



# AEROSPACE STANDARD

**AS6039™****REV. E**Issued 1997-10  
Revised 2022-06

Superseding AS6039D

Bearings, Ball, Rod End, Double Row, Self-Aligning

## RATIONALE

Changes to this document are a result of a Five-Year Review. Updates were made to incorporate current specifications and contact information contained within the document and incorporate standard language used in other documents. In addition, clarification defining the responsibilities of grease shelf life, as agreed upon by the committee on similar documents.

### 1. SCOPE

#### 1.1 Scope

This SAE Aerospace Standard (AS) covers sealed, self-aligning, anti-friction, rod end ball bearings with application in temperature ranges (1) -65 to 250 °F and (2) -65 to 300 °F with 20% reduction of dynamic load carrying capacity when subjected to operation above 250 °F.

#### 1.2 Classification

The bearings shall be of the following types, as specified (see 6.2):

- Type I - Bearing, ball, solid shank, rod end (AS21150)
- Type II - Bearing, ball, external thread, rod end (AS21151)
- Type III - Bearing, ball, hollow shank, rod end (AS21152)
- Type IV - Bearing, ball, internal thread, rod end (AS21153)

### 2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

#### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2417            Plating, Zinc-Nickel Alloy

AMS3652            Polytetrafluoroethylene (PTFE) Film, Non-Critical Grade

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|              |                                                                                                                 |
|--------------|-----------------------------------------------------------------------------------------------------------------|
| AMS3666      | Polytetrafluoroethylene (PTFE) Sheet, Glass Cloth Reinforced                                                    |
| AMS6274      | Steel, Bars, Forgings, and Mechanical Tubing, 0.50Cr - 0.55Ni - 0.20Mo (0.18 - 0.23C) (SAE 8620)                |
| AMS6440      | Steel, Bars, Forgings, and Tubing, 1.45Cr (0.93 - 1.05C) (SAE 52100), For Bearing Applications                  |
| AMS-QQ-P-416 | Plating, Cadmium (Electrodeposited)                                                                             |
| AS8879       | Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter                         |
| AS21150      | Bearing, Ball, Rod End, Double Row, Precision, Solid Shank, Self-Aligning, Airframe, Type I, -65 to 300 °F      |
| AS21151      | Bearing, Ball, Rod End, Double Row, Precision, External Thread, Self-Aligning, Airframe, Type II, -65 to 300 °F |
| AS21152      | Bearing, Ball, Rod End, Double Row, Precision, Hollow Shank, Self-Aligning, Airframe, Type III, -65 to 300 °F   |
| AS21153      | Bearing, Ball, Rod End, Double Row, Precision, Internal Thread, Self-Aligning, Airframe, Type IV, -65 to 300 °F |

## 2.2 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

|               |                                                                                  |
|---------------|----------------------------------------------------------------------------------|
| MIL-STD-129   | Military Marking for Shipment and Storage                                        |
| MIL-STD-130   | Identification Marking of U.S. Military Property                                 |
| MIL-DTL-197   | Packaging of Bearings, Associated Parts and Subassemblies                        |
| MIL-PRF-23827 | Grease, Aircraft and Instrument, Gear and Actuator Screw, NATO Code Number G-354 |
| MIL-PRF-81322 | Grease, Aircraft, General Purpose, Wide Temperature Range, NATO Code G-395       |

## 2.3 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

|             |                                                                          |
|-------------|--------------------------------------------------------------------------|
| ANSI/ABMA 4 | Tolerance Definitions and Gauging Practices for Ball and Roller Bearings |
|-------------|--------------------------------------------------------------------------|

## 2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

|            |                                                                                                                          |
|------------|--------------------------------------------------------------------------------------------------------------------------|
| ASTM D3951 | Standard Practice for Commercial Packaging                                                                               |
| ASTM D4550 | Standard Specification for Thermoplastic Elastomer-Ether-Ester (TEEE)                                                    |
| ASTM E1444 | Standard Practice for Magnetic Particle Testing for Aerospace                                                            |
| ASTM F2215 | Standard Specification for Balls, Bearings, Ferrous and Nonferrous for Use in Bearings, Valves, and Bearing Applications |

## 2.5 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), [www.asme.org](http://www.asme.org).

ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

## 2.6 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 12103-1 Road Vehicles - Test Contaminants for Filter Evaluation - Part 1: Arizona Test Dust

## 3. REQUIREMENTS

### 3.1 Aerospace Standards (AS)

The individual item requirements shall be specified herein and in accordance with the applicable AS sheets. In the event of any conflict between the requirements of this specification and the AS sheet, the latter shall govern.

### 3.2 Qualifications

Products furnished under this standard shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL-AS6039) at the time of award of contract (see Sections 4 and 6). See Qualified Products Database (QPD) at <https://assist.dla.mil> or <https://quicksearch.dla.mil/>.

#### 3.2.1 Product Change

Any change in product design, including raceway geometry or dimensions, rolling element dimensions, rolling element quantity, seals, materials, processing procedures or plant location shall be reported to the Qualifying Activity and will require requalification of the product to an extent determined by the Qualifying Activity. Any other specific changes which must be brought to the qualifying activity's attention will be identified in the qualification notification letter. For the purposes of this specification "change in processing procedures" means a change in any of the following: (1) the company performing the outer raceway case hardening, or (2) the company performing the final machining of the outer and inner race.

#### 3.2.2 Product Manufacture

The bearing manufacturer shall be capable of performing the preponderance of manufacturing operations in-house but may subcontract these operations at its option. Component inspection shall be performed at the plant listed on the Qualified Products List. If manufacturing operations are performed in more than one plant, the manufacturer's additional plant(s) shall be reported to the Qualifying Activity. The manufacturer is responsible for meeting all requirements of the specification and for the quality of the end product, whether it is manufactured totally in-house or some of the operations are performed by a subcontractor. Inherent in the responsibility for the end product is the responsibility to verify that the subcontractor's processes meet specification requirements. A change in subcontractor need not be reported to the qualifying activity unless specifically identified in the qualification notification letter. (NOTE: Bearings partly or completely manufactured in foreign countries shall be subject to the laws and procurement regulations pertaining to acquisition of foreign made products.)

### 3.3 Certification of Qualification

To retain qualification of a product approved for listing on the Qualified Products List (QPL), the Qualifying Activity shall require the manufacturer to verify by certification that the manufacturer's product complies with the requirements of this specification. This verification by certification will be in 2 year intervals from the date of original qualification and will be initiated by the Qualifying Activity. The Qualifying Activity reserves the right to re-examine or require the manufacturer to retest the qualified product whenever deemed necessary to ensure that the product continues to meet any or all of the specification requirements. Sample size and applicable tests to be determined by the Qualifying Activity.

### 3.4 Material

The bearing shall conform to materials as listed on AS21150, AS21151, AS21152, or AS21153, as applicable (see 6.2b). Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. None of the above shall be interpreted to mean that the use of used or rebuilt products will be allowed.

### 3.5 Design and Construction

Only factory new bearings, as specified herein, shall be furnished. Details of the working parts shall be optional.

#### 3.5.1 Rings

The outer ring shall be of single-piece construction with the rod end shank. The inner ring shall be of a single-piece construction.

#### 3.5.2 Balls

Balls shall meet the requirements of ASTM F2215 and be as specified on the applicable AS sheet.

#### 3.5.3 Threads

##### 3.5.3.1 Class 1 Rod Ends (External Thread)

Dimensions, form, and contour shall conform to AS8879. Rerolling of threads to correct dimensional deficiencies shall not be permitted.

##### 3.5.3.2 Class 2 Rod Ends (Internal Thread)

Threads shall conform to AS8879.

##### 3.5.3.3 Thread Discontinuities (Laps, Seams, and Surface Irregularities)

Threads shall have no multiple or single laps at the root or on the sides (Figure 3), except that laps are permissible at the crest which do not exceed 25% of basic thread depth, and on the sides outside the pitch diameter (see Figure 4). Deviation from the thread contour is permissible at the crest of the thread as shown in Figure 4. The incomplete thread at each end of the thread may also deviate from contour.

#### 3.5.4 Dimensions and Tolerances

Dimensions and tolerances shall be in accordance with the applicable AS sheet.

#### 3.5.5 Shank Alignment

The point representing the center of self-alignment motion shall be coincident with the axis of the rod end within 0.010 inch.

#### 3.5.6 Weight

The approximate weight of the bearing shall be as specified on the applicable AS sheet.

### 3.5.7 Plating

All external surfaces of the bearing, excluding the bore, seal, and seal retainer, shall be either zinc-nickel plated in accordance with AMS2417, Type 2, Grade B or cadmium plated per AMS-QQ-P-416, Type I, Class 2 as specified on the applicable AS sheet. All external unthreaded surfaces shall have a plating thickness of 0.0003 to 0.0006 inch. The plating thickness of the bore chamfers shall be a maximum of 0.0006 inch. External threaded (AS21151) shanks shall have a plating thickness range of 0.0002 to 0.0005 inch. Hollow (AS21152) and internally threaded (AS21153) shanks need not be internally plated.

### 3.5.8 Identification of Products

Bearings shall be permanently and legibly marked with the bearing manufacturer's part number, name or symbol (in accordance with MIL-STD 129 and MIL-STD-130), and lot traceability. The individual bearing package and container shall be marked with the complete AS part number, and the manufacturer's name, trademark, or brand, part number, and date of lubrication in accordance with MIL-STD-129.

### 3.5.9 Hardness

The inner ring and balls shall be through-hardened and shall have a hardness as specified on the applicable AS sheet. The outer raceways shall be case hardened, and the hardness on the surface shall be as specified on the applicable AS sheet.

### 3.5.10 Surface Roughness

The sides of the inner ring shall have a smooth machine finish that shall not exceed 63 microinches (Ra). Otherwise, the surface roughness shall be as specified on the applicable AS sheet.

### 3.5.11 Seals (Grease Retention)

The seals shall be capable of withstanding the test requirements as specified in 4.5.4.1 without failure. Grease conforming to MIL-PRF-81322 shall be injected into the bearing. The amount of grease shall be measured by weight and shall be at least 80% of the nominal theoretical volume within the rod end. Not less than 25% of the bearing lubricant by weight shall be retained in the bearing at the end of 100 hours of testing.

### 3.5.12 Seals (Dust Contamination):

After completion of the dust test specified in 4.5.4.2, seven out of ten tested bearings shall meet the following requirements:

- Radial clearance shall not increase more than 50% or 0.0002 inch over the pretest value, whichever is greater.
- Starting torque shall not increase more than 100% or 2 in-oz over the pretest value, whichever is greater.

### 3.5.13 Lubrication

The bearing shall be thoroughly cleaned prior to lubrication. Grease conforming to MIL-PRF-81322 or MIL-PRF-23827 shall be injected into the bearing, filling the bearing voids 80% minimum full. The bearing bore and the inside diameter of hollow or internally threaded shanks shall also be coated with MIL-PRF-81322 or MIL-PRF-23827 grease.

#### 3.5.13.1 Delivery Date and Shelf Life

Bearings shall not have been lubricated more than 36 months prior to date of delivery to the end user who in this instance, is defined as the person or organization that will be permanently removing the bearings from their packaging. The shelf life of bearings beyond this point is not defined by this specification.

### 3.6 Performance

#### 3.6.1 Internal Clearance (Qualification)

Radial and axial clearance, measured before the radial and axial limit load rating tests (see 4.5.6 and 4.5.7), shall not exceed the limits as specified on the applicable AS sheet.

#### 3.6.2 Internal Clearance (Acceptance)

When tested in accordance with 4.5.6 and 4.5.7, the radial and axial clearance shall be within the limits specified on the applicable AS sheet.

#### 3.6.3 Radial Strength

##### 3.6.3.1 Radial Limit Load Rating

When tested in accordance with 4.5.8, the bearing shall have a radial limit load rating of not less than the values specified on the applicable AS sheet. If the smoothness of operation of the bearing has been lessened perceptibly or the radial clearance has increased by more than 0.0002 inch from the initial measurement, the bearing shall be considered to have failed and the lot rejected.

##### 3.6.3.2 Radial Ultimate Load

When tested in accordance with 4.5.9, the minimum static radial ultimate load shall be not less than 1-1/2 times the radial limit load value specified on the applicable AS sheet. Bearings that cannot be turned by hand, or that have parts fractured, shall be considered to have failed.

#### 3.6.4 Axial Strength

##### 3.6.4.1 Axial Limit Load Rating

When tested in accordance with 4.5.10, the bearing shall have an axial limit load rating of not less than the values specified on the applicable AS sheet. If the smoothness of operation of the bearing has been lessened perceptibly or if the axial clearance has increased by more than 0.0005 inch from the initial measurement, the bearing shall be considered to have failed and the lot rejected.

##### 3.6.4.2 Axial Ultimate Load

When tested in accordance with 4.5.11, the minimum static axial ultimate load shall not be less than 1-1/2 times the axial limit load value specified on the applicable AS sheet. Bearings that cannot be turned by hand, or that have parts fractured, shall be considered to have failed.

#### 3.6.5 Radial Dynamic Load Rating

When tested in accordance with 4.5.12, the bearing shall have a radial dynamic load rating of not less than the value specified on the applicable AS sheet. A bearing shall be considered to have failed if any of the following defects are detected: wear of the outer raceway greater than 0.002 inch or 0.002 inch radial displacement during dynamic testing; spalling, cracking detected by Magnetic Particle Inspection (MPI), or fracture of any component. If more than five bearings show evidence of failure, the entire lot shall be considered to have failed the test.

#### 3.6.6 Bearing Starting Torque

The amount of torque required to begin rotation of the bearing shall be measured as specified (see 4.5.14). Starting torque shall be within the maximum allowable values as specified on the applicable AS sheet.