



Standard Specification for Rollers, Bearing, Needle, Ferrous, Solid¹

This standard is issued under the fixed designation F2511; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the procurement requirements for solid ferrous needle bearing rollers including the MS19065 spherical ended solid ferrous needle rollers as specified in Specification F2443.

1.2 *Intended Use*—The rollers covered in this specification are intended for use in bearings and bearing applications.

1.3 This specification contains many of the requirements of MIL-R-22440, which was originally developed by the Department of Defense and maintained by the Defense Supply Center in Richmond. The following government activity codes may be found in the Department of Defense, Standardization Directory SD-1.²

| Preparing Activity | Custodians | Review Activities |
|--------------------|--------------|-------------------|
| DLA-GS4 | Army-AT | Army-CR4 |
| | Navy-OS | Air Force-84 |
| | Air Force-99 | |
| | DLA-GS4 | |

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:³

A295/A295M Specification for High-Carbon Anti-Friction Bearing Steel

¹ This specification is under the jurisdiction of ASTM Committee F34 on Rolling Element Bearings and is the direct responsibility of Subcommittee F34.01 on Rolling Element.

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² The Military codes that are listed in SD-1 give the address and phone numbers of the DoD contacts. These are found in the DoD's ASSIST website <http://assist.daps.dla.mil/online/start/>.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

D1974 Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes

D3951 Practice for Commercial Packaging

D3953 Specification for Strapping, Flat Steel and Seals

D5118/D5118M Practice for Fabrication of Fiberboard Shipping Boxes

D5168 Practice for Fabrication and Closure of Triple-Wall Corrugated Fiberboard Containers

D6251/D6251M Specification for Wood-Cleated Panelboard Shipping Boxes

E18 Test Methods for Rockwell Hardness of Metallic Materials

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E384 Test Method for Knoop and Vickers Hardness of Materials

F2443 Specification for Roller, Bearing, Needle, Ferrous, Solid, Spherical End

2.2 ANSI Standards:⁴

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

ASME Y14.5 Dimensioning and Tolerancing

ANSI/ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.3 ISO Standards:⁵

ISO 5593 Rolling Bearings—Vocabulary

ISO 10012–1 Quality Assurance Requirements for Measuring Equipment

2.4 Military Standards:⁶

MIL-PRF-121 Barrier Materials, Greaseproof, Waterproof, Flexible, Heat-Sealable

MIL-STD-129 Military Marking for Shipment and Storage

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁵ Available from International Organization for Standardization (ISO), 1 rue de Varembe, Case postale 56, CH-1211, Geneva 20, Switzerland.

⁶ Available from the DOD's Assist internet site located at: <http://assist.daps.dla.mil/online/start/>.

MIL-PRF-131 Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-Sealable

MIL-STD-2073-1 DOD Standard Practice for Military Packaging

MIL-PRF-22191 Barrier Materials, Transparent, Flexible, Heat-Sealable

MIL-R-22440 Roller, Bearing, Needle, Ferrous, Solid

2.5 *SAE Standards*.⁷

SAE AMS-STD-66 Steel, Chemical Composition and Hard-
enability

SAE J418a Grain Size Determination of Steel

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to ISO 5593.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *heat of steel*—batch of steel that was produced in a single furnace run. Steel from the same “heat” may be found in several different billets, bars, or coils of wire.

3.2.2 *lot*—lot shall consist of the finished rollers of the same type, diameter, length, and material, manufactured under the same conditions, and submitted for acceptance at the same time. This inspection lot shall be identified by a unique number (manufacturer’s lot control number) that will provide the traceability of the rollers to be finished bearing assemblies.

3.2.3 *surface roughness (Ra)*—the Ra, or roughness average, surface roughness is the arithmetic average of the absolute value of the departure of the filtered roughness profile measured from the mean line. Ra values are normally specified in microinches (micrometres). 1 $\mu\text{in.} = 0.0254 \mu\text{m}$ (1 $\mu\text{m} = 39.37 \mu\text{in.}$). See ASME B46.1 for more information on surface roughness.

4. Classification

4.1 The rollers shall be of the following types, as specified in the contract or order (see Section 5 and Fig. 1):

4.1.1 *Type I*—Spherical end.

4.1.2 *Type II*—Flat end.

4.1.3 *Type III*—Ball end.

4.1.4 *Type IV*—Crankpin end.

4.1.5 *Type V*—Conical end.

4.1.6 *Type VI*—Trunnion end.

5. Ordering Information

5.1 Procurement documents should specify the following:

5.1.1 Title, number, and date of this specification,

5.1.2 Type of rollers required (see 4.1),

5.1.3 Material required, if different than 6.1,

5.1.4 Diameter and length of rollers required (see 8.1),

5.1.5 Quantity required,

5.1.6 Dimensions and tolerances governing formulation of roller ends, if different than 8.1,

5.1.7 Inspection records required (see 16.1.1),

5.1.8 Required levels of packaging (see 15.1),

5.1.9 Preservative required, if different than 15.2.1.2 and 15.2.1.3,

5.1.10 Method of unit packaging required (see 15.2.1.3),

5.1.11 Number of rollers per unit package (see 15.2.1.3),

5.1.12 When case liner is not required (see 15.3.1.3), and

5.1.13 Special marking, if required (see 15.4).

6. Materials and Manufacture

6.1 *Material*—Unless otherwise specified in the contract or order (see Section 5), the rollers shall be manufactured from chrome alloy steel conforming to the chemical composition of steel number AISI E52100 of SAE AMS-STD-66, AMS 6440 or AMS 6444. The steel shall be homogeneous in structure, free from pipes, seams, laminations, bursts, flakes, excessive segregation, and other detrimental defects (see 11.2.1). The steel shall have an austenite grain size of 7 or finer (see 11.3.3). The rollers shall be free from surface decarburization (see 11.2.2).

6.1.1 *Inclusion Rating*—The chrome alloy steel shall not exceed the inclusion rating specified for billets for wire and rods used in the manufacture of balls and rollers, as specified in Specification A295/A295M.

7. Other Requirements

7.1 *Hardness*—The rollers shall have a uniform hardness of 60 to 64 Rockwell C or equivalent (see 11.2.3).

8. Dimensions and Permissible Variations

8.1 *Construction and Dimensions*—The rollers shall be of the type, diameter, and length specified in the contract or order (see Section 5) and shall be of solid construction. An illustration of the types of rollers covered herein is shown in Fig. 1. Unless otherwise specified in the contract or order (see Section 5), dimensions and tolerances governing the formation of the ends of the roller shall be in accordance with commercial practice. Dimensions and tolerances shall be interpreted in accordance with ASME Y14.5.

8.1.1 *Diameter*—The diameter of the roller shall be within +0.0000 in. (+0.000 mm) to –0.0002 in. (–0.005 mm) of the value specified in the contract or order (see Section 5).

8.1.2 *Length:*

8.1.2.1 *Types I, III, V, and VI*—The length of the roller shall be within +0.000 in. (+0.00 mm) to –0.020 in. (–0.51 mm) of the value specified in the contract or order (see Section 5).

8.1.2.2 *Type II*—The length of the roller shall be within +0.000 in. (+0.00 mm) to –0.006 in. (–0.15 mm) of the value specified in the contract or order (see Section 5).

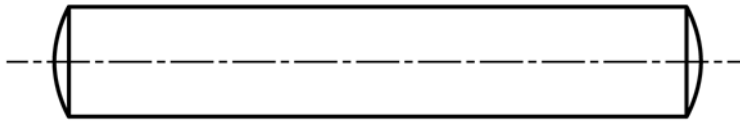
8.1.2.3 *Type IV*—The length of the roller shall be within +0.000 in. (+0.00 mm) to –0.010 in. (–0.25 mm) of the value specified in the contract or order (see Section 5).

9. Workmanship, Finish, and Appearance

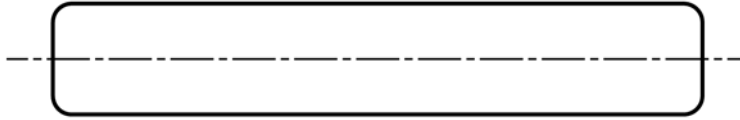
9.1 *Visual Appearance*—The cylindrical surface of the roller shall be free from scratches, pits, rust, indications of soft spots, and other surface imperfections.

9.2 *Surface Roughness*—The surface roughness of the roller diameter shall not exceed 8 $\mu\text{in. Ra}$ (0.20 $\mu\text{m Ra}$). Surface roughness shall be interpreted in accordance with ASME B46.1.

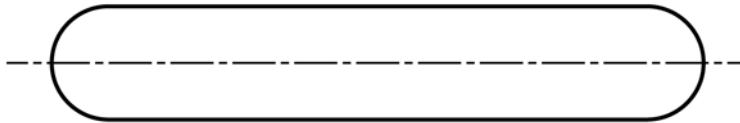
⁷ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.



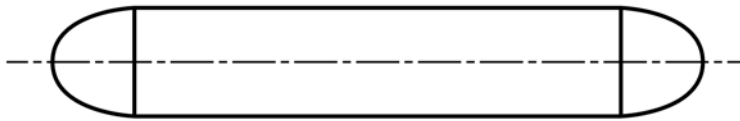
Type I - Spherical Ends



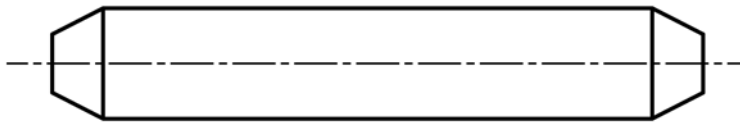
Type II - Flat Ends



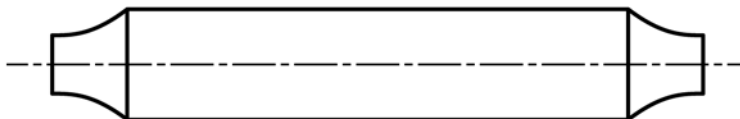
Type III - Ball Ends



Type IV - Crankpin Ends



Type V - Conical Ends



Type VI - Trunnion Ends

FIG. 1 Types of Rollers

10. Sampling

10.1 *For Examination*—A sample of rollers shall be selected from each lot by the inspector in accordance with the procedures of ANSI/ASQ Z1.4 with an AQL of 1.0%.

10.2 *For Tests*—A sample of rollers shall be selected from each lot by the inspector in accordance with the procedures of ANSI/ASQ Z1.4 with an AQL of 4.0%.

11. Inspection

11.1 Examination:

11.1.1 *Dimensional and Visual Examination*— The sample rollers, selected in accordance with 10.1, shall be dimensionally and visually examined to determine compliance with 8.1 and 9.1 respectively. Any unit of the sample containing one or more defects shall be rejected. If no defects are found in the sample, the sample lot shall be accepted. If any defects are found in the sample, the entire lot shall be inspected for the defective characteristic and defective parts removed from the lot.

11.1.2 *Surface Roughness Examination*— The sample rollers, selected in accordance with 10.1, shall be examined to determine compliance with 9.2. Any unit of the sample, which does not comply with the requirements specified in 9.2, shall be rejected. Lot acceptance shall be in accordance with 10.1. If no defects are found in the sample, the sample lot shall be accepted. If any defects are found in the sample, the entire lot shall be inspected for the defective characteristic and defective parts removed from the lot.

11.2 Tests:

11.2.1 *Hot Acid Etch Test*—The sample rollers, selected in accordance with 10.2, shall be etched for a minimum period of 15 min in a solution of 50 % hydrochloric acid and 50 % water. The temperature of the solution shall be 160°F to 180°F. After etching, the sample rollers shall be examined at a magnification of 4 diameters. If any unit of the sample contains one or more defects, such as cracks, seams, laps, pits, or other detrimental defects (see 6.1 and 9.1), the lot shall be rejected.

11.2.2 *Decarburization Test*—The sample rollers, selected in accordance with 10.2, shall be totally immersed in 5 % Nital solution (concentrated nitric acid in alcohol) for a minimum period of 30 s. The temperature of the solution shall be 75 to 85°F. If any unit of the sample exhibits areas of white to light gray, the lot shall be rejected.

11.2.3 *Hardness Test*—The sample rollers, selected in accordance with 10.2, shall be tested for compliance with 7.1. The test procedures shall be in accordance with Test Methods E18 Rockwell for superficial hardness tests and Test Method E384 for microhardness testing. Tables E140 shall be used for hardness conversion to the C Rockwell scale. The rollers shall be subjected to the test on flats of sufficient width, and material of sufficient thickness, to give a true reading. For rollers less than 1/16 in. (1.6 mm) in diameter, an appropriate superficial hardness or microhardness method shall be used. If any unit of the sample does not comply with the requirements of 7.1, the lot shall be rejected. The manufacturer may have a standard repair procedure to retemper the rollers. The rollers would require reinspection after a retempering process.

11.3 *Inspection of Material*—The material used in the manufacture of the rollers furnished under this specification shall have been inspected in accordance with and passed the following examination and tests.

11.3.1 *Chemical Analysis*—A chemical analysis shall be made on each heat of steel. The samples for analysis shall be selected from the billets, bars, or wire used in the manufacture of the rollers. The chemical analysis shall be conducted in accordance with the test methods of the material specification or Test Methods, Practices, and Terminology A751. The chemical composition determined by the above procedures shall be within the check analysis tolerances specified in SAE AMS-66 and standard industry practice.

11.3.2 *Macro-Examination*—A macro-examination shall be made on each heat of steel. The samples for examination shall be selected from the billets for the wire or rods used in the manufacture of the rollers. The samples shall be selected in accordance with Method E381. The macro-examination shall be conducted in accordance with Method E381. The quality and cleanliness of the steel as indicated by the results of the macro examination shall be equal to or better than macrographs S2, R2, and C2 of Method E381 with defects D1 through D8 unacceptable.

11.3.3 *Austenitic Grain Size Test*—An austenitic grain size test shall be made on each heat of steel. The samples for test shall be selected from the billets for the wire or rods used in accordance with SAE J418a. The austenitic grain size determined by the above procedures shall be within the range specified in 6.1.

11.3.4 *Inclusion Rating Test*—An inclusion rating test shall be made on each heat of steel. The samples for test shall be selected from the billets for the wire or rods used in the manufacture of the rollers. The test shall be conducted in accordance with the inclusion rating test specified in Specification A295/A295M. The inclusion rating determined by the above procedures shall conform to the requirements specified in 6.1.1.

11.4 *Preservation, Packaging, Packing, and Marking*—The inspector shall ascertain that the preservation, packaging, packing, and marking of rollers furnished under this specification are in accordance with the requirements of Section 15. If no preservation, packaging, packing, or marking defects are found, the shipment shall be accepted.

11.4.1 *Classification of Defects*—For packing and marking requirements not covered by referenced specifications, the following classification of defects shall apply:

11.4.1.1 Closure and sealing of caseliner incorrect/defective—major defect.

11.4.1.2 Closure of shipping container incorrect/defective—major defect.

11.4.1.3 Strapping not specified type and class or incorrectly applied when required—major defect.

11.4.1.4 Gross weight of shipping container exceeds limit specified—major defect.

11.4.1.5 Marking missing, illegible, or incorrect—major defect.

11.4.2 Any shipments found to contain a major defect shall be rejected. An inspector may choose to reject only the

defective portion of a shipment if the major defect only affects only a portion of a shipment.

12. Rejection and Reinspection

12.1 The disposition of rejected rollers shall be in accordance with the provisions in Section 11.

13. Certification

13.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

14. Product Marking

14.1 Marking of individual needle rollers is normally not practical. The marking would adversely affect performance; therefore, any identification markings usually appear on the packaging that contains the rollers.

15. Packaging and Package Marking

15.1 The rollers shall be prepared for shipment in accordance with Levels A, B, or Commercial, as specified in the contract or order (see Section 5).

15.2 *Preservation and Packaging* :

15.2.1 *Level A*:

15.2.1.1 *Cleaning, Drying, and De-Magnetization*—The rollers shall be cleaned and de-magnetized. The cleaning process shall be in accordance with Table J.III Code 1 of Specification MIL-STD-2073-1.

15.2.1.2 *Preservative*—Unless otherwise specified in the contract or order (see Section 5), the rollers shall be coated with a preservative conforming to Code 06, or immersed in a preservative conforming to Code 17, of Specification MIL-STD-2073-1 (see 15.2.1.3)

15.2.1.3 *Unit Packaging*—The rollers shall be unit packaged in accordance with method 41 or method 44, of Specification MIL-STD-2073-1 as specified in the contract or order (see Section 5). Unless otherwise specified (see 15.2.1.2), Code 06 preservative shall be used for method 41 packaging and Code 17 preservative shall be used for method 44 packaging. The unit package shall contain rollers of the same material, type, diameter, and length. The number of rollers per unit package shall be as specified in the contract or order (see Section 5).

15.2.1.4 *Intermediate Packaging*—Rollers unit packaged in accordance with method 41 (see 15.2.1.3) shall be repackaged in fiberboard boxes conforming to type I or H, class 1 of Practice D5118/D5118M or Practice D5168. Suitable cushioning shall be provided to prevent movement within the boxes. The boxes (either Practice D5118/D5118M or Practice D5168) shall be closed and sealed in accordance with the appendix thereto. The intermediate package shall contain rollers of the same material, type, diameter, and length. The gross weight of the intermediate package shall not exceed 10 lb.

15.2.2 *Level B, Preservation and Packaging*—Same as Level A (see 15.2.1).

15.2.3 *Commercial*—Cleaning, drying, preservation, and packaging shall be in accordance with the manufacturer's commercial practice, provided that such practices are adequate to ensure receipt of the undamaged item at the destination.

15.3 *Packing*:

15.3.1 *Level A*—Rollers preserved as specified in 15.2 shall be packed in wood-cleated fiberboard boxes conforming to overseas type or cleated-plywood boxes conforming to overseas type of Specification D6251/D6251M.

15.3.1.1 The gross weight of the boxes shall not exceed 200 lb (90.7 kg). Suitable blocking, bracing, and cushioning shall be provided to prevent movement within the boxes.

15.3.1.2 The boxes shall be closed and sealed in accordance with Practice D1974. Flat steel strapping shall be in accordance with Specification D3953.

15.3.1.3 Unless otherwise specified in the contract or order (see Section 5), the boxes shall be fitted with a waterproof case liner/bag conforming to MIL-PRF-121, MIL-PRF-131, or MIL-PRF-22191 with seams and closures sealed.

15.3.1.4 The boxes shall contain rollers of the same type, diameter, and length.

15.3.2 *Level B*—Rollers preserved as specified in 15.2 shall be packed in wood-cleated fiberboard boxes or cleated-plywood boxes conforming to domestic type of Specification D6251/D6251M.

15.3.2.1 Except as specified above, level B packing shall conform to the requirements of 15.3.1.

15.3.3 *Commercial*—Rollers preserved as specified in 15.2 shall be packed to afford protection against damage during direct shipment from the supply source to the first receiving activity for immediate use. Containers shall comply with consolidated freight classification rules or other common carrier regulations applicable to the mode of transportation. See Practice D3951.

15.4 *Markings*—In addition to any special markings required by the contract or order (see Section 5), interior packages, and shipping containers shall be marked in accordance with MIL-STD-129. The markings shall include the type, diameter, and length of rollers and lot number. The markings on the unit package shall include the type of preservative used for preservation (see 15.2.1.2).

16. Quality Assurance

16.1 *Quality Assurance Provisions* :

16.1.1 *Commercial Orders*—Inspections of the product shall be agreed upon between the purchaser and the supplier as part of the purchase contract or order.

16.1.2 *Government Orders*—Unless otherwise specified herein, the supplier is responsible for the performance of all inspection requirements prior to submission for government inspection and acceptance. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the government. Inspection records of the examinations and tests shall be kept complete and available to the government as specified in the contract or order (see Section 5).

17. Keywords

17.1 bearing; ferrous roller; MIL-R-22440; needle roller;
roller

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