonstrating proven performance as a sliding material and its suitability for the allowable maximum pressure on the ASM used in the design of the bearings, and for the coefficient of friction and wear rates of the ASM.

- c) Unless specified otherwise, for the ASM pad design, the operating bearing temperature must be taken as the higher of 40°C or the effective bearing temperature for the location where the bearings will be installed.
- d) The effective bearing temperature is the maximum shade air temperature to AS5100.2 Bridge Design, Part 2: Design loads, minus 4°C.

3.4 Steel other than stainless steel

- a) Steel, other than stainless steel, used in the manufacture of the bearings must conform to:
 - i) AS/NZS 3678 Structural steel - Hot-rolled plates, floorplates and slab; and
 - ii) AS/NZS 3679 Structural steel.
- b) Welding must conform to AS 1554 Structural steel welding.

3.5 Stainless steel

- a) The stainless steel plate mating with the PTFE must be to “ASTM A240/A240M-03b Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications”, Type 304 or better.
- b) The sliding surface must:
 - i) be polished to a bright mirror finish;
 - ii) be less than 0.4 µm Ra (centre line average) in both directions; and
 - iii) have a Brinell hardness of not less than 125.

4 Protective treatment of bearings, fixing plates and shim plates

- a) Subject to section 4b), all steel surfaces on bearings, fixing plates and shim plates must be treated in accordance with ST-SS-S2 “Protective Treatment of Structural Steelwork”.
- b) Protective treatment must not be applied to stainless steel sliding surfaces of bearings.
- c) During the application of protective treatment to bearings, care must be taken to prevent stainless steel sliding surfaces from being damaged or coated.

5 Inspection of bearings

- a) Prior to delivery to the Site, the Contractor must arrange for each spherical bearing to be dismantled by the manufacturer and visually inspected by a third party nominated under the process detailed in section 6.1c).
- b) Bearings must not be separated or dismantled after delivery to the Site.

6 Testing of bearings

6.1 Testing

- a) The Contractor is responsible for arranging all required testing of bearings by a third party in the presence of the manufacturer, in accordance with this section 6, including the testing scope set out in section 6.1j).
- b) All testing of bearings must be carried out in the presence of a third party who will be an appropriately qualified person(s) nominated by the Contractor in accordance with section 6.1c).
- c) At least 10 Business Days’ prior to the commencement of bearing testing or inspection (as applicable), the Contractor must submit details of a nominated third party to the Principal for

approval, which will constitute a **Hold Point**. Testing or inspection of the relevant bearings (as applicable) must not commence until the Hold Point has been released.

- d) The Contractor must provide the nominated third party referred to in section 6.1c) with at least 10 Business Days' notice prior to the commencement of testing.
- e) Testing of bearings must not commence until notice in accordance with section 6.1d) has been given.
- f) Testing of bearings must be carried out at a NATA approved laboratory.
- g) The method of testing the bearings must be submitted as part of the Construction Documentation.
- h) The equipment for testing bearings must be capable of determining loads to an accuracy of $\pm 3\%$ and deflections to $\pm 1\%$.
- i) Where necessary to achieve the specified accuracy for testing required in section 6.1h), equipment must be calibrated and test results corrected accordingly.
- j) Testing must be carried out on one representative bearing from every 10 bearings, or part thereof, for each size and type of bearing used in the Works.
- k) After load testing, and prior to delivery to Site, spherical bearings must be dismantled and examined by the third party nominated in section 6.1c).

6.2 Test loads

- a) Testing of elastomeric bearings for compression, compression stiffness, and shear stiffness must be carried out in accordance with AS 5100.4 Bridge design, Part 4: Bearings and deck joints.
- b) Elastomeric bearings which are required to resist horizontal forces must be further tested to 1.5 times the rated serviceability state horizontal load for the bearings while loaded in compression to the concurrent serviceability state vertical load. The load must be maintained for 3 minutes.
- c) Load testing of spherical bearings must be in accordance with AS 5100.4 Bridge design, Part 4: Bearings and deck joints.

6.3 Test for coefficient of friction of PTFE

- a) The coefficient of friction of sliding surfaces of expansion bearings must:
 - i) be taken as the average result of 5 tests; and
 - ii) be determined for both minimum and maximum vertical serviceability state loads.
- b) In determining the coefficient of friction required in this section 6.3, the bearings may be given up to 2 preliminary sliding runs under load prior to taking the test readings.
- c) The friction coefficient of the sliding surfaces must not exceed the values given in Table ST-BF-C1 6-1 for the relevant stresses on the PTFE surface. Values must be interpolated for intermediate bearing pressures.

Table ST-BF-C1 6-1 Friction coefficient of PTFE sliding surfaces

Bearing pressure (MPa)	Friction coefficient
5	0.08
10	0.06
20	0.04
30 or greater	0.03

6.4 Test for coefficient of friction of ASM

- a) The coefficient of friction of sliding surfaces of expansion bearings must:

- i) be taken as the average result of 5 tests; and
 - ii) be determined for both minimum and maximum vertical serviceability state loads.
- b) In determining the coefficient of friction required in this section 6.4, the bearings may be given up to 2 preliminary sliding runs under load prior to taking the test readings.
- c) The friction coefficient of the sliding surfaces must not exceed the values given in Table ST-BF-C1 6-2 for the relevant stresses on the ASM surface. Values must be interpolated for intermediate bearing pressures.

Table ST-BF-C1 6-2 Friction coefficient of ASM sliding surfaces

Bearing pressure (MPa)	Friction coefficient
15	0.08
45	0.04
60	0.032
90 or greater	0.03

6.5 Failure to meet requirements

- a) Bearings must not exhibit any signs of failure, including:
- i) splitting or permanent deformation of the elastomer;
 - ii) for elastomeric bearings, signs of misplaced steel plates, bond failure or surface Defects, such as tears or splits;
 - iii) tearing, cracking, or permanent deformation of the PTFE sliding surface; or
 - iv) for spherical bearings:
 - A. tearing, cracking or excessive deformation of the sliding surfaces;
 - B. cracking, indentation or permanent deformation of any part of the bearing;
 - C. abrasive marks indicating abnormal contact between the metal surfaces of the bearing;
 - D. failure or permanent deformations of the guide bars; and
 - E. damage to chromium plating where applicable.
- b) Where a bearing exhibits signs of failure during testing, including those set out in section 6.5a), 2 additional bearings from the same batch must also be tested.
- c) If either of the 2 additional bearings tested in accordance with section 6.5b) do not meet the requirements of this Master Specification Part, the Contractor must also undertake testing of all remaining bearings in the relevant batch.

7 Marking and delivery

- a) Bearings must be supplied in sets held together to prevent damage to components during transport.
- b) Spherical bearings must be held together with metal erection straps to prevent misalignment or separation. The erection straps must not be removed until the time specified by the manufacturer's specifications.
- c) Spherical expansion bearings must be supplied with the sliding plate set to the correct offset.
- d) All set screws that cannot be installed with temporary erection straps in place must be in place when the bearing is supplied.
- e) The Contractor must inspect the bearings upon delivery to verify that dimensions, bolt sizes, hole sizes, and offsets are correct.

- f) The Contractor must verify that each spherical bearing, and its components can be installed without disassembling or separating the bearing.

8 Installation

8.1 General

- a) Bearings must be installed in accordance with the Design Documentation and the manufacturer's specifications.
- b) Spherical bearings must not be allowed to be disassembled or separated once delivered to Site.
- c) The lateral position and alignment of a bearing or bearing component must not be changed at any time.
- d) All elastomeric bearings must have keeper plates at the top and bottom. A tapered steel bearing plate between the bridge girder and upper (flat) bearing plate must be used.

8.2 Installation temperature

- a) Bearings must be installed in position to conform to the actual mean structure temperature at the time of installation.
- b) Where the actual mean structure temperature at the time of installation cannot be determined, the installation temperature may be taken as the mean shade temperature at the underside of the deck or inside the cells of box girder bridges for:
- i) the 2 consecutive days prior to bearing installation in concrete structures; and
 - ii) the 1-day period prior to bearing installation for steel and steel composite structures.
- c) The Contractor must record and submit details of the installation of the bearing as part of the Quality Management Records, including installation date, temperature and setting dimension.

9 Hold Points

Table ST-BF-C1 9-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table ST-BF-C1 9-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
2.2b)	Submission of pre-installation Quality Management Records	Documentation	5 Business Days review
6.1c)	Submission of the details of the nominated third party to be present for all testing	Documentation	5 Business Days review