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REVISION REGISTER

<table>
<thead>
<tr>
<th>Ed/Rev Number</th>
<th>Clause Number</th>
<th>Description of Revision</th>
<th>Authorised By</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed 1/Rev 0</td>
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<td>09.08.18</td>
</tr>
</tbody>
</table>
SPHERICAL BEARINGS – STRUCTURAL STEEL

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IC-QA-B292

VERSION FOR:
DATE:
# CONTENTS

<table>
<thead>
<tr>
<th>CLAUSE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOREWORD</td>
<td>II</td>
</tr>
<tr>
<td>RMS Copyright and Use of this Document</td>
<td>ii</td>
</tr>
<tr>
<td>Revisions to Previous Version</td>
<td>ii</td>
</tr>
<tr>
<td>Project Specific Changes</td>
<td>ii</td>
</tr>
<tr>
<td>1 GENERAL</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Scope</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Structure of the Specification</td>
<td>1</td>
</tr>
<tr>
<td>1.3 Definitions</td>
<td>2</td>
</tr>
<tr>
<td>1.4 Quality Management System</td>
<td>3</td>
</tr>
<tr>
<td>1.5 Approved Bridge Components and Systems</td>
<td>3</td>
</tr>
<tr>
<td>2 DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>2.1 General</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Design Calculations and Certifications</td>
<td>4</td>
</tr>
<tr>
<td>2.3 Approved Sliding Material</td>
<td>4</td>
</tr>
<tr>
<td>3 MATERIALS</td>
<td>5</td>
</tr>
<tr>
<td>3.1 Mating Sliding Surfaces</td>
<td>5</td>
</tr>
<tr>
<td>3.2 Ferrous Materials</td>
<td>5</td>
</tr>
<tr>
<td>3.3 Non-metallic Sliding Pads and Strips</td>
<td>6</td>
</tr>
<tr>
<td>3.4 Lubricant</td>
<td>6</td>
</tr>
<tr>
<td>3.5 Material Conformity</td>
<td>7</td>
</tr>
<tr>
<td>4 FABRICATION</td>
<td>7</td>
</tr>
<tr>
<td>4.1 General</td>
<td>7</td>
</tr>
<tr>
<td>4.2 Flatness of Surfaces</td>
<td>7</td>
</tr>
<tr>
<td>4.3 Bearing Concave and Convex Plates</td>
<td>8</td>
</tr>
<tr>
<td>4.4 Stainless Steel Sliding Surface</td>
<td>8</td>
</tr>
<tr>
<td>4.5 Hard Chromium Plated Surfaces</td>
<td>8</td>
</tr>
<tr>
<td>4.6 Guide Bars</td>
<td>9</td>
</tr>
<tr>
<td>4.7 Non-metallic Sliding Surfaces</td>
<td>9</td>
</tr>
<tr>
<td>4.8 Attachment Plates</td>
<td>9</td>
</tr>
<tr>
<td>5 PROTECTIVE TREATMENT</td>
<td>10</td>
</tr>
<tr>
<td>5.1 General</td>
<td>10</td>
</tr>
<tr>
<td>5.2 Surface Preparation</td>
<td>10</td>
</tr>
<tr>
<td>5.3 Zinc Metal Spray</td>
<td>11</td>
</tr>
<tr>
<td>5.4 Hot-dip Galvanizing</td>
<td>11</td>
</tr>
<tr>
<td>5.5 Paint Application</td>
<td>11</td>
</tr>
<tr>
<td>6 TESTING OF BEARINGS</td>
<td>11</td>
</tr>
<tr>
<td>6.1 General</td>
<td>11</td>
</tr>
<tr>
<td>6.2 Geometrical Verification</td>
<td>12</td>
</tr>
<tr>
<td>6.3 Load Tests</td>
<td>12</td>
</tr>
<tr>
<td>6.4 Criteria for Acceptance</td>
<td>13</td>
</tr>
<tr>
<td>6.5 Bearing Report</td>
<td>14</td>
</tr>
<tr>
<td>7 IDENTIFICATION AND DELIVERY</td>
<td>14</td>
</tr>
<tr>
<td>7.1 Identification</td>
<td>14</td>
</tr>
<tr>
<td>7.2 Delivery</td>
<td>14</td>
</tr>
</tbody>
</table>
FOREWORD

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REVISIONS TO PREVIOUS VERSION

This is the first version.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. Additional Text.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. Deleted Text.
1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the supply of structural steel spherical approved
sliding material (ASM) bearings and associated attachment plates, including their design and
fabrication.

For requirements on installation of bearings, refer to Specification RMS B284.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Project Specific Requirements

Project specific details are shown in Annexure B292/A.

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure B292/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure B292/C list the HOLD POINTS that must be observed. Refer to
Specification RMS Q for the definition of HOLD POINTS.

The records listed in Annexure B292/C are Identified Records for the purposes of RMS Q
Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in
Annexure B292/D and must be implemented.

1.2.5 Frequency of Testing

The Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of
the item, which must not be less than the frequency specified in Annexure B292/L. Where a minimum
frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to
the requirements of RMS Q.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be
supported by a statistical analysis verifying consistent process capability and product characteristics.
The Principal may vary or restore the specified minimum frequency of testing, either provisionally or
permanently, at any time.
1.2.6 Referenced Documents

Unless otherwise specified, the applicable issue of a referenced document, other than an RMS Specification, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure B292/M.

1.3 DEFINITIONS

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

**Approved sliding material (ASM)**
A generic term adopted by AS 5100.4 for a new sliding material (not PTFE) based on a modified ultra-high molecular weight polyethylene and which has high compressive strength, low friction and high wear-resistance.

**Bearing concave and convex plates**
Steel plates with curved (spherical) surfaces to accommodate bearing rotation.

**Bearing internal surfaces**
Internal surfaces of bearing covered by sliding materials.

**Bearing group**
Bearings of the same type, with the same sliding pad and spherical surface geometry and with similar load capacity, for the purpose of testing. Bearings within a group may have different translational movement ranges.

**Bearing type**
Fixed, free sliding or guided sliding bearing.

**Effective bearing temperature**
The maximum shade air temperature to AS 5100.2 minus 4°C. This term is used in the design of ASM pads.

**Nominal dimension**
The distance between any two points.

**Sliding plate**
A steel plate in a sliding bearing fitted with a sliding surface to allow relative movement between the plate and the bearing.

**Structural Engineer**
A Professional Engineer who is a Chartered Member of Engineers Australia (or equivalent) practising in the field of structural engineering. An equivalent to membership of Engineers Australia would be an Engineer registered on the National Engineering Register (NER) in the general area of practice of Structural Engineering.

**Surface roughness parameter ($R_a$)**
Measurement of roughness of a surface as specified in ISO 3274.

**Surface roughness parameter ($R_{y5i}$)**
Measurement of roughness of a surface as specified in ISO 4287.
1.4 QUALITY MANAGEMENT SYSTEM

The manufacturer/supplier of the bearings under this Specification must have in place quality management systems independently certified as fully complying with AS/NZS ISO 9001, by an organisation accredited by JAS-ANZ or an affiliated international certification organisation. Provide evidence of the certification.

The Principal may conduct audits and inspections of the suppliers’ procedures and processes during the course of the Contract.

1.5 APPROVED BRIDGE COMPONENTS AND SYSTEMS

Unless otherwise approved by the Principal, use only spherical bearing types that have been approved by RMS. The list of RMS approved bridge proprietary products can be found at: http://www.rms.nsw.gov.au/business-industry/partners-suppliers/documents/tenders-contracts/listofapprovedbridgecomponentsystems.pdf

2 DESIGN

2.1 GENERAL

2.1.1 Codes and Standards

Design bearings to comply with the requirements of AS 5100.4, EN 1337, relevant European Technical Approvals and RMS Bridge Technical Directions, unless otherwise specified. The requirements of AS 5100.4 take precedence over EN1337 where there is a conflict between the two.

Design bolts to AS 5100.6.

Design steel components to AS 5100.6 or another bearing design standard approved by the Principal. Regardless of the design standard used, the relevant capacity reduction factors in AS 5100.6 must apply.

2.1.2 Design Loads and Movements

Design spherical bearings for Ultimate Limit State (ULS) effects.

Design and dimension all associated plane sliding surfaces to accommodate the ULS movements plus an additional movement of ± 25 mm, and all associated spherical sliding surfaces to accommodate the ULS rotation plus an additional rotation of 0.01 radians, without exposing the smaller sliding surface. Unintended metal to metal contact must not occur at the ULS movements or rotations.

Design the guide bars to withstand the lateral forces shown on the Drawings and dimension them such that the bearing movement is guided throughout the specified limits of translation and rotation.

2.1.3 ASM Pad Design – Temperature

Unless specified otherwise, for the ASM pad design, use as the operating bearing temperature the higher of 40°C or the effective bearing temperature (refer to Clause 1.3 for definition of “effective bearing temperature”) for the location where the bearings will be installed.
2.1.4 Other Requirements

Allow for construction tolerances in the design and fabrication of the bearings and attachment plates, where required for the construction method adopted.

Design the bearings such that the fasteners connecting the bearings to the attachment plates can be replaced without lifting the bridge superstructure.

Design the bearings to allow their removal at a maximum jacking lift of 10 mm unless specified otherwise on the Drawings.

The bearing attachment plates and anchor bolts must not obstruct the movement and rotation of the bearing and must allow its removal and replacement.

Where possible, position the larger of the mating sliding surfaces above the smaller to prevent dirt from accumulating on the sliding surfaces.

Provide for mechanical lifting and handling of the bearings where required.

2.2 Design Calculations and Certifications

Submit the following for each bearing group:

(a) Confirmation of all load cases (axial and shear loads, and rotation and movement in each direction, as applicable).

(b) Drawings of the assembled bearing and attachment plates to scale with overall dimensions including bearing concave and convex plates dimensions.

(c) Design calculations of the bearing including sliding pad mean and peak pressures, maximum bearing stress on substructure and superstructure giving method of calculation, forces on bolts and dowels with required sizes and grades, and stress checks on steel structural components.

(d) Any variations from the details of the bridge proprietary bearing as approved by the Roads and Maritime Services (refer to Clause 1.5).

(e) A certificate from a Structural Engineer (refer Clause 1.3 for definition of “Structural Engineer”) experienced in the structural design of bearings verifying that all bearings and attachments comply with the requirements of the Drawings and this Specification.

2.3 Approved Sliding Material

Submit details of the proposed ASM to the Principal 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.
3 MATERIALS

3.1 MATING SLIDING SURFACES

3.1.1 Materials for Sliding Surfaces

Materials for sliding surfaces under this Specification include ASM, polytetrafluoroethylene (PTFE), composite materials, stainless steel sheets, and chromium plated steel surfaces.

3.1.2 Material Combinations

Material combinations for mating sliding surfaces must conform to Table B292.1.

<table>
<thead>
<tr>
<th>Type</th>
<th>Sliding Surface Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curved surface</td>
<td>ASM on stainless steel; or</td>
</tr>
<tr>
<td></td>
<td>ASM on hard chromium plated steel</td>
</tr>
<tr>
<td>Plane surface</td>
<td>ASM on stainless steel</td>
</tr>
<tr>
<td>Guides</td>
<td>ASM on stainless steel; or</td>
</tr>
<tr>
<td></td>
<td>PTFE on stainless steel; or Composite material on stainless steel</td>
</tr>
</tbody>
</table>

The backing plates to the sliding surfaces must be adequately rigid when calculated using the method specified in EN 1337-2, to ensure uniform loading and avoid unacceptable deformation.

3.2 FERROUS MATERIALS

3.2.1 Bearing Plates, Sliding Plate, Guide Bars and Attachment Plates

Concave and convex bearing plates, plane sliding plate, guide bars and attachment plates must be fabricated from structural steel conforming to AS/NZS 3678 and/or AS/NZS 3679.1 or approved equivalent.

Curved bearing plates that are hard chromium plated (refer to Clauses 3.2.2 and 4.4) must be Grade 350 or higher.

3.2.2 Metallic Sliding Surfaces

(a) Stainless steel surface

Sliding surfaces made from stainless steel sheets must conform to ASTM A240M Grade 316 L or equivalent. The minimum thickness of stainless steel sheets must be 2.5 mm.

The sliding surface of the stainless steel sheet must be 2B surface finish, mechanically polished to mirror finish with a maximum surface roughness \( R_a \) of 0.4 \( \mu \text{m} \), or roughness \( R_{\text{max}} \) of 1 \( \mu \text{m} \).
(b) Chromium plated surface

Hard chromium plating of sliding surfaces must be in accordance with AS 2453 with minimum thickness of at least 100 µm.

The chromium plated surface must have a surface roughness $R_{a}$ of not more than 3 µm. Where necessary, polish the base material and/or hard chromium plating to achieve the specified roughness.

3.2.3 Bolts, Nuts, Screws and Washers

All bolts, nuts, screws and washers used must comply with Specification RMS B240.

3.3 Non-metallic Sliding Pads and Strips

3.3.1 General

The minimum thickness of ASM pads and strips must be 8 mm.

3.3.2 Sliding Pads

Plane or curved sliding pads must be made of ASM and must be dimpled and filled with lubricant conforming to Clause 3.4.

3.3.3 Guide Sliding Strips

Guide sliding strips must be made from either ASM or PTFE. The PTFE for guide sliding strips must be durable filled PTFE, with the fillers being either milled glass fibre (25% maximum) or carbon fibre (25% maximum).

Alternatively, guide sliding strips may be a multilayered composite material, e.g. a three layer composite comprising a bronze backing strip, a sintered interlocking porous impregnated matrix, and an overlay of PTFE/lead, graphite/lead or similar mixture.

Guide sliding strips do not need to be dimpled.

3.4 Lubricant

Lubricant for filling the dimples in the ASM sliding pad must be made of silicone compounds. The lubricant must comply with Table B292.2.

<table>
<thead>
<tr>
<th>Property</th>
<th>Method of Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worked penetration</td>
<td>ASTM D217</td>
<td>&lt; 260 (1, 2)</td>
</tr>
<tr>
<td>Evaporation after 22 hr at 150°C</td>
<td>ASTM D972</td>
<td>&lt; 2%</td>
</tr>
</tbody>
</table>

Notes:

(1) Unit of measurement is one tenth of a millimetre.

(2) Penetration results up to 295 may be accepted for lubricants complying with the requirements of EN 1337-2.

The lubricant must retain its room temperature consistency over a temperature range of –40°C to +200°C and be compatible with all the components in contact with it.
3.5 MATERIAL CONFORMITY

Provide documentary evidence including certificates of compliance to verify conformity of all materials to the requirements of this Specification.

Provide a certificate of compliance with each bearing supplied confirming that the ASM used is the same material as that approved for the particular bearing (refer to Clause 1.5).

Testing of materials must be carried out in laboratories accredited by NATA for the test, or in laboratories accredited for that test by an organisation with Mutual Recognition Agreement (MRA) with NATA. If no such facilities are available for a test, the test must be carried out in a laboratory approved by the Principal with the results reported in a format acceptable to the Principal.

4 FABRICATION

4.1 GENERAL

HOLD POINT

<table>
<thead>
<tr>
<th>Process Held:</th>
<th>Fabrication of bearings.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details:</td>
<td>All documents stated in Annexure B292/D, at least 10 working days before the proposed commencement of fabrication of the bearings.</td>
</tr>
<tr>
<td>Release of Hold Point:</td>
<td>The Principal will consider the submitted documents for compliance with this Specification, prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

All fabricated items of the bearings must be free from defects including weld spatter.

Round all sharp edges, corners and weld crests to a minimum radius of 1.5 mm except where specified otherwise in this Specification. Chamfer the edges of drilled holes.

4.2 FLATNESS OF SURFACES

4.2.1 Curved Sliding Surfaces

The flatness along the profile of all curved surfaces must not exceed the tolerance specified for plane surfaces in Clause 4.2.2.

4.2.2 Plane Sliding Surfaces

The flatness of all plane sliding surfaces must not exceed 0.0003 times the larger dimension of the sliding material or 0.2 mm, whichever is greater.

4.2.3 Guide Bars

The flatness of contact surfaces of guide bars must not exceed 0.001 times the nominal dimension.

4.2.4 Attachment Plates

The flatness of attachment plates must conform to the requirements of Specification RMS B201.
4.3 **BEARING CONCAVE AND CONVEX PLATES**

Manufacture each plate from one piece of steel.

Welding of ancillary elements to allow fixing of the bearing to the attachment plates must be Category SP or better conforming to the relevant part of AS 1554.

For bearings which will be subjected to uplift loading at ULS, carry out inspection of the welding (if any) of ancillary elements of the bearings designed to carry the uplift loading, as follows:

(a) magnetic particle inspection on 100% of the weld;
(b) ultrasonic testing on at least 20% of the weld of each element;

unless directed otherwise by the Principal.

4.4 **STAINLESS STEEL SLIDING SURFACE**

4.4.1 General

The stainless steel sheet in the assembled bearing must be larger than the ASM pad, extending beyond the edges of the ASM pad to accommodate the limits of translation specified in Clause 2.1.2.

Attach the stainless steel sheet to the backing plate by continuous welds along the edges. The backing plate must extend beyond the stainless steel sheet to accommodate the welds. The welded perimeter of the stainless steel sheet must not come in contact with the ASM.

4.4.2 Welding

Welding must conform to AS/NZS 1554.6 Category 2B, surface condition II. Use prequalified welding consumables in accordance with AS/NZS 1554.6 for the combination of materials involved. The weld size must not exceed the thickness of the stainless steel sheet.

Submit welding procedures in accordance with AS/NZS 1554.6 prior to welding. The welding procedures must detail the welding sequence necessary to eliminate distortion and to ensure flatness of the sheet and its full contact with the backing plate.

After welding, the flatness of the sliding sheet must conform to the requirements of Clause 4.2.

4.4.3 Passivation and Repolishing

Passivate all welds and heat affected zones of the stainless steel sheet and repolish the sheet to a maximum surface roughness $R_a$ of 0.4 $\mu$m.

4.5 **HARD CHROMIUM PLATED SURFACES**

4.5.1 General

Do not use hard chromium plated sliding surfaces in an environment where airborne particles of chlorides and fluorine are present in the environment, such as in industrial environment, unless special provisions are made to protect the surface.

Where hard chromium plated steel is selected as one of the sliding surface combination (refer Table B292.1), the entire curved surface of the bearing convex plate must be hard chromium plated.
4.5.2 Defects

Hard chromium plating and its base surface must be free from surface porosity, shrinkage cracks and inclusions. Small defects may be repaired, e.g. by pinning prior to hard chromium plating.

Visually inspect the hard chromium plated surface for cracks and pores. Carry out a non-destructive Ferroxyl test in accordance with AS 2331.3.9 to detect any discontinuities, without counting them, in the hard chromium plated surface. Reject the hard chromium plating where any discontinuity is detected.

4.6 GUIDE BARS

Manufacture each guide bar from one piece of steel. Where connected by screws, recess the guide bars into the plane sliding plates, or the bearing convex or concave plates, as applicable. Alternatively, the guide bar and the connecting sliding plate may be manufactured from one piece of steel by machining or by welding to form a single piece.

The two contact surfaces of the guide bar(s) must be parallel to each other, with a flatness conforming to that specified in Clause 4.2.3.

The maximum gap between a guide and its corresponding sliding surface must not exceed 3 mm when the other side is in full contact.

The combination of sliding surfaces of guided bars must be in accordance with Clause 3.1.

4.7 NON-METALLIC SLIDING SURFACES

4.7.1 ASM Pads

Restrain the ASM pad by recessing it into the backing material to a depth conforming to AS 5100.4.

The flatness of the sliding surfaces must conform to the requirements of Clause 4.2.

The shoulder of the recess into the backing material must be sharp and square to resist extrusion of ASM. Do not leave any gap between the inner face of the recess and ASM apart from intermittent gaps of not more than the larger of 0.001 times the diameter or 0.6 mm.

Permanently lubricate the ASM pad in accordance with AS 5100.4.

4.7.2 ASM, PTFE and Composite Material Guide Strips

Restrain ASM and PTFE sliding strips by recessing in addition to mechanical fixing and/or adhesive bonding. The average adhesion-in-peel strength of the adhesive compound must not be less than 30 N when tested under standard conditions to ASTM C794.

Restrain composite material sliding strips by mechanical fixing.

The flatness of the sliding surfaces must conform to the requirements of Clause 4.2.

4.8 ATTACHMENT PLATES

Use separate structural steel attachment plates above and below the spherical bearings. The minimum mean thickness of the attachment plates must be 20 mm.
Attachment plates may be tapered to correct lack of parallelism caused by various effects including longitudinal grade, crossfall in the carriageway and hog or camber of the superstructure.

5  PROTECTIVE TREATMENT

5.1  GENERAL

5.1.1  Standards

Unless otherwise specified, all work required for the protective treatment must comply with the requirements of AS/NZS 2312.1 or AS/NZS 2312.2, as relevant, and this Specification.

5.1.2  Coating Systems

Unless otherwise specified, the coating systems for the bearing and attachment plates must be in accordance with Table B292.3.

Table B292.3 – Coating Systems for Bearings and Attachment Plates

<table>
<thead>
<tr>
<th>Component</th>
<th>Bearing External Surfaces</th>
<th>Bearing Internal Surfaces</th>
<th>Attachment Plates</th>
<th>Fasteners</th>
<th>Stainless Steel Sheet</th>
<th>Chromium Plated Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>ZP (1)</td>
<td>No treatment (4)</td>
<td>HDG (2) or ZP (1)</td>
<td>HDG (2)</td>
<td>No treatment (3)</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

- (1) ZP: Zinc metal spray and paint system as detailed in Annexure B292/E.
- (2) HDG: Refer to Clause 5.4.
- (3) Do not coat stainless steel sliding surfaces and chromium plated surfaces, and protect these surfaces from being coated or damaged during the application of the protective treatment to adjacent areas.
- (4) Primer may be applied to the recess for ASM but do not apply any treatment below the stainless steel sheet on the backing plate to prevent interference with welding.

5.1.3  Application of Protective System

Apply the protective treatment under factory conditions prior to assembly of the bearings. Carry out repairs to damaged coatings in accordance with the paint manufacturer’s recommendations.

The protective treatment of the attachment plates where attached to steel girders, must be the same as that of the steel girders.

5.1.4  Paints

All paints must be from a single manufacturer and comply with the Australian Paint Approval Scheme (APAS) specifications stated in Annexure B292/E. Record details of paint used.

5.2  SURFACE PREPARATION

Clean steelwork surfaces which are to receive protective treatment, except those to be galvanized, by abrasive blasting in accordance with AS 1627.4 using crushed sharp angular metallic abrasive grit.
Before abrasive blasting, clean the areas contaminated with oil, grease, fingerprints, salt residues or other contaminants using alkaline solutions in accordance with AS 1627.1.

Prepare steelwork surfaces to be galvanized in accordance with AS/NZS 4680 and AS/NZS 1214 as appropriate.

5.3 **ZINC METAL SPRAY**

Apply the zinc metal using an electric arc spray method for melting the zinc wire. Apply the spray to dry, dust free and clean surfaces within 24 hours after abrasive blasting to avoid any discolouration or contamination of the surfaces.

The temperature of the steelwork must be at least 3°C above the dew point.

The specified coating thickness must be the minimum local thickness on the significant surface of a single component in the bearing. Seal the zinc metal coating with an appropriate sealer prior to application of top coat.

5.4 **HOT-DIP GALVANIZING**

Carry out hot-dip galvanizing in accordance with AS/NZS 4680 for applicable attachment plates and AS/NZS 1214 for fasteners.

Quench all galvanized items in a passivating chromate solution immediately after galvanizing.

5.5 **PAINT APPLICATION**

Apply paint using airless or air-assisted airless spraying methods to zinc sprayed steelwork no later than 24 hours after the zinc spraying. Apply a stripe coat of paint to all edges of the surfaces to be painted prior to spraying. Brush shadowed areas before spraying.

Apply paint coats under the environmental conditions specified by the paint manufacturer. Cure finished paintwork for a minimum of three days before dispatch of bearings to site, unless otherwise recommended by the manufacturer.

6 **TESTING OF BEARINGS**

6.1 **GENERAL**

Test bearings in accordance with Clause 6 and at the frequency specified in Annexure B292/L. Carry out the vertical, lateral and rotation load tests on the same bearing.

Test bearings fully assembled.

The direction of loads/rotations applied in all the tests must replicate the design conditions.

On completion of all load tests on each bearing tested, dismantle the bearing tested and inspect for the defects listed in Clause 6.4.

Re-lubricate all sliding surfaces for final assembly.
6.2 GEOMETRICAL VERIFICATION

Check bearing dimensions, flatness, surface roughness and clearances to verify compliance with the requirements of Clauses 3 and 4.

6.3 LOAD TESTS

6.3.1 General

Carry out the types of load tests in accordance with Table B292.4.

<table>
<thead>
<tr>
<th>Bearing Type</th>
<th>Vertical</th>
<th>Lateral</th>
<th>Friction</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Free sliding</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Guided sliding</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The relevant load tests must be performed on the nominated bearing for testing.

Tests must be carried out in laboratories accredited by NATA for the test or laboratories accredited for that test by an organisation with Mutual Recognition Agreement with NATA, unless approved otherwise by the Principal.

6.3.2 Vertical Load Test

Load the bearings in compression to the maximum ULS vertical load shown on the Drawings, maintain this load for one minute, and then release the load. Reapply the load to the maximum ULS vertical load and maintain it for a minimum loading period of three minutes (the loading period is the time the bearing sustains a test load of at least 95% of the initial load).

Carry out a visual inspection of the bearing while under the second stage loading and report any sign of damage in accordance with Clause 6.4.

6.3.3 Lateral Load Test

Test bearings which are required to resist lateral forces by applying the following test loads:

(a) maximum ULS lateral load while loaded in compression to the concurrent minimum ULS vertical load shown on the Drawings;

(b) maximum ULS lateral load while loaded in compression to the concurrent maximum ULS vertical load shown on the Drawings.

In both cases, apply the vertical load first and then apply the lateral loads gradually. Maintain the test loads for a minimum loading period of three minutes.

Carry out a visual inspection of the bearing while under the applied loading, and report any sign of damage in accordance with Clause 6.4.
6.3.4 Rotation Capacity Test

Load the bearings in compression to a test load of 0.7 times the maximum ULS vertical load shown on the Drawings while at the design rotation specified in the Drawings. Maintain this vertical load for a minimum loading period of three minutes.

Carry out a visual inspection of the bearing while under the applied loading and report any sign of damage in accordance with Clause 6.4.

6.3.5 Coefficient of Friction Test

Determine the coefficient of friction of plane sliding surfaces using vertical loads corresponding to vertical pressures on the ASM pad of 15 and 60 MPa, unless shown otherwise on the Drawings, at an ambient temperature between $5^\circ C$ and $35^\circ C$.

The test displacement must be equal to the design displacement value but not exceeding 50 mm. Apply the vertical load and maintain it for three minutes before starting sliding. The test sliding speed must be in the range of 2.5 to 25 mm/minute.

Record the maximum horizontal force during sliding. Repeat the sliding and the horizontal force measurements to obtain the average of five measurements. Where bearings are tested in pairs, calculate the coefficient of friction of the bearings using the equation below:

\[
\text{Coefficient of friction} = \frac{\text{Average horizontal force}}{2 \times \text{vertical load}}
\]

The measured coefficient of friction must not exceed the values specified in Table B292.5 for the relevant pressure on the ASM.

<table>
<thead>
<tr>
<th>ASM pressure</th>
<th>15 MPa</th>
<th>45 MPa</th>
<th>60 MPa</th>
<th>$\geq 90$ MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum coefficient of friction</td>
<td>0.04</td>
<td>0.02</td>
<td>0.016</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Note:
Interpolate friction values linearly for intermediate ASM pressures.

6.4 CRITERIA FOR ACCEPTANCE

6.4.1 General

Reject any bearing that does not meet the requirements of the geometrical verification in Clause 6.2 or any of the load tests in Clause 6.3, or exhibits any signs of damage during or after the testing.

Such signs of damage include:

(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 guide bars;
(e) damage to chromium plating where applicable.
6.4.2 Acceptance of Remainder

If a bearing is rejected, test two additional bearings from the group of bearing represented by the failed bearing. If both bearings meet the requirements of this Specification, the Principal may accept the remaining bearings in the bearing group. Should one or both of the bearings not meet the requirements of this Specification, test each of the remaining bearings in the group for compliance.

The additional testing will be carried out at your own cost.

6.5 BEARING REPORT

Provide a bearing report verifying that all bearings conform to the requirements of this Specification. The report must include:

(a) a summary of all test results with clear identification of the bearings tested;
(b) geometrical verification of all bearing dimensions;
(c) protective treatment certification.

7 IDENTIFICATION AND DELIVERY

7.1 IDENTIFICATION

Identify each bearing and fit a name plate to the bearing in accordance with AS 5100.4. Indicate the applicable installation locations of the bearings.

Ensure that the bearing orientation, the centreline and the direction(s) of movement as appropriate are readily identifiable to facilitate correct placement.

7.2 DELIVERY

<table>
<thead>
<tr>
<th>HOLD POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held: Delivery of bearings to site.</td>
</tr>
<tr>
<td>Submission Details: Bearing test report in accordance with Clause 6.5, at least 10 working days before the proposed date for delivery of bearings to site.</td>
</tr>
<tr>
<td>Release of Hold Point: The Principal will consider the submitted documents for compliance with this Specification, prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

Provide temporary transit clips or equivalent, which must be easily removable, to hold the bearing components assembled during delivery. Do not remove the transit clips and/or bolts until after completion of installation in the bridge structure.

Supply mating parts of bearings in sets held together at the correct preset and skew with metal transit clips and/or bolts to prevent misalignment and/or damage of the components during transport and erection.

Protect bearings in dust and moisture resistant wrappings after assembly and during transportation to site and keep them secured in a horizontal condition.
ANNEXURE B292/A – JOB SPECIFIC REQUIREMENTS

Refer to Clause 1.2.1.

<table>
<thead>
<tr>
<th>Paint System</th>
<th>Colour of Paint Coat</th>
</tr>
</thead>
</table>

ANNEXURE B292/B – PAYMENT

Refer to Clause 1.2.2.

In the Schedule of Prices accompanying the Lump Sum Tender, payment for the cost of supply of structural steel spherical bearings will be made under the following Pay Items B292P1 (a) to (c), as appropriate.

Provide separate rates for each load combination.

Pay Item B292P1       Supply of Spherical Bearings – Structural Steel
(a)    Fixed
(b)    Free sliding
(c)    Guided sliding

The unit of measurement is “each”.

The rate must include the costs of materials, labour, testing and delivery to site.
ANNEXURE B292/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

<table>
<thead>
<tr>
<th>Clause</th>
<th>Point</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Hold</td>
<td>Submission of planning documents</td>
</tr>
<tr>
<td>7.2</td>
<td>Hold</td>
<td>Submission of bearing report</td>
</tr>
</tbody>
</table>

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of RMS Q Annexure Q/E.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description of the Identified Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>Bearing design calculations, drawings and certification</td>
</tr>
<tr>
<td>2.2</td>
<td>Any variations from the previously approved bearing details</td>
</tr>
<tr>
<td>3.5</td>
<td>Documentary evidence of materials conformity</td>
</tr>
<tr>
<td>5.1</td>
<td>Protective treatment details</td>
</tr>
<tr>
<td>6.5</td>
<td>Bearing report</td>
</tr>
</tbody>
</table>

ANNEXURE B292/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. Review the requirements of this Specification and other Contract Documents to determine any additional documentation requirements.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description of Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5.2</td>
<td>Technical procedure for welding of stainless steel sheet</td>
</tr>
<tr>
<td>4.7</td>
<td>Technical procedure for lubricating the ASM pad</td>
</tr>
<tr>
<td>5</td>
<td>Technical procedures for protective treatment</td>
</tr>
<tr>
<td>6.1</td>
<td>Technical procedure for dismantling and reassembly of test bearings</td>
</tr>
</tbody>
</table>
ANNEXURE B292/E – ZP COATING SYSTEM

E1 Coating System

Coating system consists of zinc coat, sealer and wet paint coating applied in their respective order.

E2 Surface Preparation

(a) Abrasive blast cleaned to Class 3 in accordance with AS 1627.4.
(b) Nominal surface profile of 75µm.
(c) Surface profile measured in accordance with Method A in AS 3894.5.

E3 Zinc Coat

(a) Zinc wire: Zn 99.99 conforming to ISO 752.
(a) Minimum local thickness of 150 µm.
(b) Local coat thickness measured in accordance with AS 2331.1.3.

E4 Sealer

(a) Sealer: a proprietary low viscosity sealer compatible with the top coat.

E5 Wet Paint Coating Systems

(a) Wet paint coating systems must be either System A or System B in accordance with Table B292/E.1.

<table>
<thead>
<tr>
<th>Description</th>
<th>System A</th>
<th>System B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint</td>
<td>MIO epoxy</td>
<td>HB polyurethane</td>
</tr>
<tr>
<td>Min DFT (µm)</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Colour</td>
<td>RMS Bridge Grey to <em>Colours for Micaceous Iron Oxide Pigmented Paints</em>, produced by the NSW State Paint Group of the Government Paint Committee, June 1993</td>
<td>Colour N35 “Light Grey” to AS 2700</td>
</tr>
</tbody>
</table>

(b) System A is the default system.
(c) System B is only applied where so specified in Annexure B292/A as a job specific requirement.
(d) **MIO epoxy**: a two pack micaceous iron oxide pigmented polyamide cured epoxy coating conforming to APAS 2972.
(e) **HB polyurethane**: a full gloss two component, high build recoatable, acrylic modified polyurethane enamel, excluding two pack acrylic, included in a system conforming to APAS 2911.
(f) Minimum DFT is the minimum dry film thickness measured in accordance with Magnetic Induction Method B in AS 3894.3.

ANNEXURES B292/F TO B292/K– (NOT USED)
ANNEXURE B292/L – MINIMUM FREQUENCY OF TESTING

Refer to Clause 1.2.5.

Table B292/L.1 – Frequency of Testing

<table>
<thead>
<tr>
<th>Clause</th>
<th>Type of Test</th>
<th>Bearings per Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2</td>
<td>Geometrical verification</td>
<td>≤ 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 10 and ≤ 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 25</td>
</tr>
<tr>
<td>6.3.2</td>
<td>Vertical load test</td>
<td></td>
</tr>
<tr>
<td>6.3.3</td>
<td>Lateral load test</td>
<td>1 per group</td>
</tr>
<tr>
<td>6.3.4</td>
<td>Rotation capacity test</td>
<td>2 per group</td>
</tr>
<tr>
<td>6.3.5</td>
<td>Coefficient of friction test</td>
<td>3 per group</td>
</tr>
</tbody>
</table>

Notes:

(1) The test results are only valid where the stainless steel batch and ASM batch combination tested is the same as that used for the bearings represented by the test sample. Past test results not more than two years old obtained for previous projects for the same ASM and stainless steel batches may be accepted by the Principal.
ANNEXURE B292/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

**RMS Specifications**

RMS Q  
Quality Management System

RMS B201  
Steelwork for Bridges

RMS B240  
Supply of Bolts, Nuts, Screws and Washers

RMS B284  
Installation of Bridge Bearings

**Australian Standards**

AS/NZS 1214  
Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)

AS/NZS 1554.6  
Structural steel welding - Welding stainless steels for structural purposes

AS 1627  
Metal finishing – Preparation and pretreatment of surfaces

AS 1627.1  
Part 1: Removal of oil, grease and related contamination

AS 1627.4  
Part 4: Abrasive blast cleaning

AS/NZS 2312  
Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings

AS/NZS 2312.1  
Part 1: Paint coatings

AS/NZS 2312.2  
Part 2: Hot dip galvanizing

AS 2331  
Methods of test for metallic and related coatings

AS 2331.1.3  
Method 1.3: Local thickness tests – Magnetic method

AS 2331.3.9  
Method 3.9: Corrosion and related property tests - Metallic coatings - Porosity tests - Ferroxyl test

AS 2453  
Electroplated coatings - Chromium for engineering applications

AS 2700  
Colour standards for general purposes

AS/NZS 3678  
Structural steel - Hot-rolled plates, floorplates and slabs

AS/NZS 3679.1  
Structural steel - Hot-rolled bars and sections

AS 3894  
Site testing of protective coating

AS 3894.3  
Part 3: Determination of dry film thickness

AS 3894.5  
Part 5: Determination of surface profile

AS/NZS 4680  
Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

AS 5100  
Bridge design

AS 5100.2  
Part 2: Design loads

AS 5100.4  
Part 4: Bearings and deck joints

AS 5100.6  
Part 6: Steel and composite construction

AS/NZS ISO 9001  
Quality management systems – Requirements
### Other Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A240M</td>
<td>Standard specification for chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels and for general applications</td>
</tr>
<tr>
<td>ASTM C794</td>
<td>Standard test method for adhesion-in-peel of elastomeric joint sealants</td>
</tr>
<tr>
<td>ASTM D217</td>
<td>Standard test methods for cone penetration of lubricating grease</td>
</tr>
<tr>
<td>ASTM D972</td>
<td>Standard test method for evaporation loss of lubricating greases and oils</td>
</tr>
<tr>
<td>EN 1337-2</td>
<td>Structural bearings. Sliding elements</td>
</tr>
<tr>
<td>ISO 752</td>
<td>Zinc ingots</td>
</tr>
<tr>
<td>ISO 3274</td>
<td>Geometrical Product Specifications (GPS) – Surface texture: Profile method – Nominal characteristics of contact (stylus) instruments</td>
</tr>
<tr>
<td>ISO 4287</td>
<td>Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters</td>
</tr>
</tbody>
</table>

### APAS Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APAS 2911</td>
<td>Polyurethane coating for protection of steel</td>
</tr>
<tr>
<td>APAS 2972</td>
<td>Low build epoxy two-pack coating for the long term protection of steel in atmosphere</td>
</tr>
</tbody>
</table>