



Designation: F2443 – 04 (Reapproved 2021)

Standard Specification for Roller, Bearing, Needle, Ferrous, Solid, Spherical End¹

This standard is issued under the fixed designation F2443; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers ferrous needle rollers having spherical ends.

1.2 Spherical-ended needle rollers designed to this specification are intended for use as bearing components. A complement of rollers is run on a hardened (HRC 58-65, see Test Methods E18) shaft and in a hardened (HRC 58-65) housing bore to form the bearing.

1.3 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.

1.4 This specification contains many of the requirements of MS19065, which was originally developed by the Department of Defense and maintained by the Defense Supply Center Richmond. The following government activity codes may be found in the Department of Defense, Standardization Directory SD-1.²

Preparing activity
DLA-GS4

Custodians
Army-AT
Navy-OS
Air Force-99
DLA-GS4

Review Activities
Navy-MC
Air Force-84

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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/>.

2. Referenced Documents

2.1 *ASTM Standards:*³

A295 Specification for High-Carbon Anti-Friction Bearing Steel

E18 Test Methods for Rockwell Hardness of Metallic Materials

2.2 *ABMA Standard:*⁴

ABMA 4 Tolerance Definitions and Gauging Practices for Ball and Roller Bearings

2.3 *ANSI Standard:*⁵

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

2.4 *ASME Standards:*⁶

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

ASME Y14.5M Dimensioning and Tolerancing

2.5 *ISO Standard:*⁵

ISO 5593 Rolling Bearings—Vocabulary

2.6 *Military Standard:*⁷

MIL-STD-129 Marking for Shipping and Storage

MIL-STD-130 Identification Marking of U.S. Military Property

MIL-DTL-197 Packaging of Bearing, Associated Parts and Subassemblies

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.

⁴ Available from Techstreet, 3916 Ranchero Dr. Ann Arbor, MI, 48108, <http://www.techstreet.com>.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁷ Available on the DOD's ASSIST internet site located at: <http://assist.daps.dla.mil/online/start/>.



2.7 SAE Standards:⁸

SAE J404 Chemical Compositions of SAE Alloy Steels

SAE AMS 66 Steel: Chemical Composition and Hardenability

SAE AMS 6440 Specification for Steel Bars, Forging and Tubing

SAE AMS 6444 Specification for Steel Bars, Forging and Tubing Premium Aircraft Quality for Bearing Application

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to ABMA 4 and ISO 5593.

4. Ordering Information

4.1 When ordering parts in accordance with this specification, specify the following:

4.1.1 ASTM designation number, including year of issue,

4.1.2 Dash number (see Table 1),

4.1.3 Dimensions of roller, including:

4.1.3.1 Diameter, in. (mm),

4.1.3.2 Length, in. (mm),

4.1.3.3 Effective length, in. (mm),

4.1.4 Level of packaging and preservation (for military procurements), and

4.1.5 Required certifications.

5. Materials and Manufacture

5.1 *Rollers*—Rollers shall be manufactured of chrome alloy steel E50100, E51100, E52100, in accordance with SAE AMS 66, SAE AMS 6440, SAE AMS 6444, and Specification A295.

5.2 The use of recycled materials that meet the requirements of the applicable material specification without jeopardizing the intended use of the item is encouraged.

5.3 Material certifications are required for all materials used. Each lot of needle rollers shall be traceable to these certifications. These certifications shall be available for review by the purchaser and provided to the purchaser when specified in the contract or purchase order. The needle roller manufacturer shall determine conformance of materials on a periodic basis. These tests may be performed by the manufacturer's internal laboratory or by a laboratory external to the manufacturer. X-ray energy spectrometry, or comparable technology, may be used for the chemical identification and analysis of the materials.

6. Other Requirements

6.1 Heat Treatment:

6.1.1 *Rollers 0.125 in. (3.18 mm) and Smaller Diameter*, shall be through hardened to Rockwell HRA 81.2-83.4, in accordance with Test Methods E18.

6.1.2 *Rollers Larger than 0.125 in (3.18 mm) Diameter*, shall be through hardened to Rockwell HRC 60 to 64 in accordance with Test Methods E18.

NOTE 1—Hardness tests can be made using various techniques;

TABLE 1 Needle Roller with Spherical Ends Dimensions

MS Part No.	D_w Roller Diameter	L_w Roller Length	L_{we} Effective Length
	+0.0000 −0.0002 in.	+0.000 −0.020 in.	in.
MS 19065-1	0.0312	0.190	0.182
MS 19065-2	0.0312	0.250	0.242
MS 19065-3	0.0312	0.310	0.302
MS 19065-4	0.0469	0.250	0.238
MS 19065-5	0.0469	0.310	0.298
MS 19065-6	0.0469	0.380	0.368
MS 19065-7	0.0469	0.440	0.428
MS 19065-8	0.0625	0.380	0.354
MS 19065-9	0.0625	0.440	0.424
MS 19065-10	0.0625	0.500	0.484
MS 19065-11	0.0625	0.560	0.544
MS 19065-12	0.0625	0.620	0.604
MS 19065-13	0.0781	0.440	0.421
MS 19065-14	0.0781	0.500	0.481
MS 19065-15	0.0781	0.560	0.541
MS 19065-16	0.0781	0.620	0.601
MS 19065-17	0.0781	0.690	0.671
MS 19065-18	0.0781	0.750	0.731
MS 19065-19	0.0938	0.560	0.537
MS 19065-20	0.0938	0.620	0.597
MS 19065-21	0.0938	0.690	0.667
MS 19065-22	0.0938	0.750	0.727
MS 19065-23	0.0938	0.810	0.787
MS 19065-24	0.0938	0.880	0.857
MS 19065-25	0.1094	0.620	0.593
MS 19065-26	0.1094	0.750	0.723
MS 19065-27	0.1094	0.880	0.853
MS 19065-28	0.1094	1.000	0.973
MS 19065-29	0.1250	0.750	0.719
MS 19065-30	0.1250	0.880	0.849
MS 19065-31	0.1250	1.000	0.969
MS 19065-32	0.1250	1.120	1.089
MS 19065-33	0.1250	1.250	1.219
MS 19065-34	0.1562	1.000	0.961
MS 19065-35	0.1562	1.250	1.211
MS 19065-36	0.1562	1.500	1.461
MS 19065-37	0.1875	1.000	0.953
MS 19065-38	0.1875	1.250	1.203
MS 19065-39	0.1875	1.500	1.453
MS 19065-40	0.2188	1.000	0.945
MS 19065-41	0.2188	1.250	1.195
MS 19065-42	0.2188	1.500	1.445
MS 19065-43	0.2500	0.500	0.437
MS 19065-44	0.2500	0.750	0.687
MS 19065-45	0.2500	1.000	0.937
MS 19065-46	0.2500	1.250	1.187
MS 19065-47	0.2500	1.500	1.437
MS 19065-48	0.2500	1.750	1.687

however, in the case of disputes, a hardness test made on flats of sufficient width to give a true reading will be considered to be the definitive value.

6.2 Protective Coating:

6.2.1 Manufacturer shall put rollers in rust-preventative packaging or coat rollers with rust-preventive film.

6.2.2 A material certification for the rust preventative shall be available for review by the purchaser. The needle roller manufacturer shall determine conformance of the rust preventative material(s) on a periodic basis. If the purchaser maintains a list of approved rust preventatives, and if the rust preventative supplied by the needle roller manufacturer is on the approved list, then the requirement for periodic testing of the rust preventative would be eliminated. For example, periodic

⁸ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://aerospace.sae.org>.

testing would not be required if parts supplied to the Department of Defense were protected with a rust preventative listed in a current QPL (Qualified Products List).

7. Dimensions and Permissible Variations

7.1 Dimensioning and tolerancing shall conform to ASME Y14.5M.

7.2 Products manufactured in accordance with this specification shall meet the requirements shown in Table 1.

7.2.1 *Roller Diameter, D_w* —Perfect form at MMC (maximum material condition) is not required.

7.2.2 The reference end form radius, R_w , is approximately equal to the roller diameter, D_w .

7.2.3 The effective length, L_{we} , is only to be used for calculating capacities.

7.3 Rollers are intended to be used in complements where they are installed in housings and used with shafts to function as a rolling bearing.

8. Workmanship, Finish, and Appearance

8.1 *Workmanship*—Cylindrical surfaces of the roller shall be free from scratches, pits, rust, indications of soft spots, and other surface imperfections.

8.2 *Surface Finish*—The effective roller surface shall have a maximum surface roughness, in accordance with ANSI B46.1, of 8 μ in. R_a (0.20 μ m R_a).

9. Inspection

9.1 Inspection of the product shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

9.1.1 Sampling inspection shall be done in accordance with ANSI/ASQC Z1.4 or Table 2. The unit product for sampling purposes shall be one roller as applicable.

9.2 Quality conformance inspection shall be conducted in accordance with Table 1 and Table 3 on each production lot of rollers.

10. Rejection and Rehearing

10.1 Products that fail to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of

TABLE 2 Sampling Plan for Quality Conformance Tests

Lot Size	Sample Size	
	A indicates the entire lot must be inspected	
	Major Characteristics	Minor Characteristics
1 to 2	A	A
3 to 8	A	3
9 to 12	A	3
13 to 15	13	3
16 to 25	13	3
26 to 50	13	5
51 to 90	13	6
91 to 150	13	7
151 to 280	20	10
281 to 500	29	11
501 to 1200	34	15
1201 to 1249	42	18
1250 to 3200	42	18
3201 to 10 000	50	22

dissatisfaction with the results of the test, the producer or supplier may make claim for rehearing.

11. Certification

11.1 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.

12. Product Marking

12.1 Marking individual rollers is not practical and would adversely affect their performance; therefore, any identification markings shall appear on the packaging that contains the rollers. Marking shall consist of the part number and the manufacturer's identification in accordance with MIL-STD-130 and MIL-STD-129.

12.1.1 The part number shall consist of the MS19065 designation plus the dash number (see Table 1), for example, MS19065-8.

13. Packaging and Package Marking

13.1 Unless otherwise specified in the contract or purchase order, military procurements shall be packaged and preserved

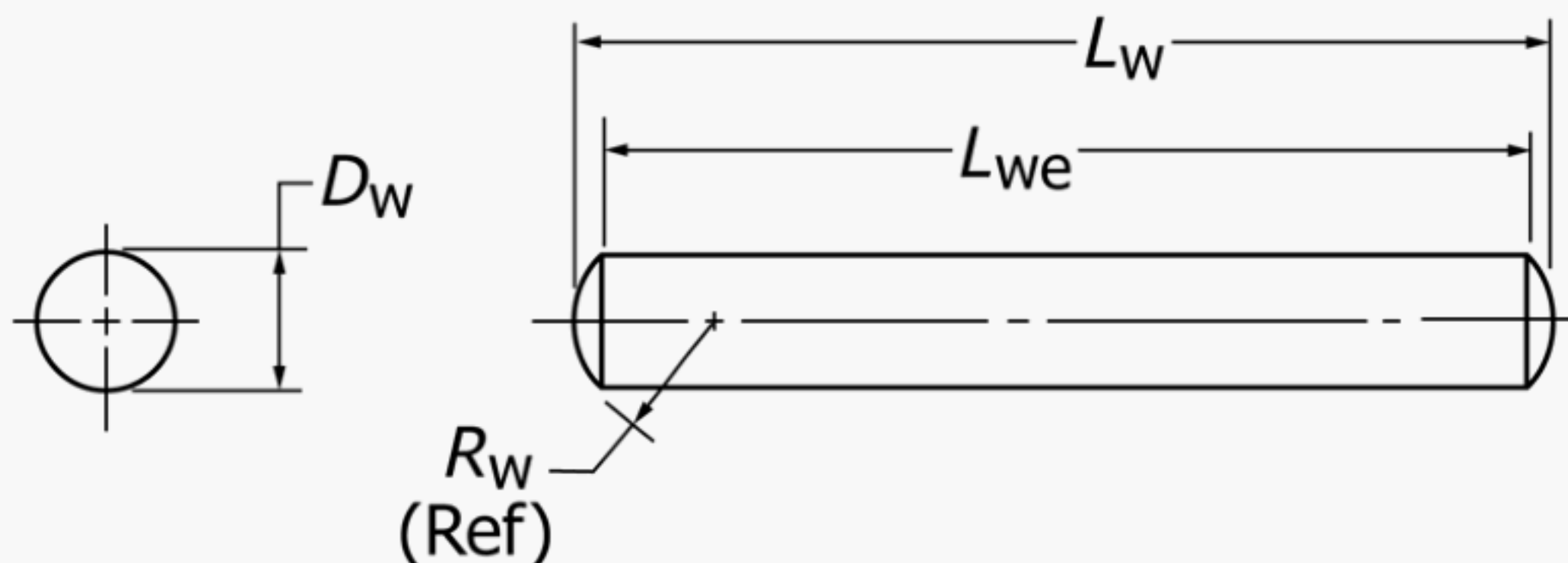


FIG. 1 Schematic Drawing—Needle Roller with Spherical End

TABLE 3 Quality Conformance

Examination or Test	Major Characteristic	Minor Characteristic	Requirement Paragraph	Test Paragraph
Dimensions				
Roller diameter, D_w	X		Fig. 1	Table 1
Roller length, L_w	X		Fig. 1	Table 1
Effective length, L_{we}		X	Fig. 1	Table 1
End form radius, R_w		X	Fig. 1	Table 1
Certification		X	11.1	
Surface finish		X	8.2	ANSI B46.1
Workmanship		X	8.1	
Marking		X	12.1	
Hardness		X	6.1.1, 6.1.2	Test Methods E18
Lubrication/protective coating		X	6.2	
Materials	X		5.3	

in accordance with MIL-DTL-197. Level of packaging and preservation method shall be as specified in the contract or purchase order.

14. Keywords

14.1 needle roller; roller; roller bearing; spherical end

APPENDIX

(Nonmandatory Information)

X1. RECOMMENDED LOAD-LIFE DATA

X1.1 The rating life, L_{10} , of a group of apparently identical roller bearings is the life in millions of revolutions that 90 % of the group will complete or exceed. For a single bearing (complement of rollers), L_{10} also refers to the life associated with 90 % reliability.

X1.1.1 As presently determined, the life that 50 % of the group of roller bearings will complete or exceed (median life, L_{50}) is usually not greater than five times the rating life.

X1.2 The basic load rating, C , for a radial rolling bearing is that calculated, constant, radial load that a group of apparently identical bearings with stationary outer raceway can theoretically endure for a rating life of one million revolutions of its inner raceway.

X1.2.1 The basic load rating is a reference value only, the base value of one million revolutions rating life having been chosen for ease of calculation.

X1.2.2 Since applied loading as great as the basic load rating tends to cause local plastic deformation of the rolling surfaces, it is not anticipated that such heavy loading would be applied.

X1.3 The basic load rating formula is intended as a guide in selecting the proper roller complement. The specific basic load rating for a group of needle rollers assembled in a full complement (cageless) needle roller bearing can be calculated by the following basic load rating equation:

$$C = f_c \times Z^{3/4} \times L_{we}^{7/9} \times D_w^{29/27} \quad (X1.1)$$

where:

- C = basic dynamic radial load rating (lbs),
- f_c = a factor which depends on the units used, the geometry of the load carrying surfaces, the accuracy of the components, and the materials used,
- Z = number of needle rollers,
- L_{we} = roller effective length (in.), and
- D_w = roller diameter (in.)

X1.3.1 Values for $f_c Z^{3/4}$ are given in [Table X1.1](#).

TABLE X1.1 Values for $f_c Z^{3/4}$

Number of Rollers	$f_c Z^{3/4}$ in in-lbs units	Number of Rollers	$f_c Z^{3/4}$ in in-lbs units
6	15 400	34	77 000
7	19 800	35	78 300
8	23 700	36	79 600
9	27 300	37	80 900
10	30 700	38	82 200
11	33 700	39	83 500
12	36 700	40	84 700
13	39 300	41	85 800
14	41 800	42	86 900
15	44 300	43	88 000
16	46 700	44	89 100
17	48 900	45	90 200
18	51 100	46	91 300
19	53 200	47	92 400
20	55 200	48	93 500
21	57 100	49	94 600
22	58 900	50	95 700
23	60 700	51	96 800
24	62 300	52	97 900
25	63 900	53	99 000
26	65 500	54	100 000
27	67 100	55	101 100
28	68 600	56	102 100
29	70 100	57	103 200
30	71 600	58	104 300
31	73 000	59	105 400
32	74 400	60	106 400
33	75 700		

X1.4 The allowable bearing load for a given bearing speed and a required rating life can be calculated by using the following bearing load and life relationship formula:

$$\text{allowable load (lbs)} = (C \times SF) / LF \quad (\text{at the given conditions}) \quad (\text{X1.2})$$

where:

C = basic dynamic radial load rating (lbs),

LF = life factor, which can be calculated with the following formula:

$$LF = (\text{life in h}/500)^{3/10}, \text{ and} \quad (\text{X1.3})$$

SF = speed factor, which can be calculated with the following formula:

$$SF = (33.333/\text{speed in RPM})^{3/10} \quad (\text{X1.4})$$

NOTE X1.1—This speed factor is the reciprocal of the speed factor that was previously given in MS19065.

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