MIL-B-17931E
27 July 1987
SUPERSEDING
MIL-B-17931D(SHIPS)
15 April 1975
(See 6.7)

MILITARY SPECIFICATION

BEARINGS, BALL, ANNULAR, FOR QUIET OPERATION

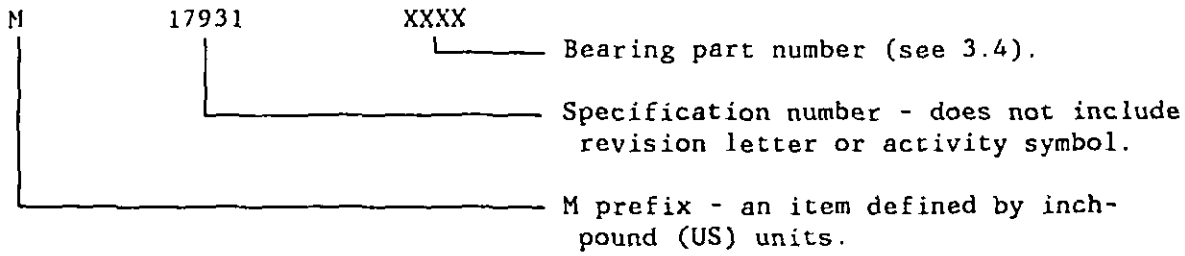
This specification is approved for use by all Departments and Agencies of the Department of the Defense.

1. SCOPE

1.1 Scope. This specification covers annular ball bearings, with industry bore codes 00 through 22, and 32 for use in quiet operating (low vibration) machinery.

1.2 Classification. Ball bearings shall be identified by the standard part numbers designated in 1.2.1, as specified (see 6.2.1). Bearings shall be of the types and classes defined in 1.2.2 as listed for each standard part number.

1.2.1 Ball bearing part numbers. Standard part numbers for ball bearings shall be as follows:



Example: M17931-G064

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 3110

1.2.2 Ball bearing types and classes. The ball bearings specified herein (see 3.4) are of the following types and classes:

Type 111 - Single row, radial, nonloading groove, both rings same width, metric.

Class 1 - Open.
Class 2 - Single shield (suffix Z).
Class 3 - Double shield (suffix ZZ).
Class 7 - Single contact seal (suffix S).
Class 8 - Double contact seal (suffix SS).

Type 120 - Single row, radial, nonloading groove, both rings same width, sealed (cartridge type without grease plug), metric bore and outside diameter (od), inch width. Type 120 bearings have prefix S3.

Class 1 - Noncontact or labyrinth seals.
Class 2 - Synthetic contact seals.

Type 131 - Single row, counterbore (primarily radial), contact angle 8 degrees 30 minutes - 10 degrees 15 minutes. Self-contained, both rings same width, metric.

Class 1 - Single bearing (suffix R).
Class 2 - Duplex pair (suffix RD), faces ground for universal mounting, that is, face-to-face (RDF), back-to-back (RDB), or tandem (RDT).

Type 133 - Single row, angular contact (contact angle 25 degrees or less), self-contained, both rings same width, metric. Angular contact bearings have prefix 7.

Class 2 - Duplex pair (suffix D), faces ground for universal mounting, that is, face-to-face (DF), back-to-back (DB), or tandem (DT).

Type 134 - Single row, angular contact (contact angle greater than 25 degrees), self-contained, both rings same width, metric. Angular contact bearings have prefix 7.

Class 1 - Single bearing.
Class 2 - Duplex pair (suffix D), faces ground for universal mounting, that is, face-to-face (DF), back-to-back (DB), or tandem (DT). Bearings having suffix DF or DB are made for that mounting only.

1.3 Navy code. The Navy code consists of a three-digit basic bearing number with prefix and/or suffix as specified in 1.2.2. The basic bearing number identifies the external boundary dimensions. The first digit of the basic bearing number identifies the bearing series (or weight) as follows:

1 Extra-light (for all types except 120)
2 Light (for all types except 120)
3 Medium (for all types except 120)
4 Heavy (for all types except 120)
5 Light (for type 120 bearings only)
6 Medium (for type 120 bearings only)

The second and third digits of the basic bearing number are the industry bore code. When multiplied by 5, these digits give the bearing bore diameter in millimeters for bore codes 04 and greater (this rule does not apply for bore codes 00 through 03).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

FF-B-171 - Bearings, Ball, Annular (General Purpose).

MILITARY

MIL-B-197 - Bearings, Antifriction; Associated Parts and Subassemblies; Preparation for Delivery of.
MIL-B-1083 - Balls, Bearing, Ferrous and Nonferrous (For Use in Bearings and Valves).
MIL-L-6085 - Lubricating Oil, Instrument, Aircraft, Low Volatility.
MIL-L-17331 - Lubricating Oil, Steam Turbine and Gear, Moderate Service.
DOD-G-24508 - Grease, High Performance, Multi-Purpose. (Metric)

STANDARD

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in this solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 295 - Standard Specification for High-Carbon Ball and Roller Bearing Steel. (DoD adopted)

E 18 - Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials. (DoD adopted)

E 112 - Standard Methods for Determining Average Grain Size. (DoD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

Standard 10 - Metal Balls.

Standard 13 - Rolling Bearing Vibration and Noise (Methods of Measuring).

Standard 20 - Metric Ball and Roller Bearings Conforming to Basic Boundary Plans.

(Application for copies should be addressed to the Anti-Friction Bearing Manufacturers Association, 1101 Connecticut Avenue, N.W., Suite 700, Washington, DC 20036.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless specific exemption has been obtained.

3 REQUIREMENTS

3.1 General. Bearings furnished under this specification shall be in accordance with FF-B-171 and as specified herein.

3.2 Materials. Materials for the bearing component parts furnished under this specification shall meet the requirements of 3.2.1 through 3.2.4.

3.2.1 Inner and outer ring material. Bearing rings shall be made of 52100 chromium-alloy steel. The steel shall be produced by the electric furnace process and vacuum-carbon-deoxidized or any other steel making process that produces steel in accordance with ASTM A 295. The finished ring material shall not exceed the inclusion rating specified for the billet material in ASTM A 295. Grain size shall be determined in accordance with ASTM E 112.

3.2.2 Ball material. Balls shall be made of 52100 chromium-alloy steel. The steel shall be produced by the electric furnace process and vacuum-carbon-deoxidized or any other steel making process that produces steel in accordance with ASTM A 295. The finished ball material shall not exceed the inclusion rating specified for the billet material in ASTM A 295. Grain size shall be determined in accordance with ASTM E 112.

3.2.3 Shield, seal, and cage material. Shields, seals and cages of ferrous, nonferrous or nonmetallic materials are acceptable. Materials shall be resistant to deterioration by lubricant, preservative, hydraulic fluid, solvents or other substances and chemicals that can be expected to come into contact with the bearing, and shall cause no deterioration of the same. Bearings with nonmetallic cages shall meet the same inspection, qualification and performance requirements of FF-B-171 as bearings with metallic cages. Materials for cages shall be of the same composition as furnished on the sample bearings submitted for FF-B-171 qualification inspection. Materials shall withstand continuous operation to 230 degrees Fahrenheit (°F).

3.2.4 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification.

3.3 Heat treatment. The heat treatment processes shall be such that the finished rings and balls meet the requirements of 3.3.1 through 3.3.3.

3.3.1 Hardness of rings. Hardness of rings shall be not less than Rockwell C 58 as determined in accordance with ASTM E 18. Hardness of rings shall not vary more than three points on the Rockwell C scale on any one ring.

3.3.2 Hardness of balls. Hardness of balls shall be as specified in MIL-B-1083 for composition 1 materials. Case hardened or work hardened balls are not acceptable. Balls shall be matched with rings so that the hardness of any ball shall be at least 2 Rockwell C points greater than the hardness of the rings.

3.3.3 Stability. Heat treatment shall be such that size change shall not exceed the following percentages after exposure to 300°F for 2500 hours:

Rings: 0.010 percent
Balls: 0.020 percent

3.4 Construction. Bearings shall comply with the requirements of tables I, II or III for the standard part number specified (see 1.2 and 6.2.1). Unless otherwise specified herein, the details of the component parts shall be optional with the contractor. Bearings shall be manufactured using new, unused component parts only.

TABLE I. Type 111 bearings.

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G001	111/1	200	0.3937 / 0.3935	1.1811 / 1.1809	0.3543	0.0003 / 0.0006	G
G002	111/8	200SS	0.3937 / 0.3935	1.1811 / 1.1809	0.3543	0.0003 / 0.0006	G
G003	111/1	101	0.4724 / 0.4722	1.1024 / 1.1022	0.3150	0.0004 / 0.0007	G
G004	111/2	301Z	0.4724 / 0.4722	1.4567 / 1.4565	0.4724	0.0004 / 0.0007	G
G005	111/1	202	0.5906 / 0.5904	1.3780 / 1.3778	0.4331	0.0004 / 0.0007	G
G006	111/2	302Z	0.5906 / 0.5904	1.6535 / 1.6533	0.5118	0.0004 / 0.0007	G
G007	111/1	203	0.6693 / 0.6691	1.5748 / 1.5746	0.4724	0.0004 / 0.0007	G
G008	111/2	203Z	0.6693 / 0.6691	1.5748 / 1.5746	0.4724	0.0004 / 0.0007	G
G009	111/3	203ZZ	0.6693 / 0.6691	1.5748 / 1.5746	0.4724	0.0004 / 0.0007	G
G010	111/8	203SS	0.6693 / 0.6691	1.5748 / 1.5746	0.4724	0.0004 / 0.0007	G
G011	111/2	303Z	0.6693 / 0.6691	1.8504 / 1.8502	0.5512	0.0004 / 0.0007	G
G012	111/8	303SS	0.6693 / 0.6691	1.8504 / 1.8502	0.5512	0.0004 / 0.0007	G
G013	111/1	204	0.7874 / 0.7872	1.8504 / 1.8503	0.5512	0.0005 / 0.0008	G
G014	111/2	204Z	0.7874 / 0.7872	1.8504 / 1.8503	0.5512	0.0005 / 0.0008	G
G015	111/8	204SS	0.7874 / 0.7872	1.8504 / 1.8503	0.5512	0.0005 / 0.0008	G

See footnote at end of table.

TABLE I. Type 111 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G016	111/1	304	0.7874 / 0.7872	2.0472 / 2.0470	0.5906	0.0005 / 0.0008	G
G017	111/2	304Z	0.7874 / 0.7872	2.0472 / 2.0470	0.5906	0.0005 / 0.0008	G
G018	111/1	205	0.9843 / 0.9841	2.0472 / 2.0470	0.5906	0.0005 / 0.0008	G
G019	111/2	205Z	0.9843 / 0.9841	2.0472 / 2.0470	0.5906	0.0005 / 0.0008	G
G020	111/1	305	0.9843 / 0.9841	2.4409 / 2.4407	0.6693	0.0005 / 0.0008	G
G021	111/2	305Z	0.9843 / 0.9841	2.4409 / 2.4407	0.6693	0.0005 / 0.0008	G
G022	111/8	305SS	0.9843 / 0.9841	2.4409 / 2.4407	0.6693	0.0005 / 0.0008	G
G023	111/1	206	1.1811 / 1.1809	2.4409 / 2.4407	0.6299	0.0005 / 0.0009	G
G024	111/2	206Z	1.1811 / 1.1809	2.4409 / 2.4407	0.6299	0.0005 / 0.0009	G
G025	111/1	306	1.1811 / 1.1809	2.8346 / 2.8344	0.7480	0.0005 / 0.0009	G
G026	111/2	306Z	1.1811 / 1.1809	2.8346 / 2.8344	0.7480	0.0005 / 0.0009	G
G027	111/3	306ZZ	1.1811 / 1.1809	2.8346 / 2.8344	0.7480	0.0005 / 0.0009	G
G028	111/8	306SS	1.1811 / 1.1809	2.8346 / 2.8344	0.7480	0.0005 / 0.0009	G
G029	111/2	406Z	1.1811 / 1.1809	3.5433 / 3.5431	0.9055	0.0005 / 0.0009	G
G030	111/1	207	1.3780 / 1.3778	2.8346 / 2.8344	0.6693	0.0005 / 0.0008	G

See footnote at end of table.

TABLE I. Type 111 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G031	111/1	307	1.3780 1.3778	3.1496 3.1494	0.8268	0.0005 0.0008	G
G032	111/2	307Z	1.3780 1.3778	3.1496 3.1494	0.8268	0.0005 0.0008	G
G033	111/3	307ZZ	1.3780 1.3778	3.1496 3.1494	0.8268	0.0005 0.0008	G
G034	111/8	307SS	1.3780 1.3778	3.1496 3.1494	0.8268	0.0005 0.0008	G
G035	111/1	208	1.5748 1.5746	3.1496 3.1494	0.7087	0.0005 0.0008	G
G036	111/1	308	1.5748 1.5746	3.5433 3.5431	0.9055	0.0005 0.0008	G
G037	111/2	308Z	1.5748 1.5746	3.5433 3.5431	0.9055	0.0005 0.0008	G
G038	111/8	109SS	1.7717 1.7715	2.9528 2.9526	0.6299	0.0005 0.0009	G
G039	111/1	209	1.7717 1.7715	3.3465 3.3463	0.7480	0.0005 0.0009	G
G040	111/1	309	1.7717 1.7715	3.9370 3.9368	0.9843	0.0005 0.0009	G
G041	111/2	309Z	1.7717 1.7715	3.9370 3.9368	0.9843	0.0005 0.0009	G
G042	111/7	309S	1.7717 1.7715	3.9370 3.9368	0.9843	0.0005 0.0009	G
G043	111/8	309SS	1.7717 1.7715	3.9370 3.9368	0.9843	0.0005 0.0009	G
G044	111/1	210	1.9685 1.9683	3.5433 3.5431	0.7874	0.0005 0.0009	G
G045	111/1	310	1.9685 1.9683	4.3307 4.3305	1.0630	0.0005 0.0009	G

See footnote at end of table.

TABLE I. Type 111 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G046	111/2	310Z	1.9685 1.9683	4.3307 4.3305	1.0630	0.0005 0.0009	G
G047	111/3	310ZZ	1.9685 1.9683	4.3307 4.3305	1.0630	0.0005 0.0009	G
G048	111/8	310SS	1.9685 1.9683	4.3307 4.3305	1.0630	0.0005 0.0009	G
G049	111/2	410Z	1.9685 1.9683	5.1181 5.1179	1.2205	0.0005 0.0009	G
G050	111/1	211	2.1654 2.1652	3.9370 3.9368	0.8268	0.0007 0.0011	G
G051	111/1	311	2.1654 2.1652	4.7244 4.7242	1.1417	0.0007 0.0011	G
G052	111/2	311Z	2.1654 2.1652	4.7244 4.7242	1.1417	0.0007 0.0011	G
G053	111/3	311ZZ	2.1654 2.1652	4.7244 4.7242	1.1417	0.0007 0.0011	G
G054	111/8	311SS	2.1654 2.1652	4.7244 4.7242	1.1417	0.0007 0.0011	G
G055	111/1	212	2.3622 2.3620	4.3307 4.3305	0.8661	0.0007 0.0011	G
G056	111/2	212Z	2.3622 2.3620	4.3307 4.3305	0.8661	0.0007 0.0011	G
G057	111/1	312	2.3622 2.3620	5.1181 5.1179	1.2205	0.0007 0.0011	G
G058	111/2	312Z	2.3622 2.3620	5.1181 5.1179	1.2205	0.0007 0.0011	G
G059	111/3	312ZZ	2.3622 2.3620	5.1181 5.1179	1.2205	0.0007 0.0011	G
G060	111/3	213ZZ	2.5591 2.5589	4.7244 4.7242	0.9055	0.0007 0.0011	G

See footnote at end of table.

TABLE I. Type 111 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant 1
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G061	111/1	313	2.5591 / 2.5589	5.5118 / 5.5116	1.2992	0.0007 / 0.0011	G
G062	111/2	313Z	2.5591 / 2.5589	5.5118 / 5.5116	1.2992	0.0007 / 0.0011	G
G063	111/1	313	2.5591 / 2.5589	5.5118 / 5.5116	1.2992	Loose	L
G064	111/1	314	2.7559 / 2.7557	5.9055 / 5.9053	1.3780	0.0008 / 0.0012	G
G065	111/2	314Z	2.7559 / 2.7557	5.9055 / 5.9053	1.3780	0.0008 / 0.0012	G
G066	111/3	314ZZ	2.7559 / 2.7557	5.9055 / 5.9053	1.3780	0.0008 / 0.0012	G
G067	111/1	215	2.9528 / 2.9526	5.1181 / 5.1179	0.9843	0.0008 / 0.0012	G
G068	111/1	315	2.9528 / 2.9526	6.2992 / 6.2990	1.4567	0.0008 / 0.0012	G
G069	111/2	315Z	2.9528 / 2.9526	6.2992 / 6.2990	1.4567	0.0008 / 0.0012	G
G070	111/2	315Z	2.9528 / 2.9526	6.2992 / 6.2990	1.4567	0.0008 / 0.0012	L
G071	111/3	216ZZ	3.1496 / 3.1493	5.5118 / 5.5116	1.0236	0.0008 / 0.0012	G
G072	111/1	316	3.1496 / 3.1493	6.6929 / 6.6926	1.5354	0.0008 / 0.0012	G
G073	111/2	316Z	3.1496 / 3.1493	6.6929 / 6.6926	1.5354	0.0008 / 0.0012	G
G074	111/1	217	3.3465 / 3.3462	5.9055 / 5.9053	1.1024	0.0009 / 0.0014	G
G075	111/3	217ZZ	3.3465 / 3.3462	5.9055 / 5.9053	1.1024	0.0009 / 0.0014	G

See footnote at end of table.

TABLE I. Type 111 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubricant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
G076	111/1	317	3.3465 3.3462	7.0866 7.0863	1.6142	0.0009 0.0014	G
G077	111/2	317Z	3.3465 3.3462	7.0866 7.0863	1.6142	0.0009 0.0014	G
G078	111/1	318	3.5433 3.5430	7.4803 7.4800	1.6929	0.0009 0.0014	G
G079	111/1	319	3.7402 3.7399	7.8740 7.8737	1.7717	0.0009 0.0014	G
G080	111/2	319Z	3.7402 3.7399	7.8740 7.8737	1.7717	0.0009 0.0014	G
G081	111/2	220Z	3.9370 3.9367	7.0866 7.0863	1.3386	0.0009 0.0014	G
G082	111/2	320Z	3.9370 3.9367	8.4646 8.4643	1.8504	0.0009 0.0014	G
G083	111/1	320	3.9370 3.9367	8.4646 8.4643	1.8504	0.0018 0.0023	G
G084	111/1	321	4.1339 4.1336	8.8583 8.8580	1.9291	0.0011 0.0016	G
G085	111/1	222	4.3307 4.3304	7.8740 7.8737	1.4961	0.0011 0.0016	G
G086	111/1	322	4.3307 4.3304	9.4488 9.4485	1.9685	0.0011 0.0016	G
G087	111/1	322	4.3307 4.3304	9.4488 9.4485	1.9685	0.0020 0.0026	G
G088	111/1	232	6.2992 6.2988	11.4173 11.4173	1.8898	0.0013 0.0021	G

[1] L means preservation/lubricant shall be oil in accordance with MIL-L-6085
G means lubricant shall be grease in accordance with DOD-G-24508.

TABLE II. Type 120 bearings.

Standard part number M17931-	Type/ class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubri-cant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
C001	120/2	S3502	0.5906 / 0.5904	1.3780 / 1.3778	0.6250	0.0004 / 0.0007	G
C002	120/2	S3503	0.6693 / 0.6691	1.5748 / 1.5746	0.6875	0.0004 / 0.0007	G
C003	120/2	S3504	0.7874 / 0.7872	1.8504 / 1.8502	0.8125	0.0005 / 0.0008	G
C004	120/1	S3604	0.7874 / 0.7872	2.0472 / 2.0470	0.8750	0.0005 / 0.0008	G
C005	120/1	S3505	0.9843 / 0.9841	2.0472 / 2.0470	0.8125	0.0005 / 0.0008	G
C006	120/2	S3605	0.9843 / 0.9841	2.4409 / 2.4407	1.0000	0.0005 / 0.0008	G
C007	120/1	S3506	1.1811 / 1.1809	2.4409 / 2.4407	0.9375	0.0005 / 0.0008	G
C008	120/2	S3606	1.1811 / 1.1809	2.8346 / 2.8344	1.1875	0.0005 / 0.0008	G
C009	120/2	S3507	1.3780 / 1.3778	2.8346 / 2.8344	1.0625	0.0005 / 0.0008	G
C010	120/2	S3607	1.3780 / 1.3778	3.1496 / 3.1494	1.3750	0.0005 / 0.0008	G
C011	120/1 [2]	S3607	1.3780 / 1.3778	3.1496 / 3.1494	1.3750	0.0005 / 0.0008	G
C012	120/1	S3608	1.5748 / 1.5746	3.5423 / 3.5431	1.4375	0.0005 / 0.0008	G
C013	120/1	S3509	1.7717 / 1.7715	3.3465 / 3.3463	1.1875	0.0005 / 0.0009	G
C014	120/1	S3609	1.7717 / 1.7715	3.9370 / 3.9368	1.5625	0.0005 / 0.0009	G

See footnotes at end of table.

TABLE II. Type 120 bearings. - Continued

Standard part number M17931-	Type/ class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Radial internal clearance min/max	Lubri-cant [1]
			Bore max/min	Od max/min	Width max (see 3.4.7)		
C015	120/2	S3610	1.9685 1.9683	4.3307 4.3305	1.7500	0.0005 0.0009	G
C016	120/2 [2]	S3610	1.9685 1.9683	4.3307 4.3305	1.7500	0.0005 0.0009	G
C017	120/1	S3611	2.1654 2.1652	4.7244 4.7242	1.9375	0.0007 0.0011	G
C018	120/2	S3612	2.3622 2.3620	5.1181 5.1179	2.1250	0.0007 0.0011	G
C019	120/2	S3613	2.5591 2.5589	5.5118 5.5116	2.3125	0.0007 0.0011	G
C020	120/1	S3614	2.7559 2.7557	5.9055 5.9053	2.5000	0.0008 0.0012	G
C021	120/1	S3615	2.9528 2.9526	6.2992 6.2990	2.6875	0.0008 0.0012	G
C022	120/2	S3618	3.5433 3.5430	7.4803 7.4800	2.8750	0.0009 0.0014	G

[1] G means lubricant shall be grease in accordance with DOD-G-24508.
[2] One seal removed.

TABLE III. Type 131, 133, and 134 bearings.

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Lubricant [2]	Preload (pounds) [3]	Negative stickout (inches) [4]
			Bore max/min	Od max/min	Width max [1] (see 3.4.7)			
A001	134/2	7203D	0.6693 / 0.6691	1.5748 / 1.5746	0.9448	G	20	----
A002	134/2	7303D	0.6693 / 0.669	1.8504 / 1.8502	1.1024	G	20	----
A003	134/2	7204D	0.7874 / 0.7872	1.8504 / 1.8502	1.1024	G	100	----
A004	134/2	7305D	0.9843 / 0.9841	2.4409 / 2.4407	1.3260	G	50	----
A005	134/2	7306D	1.1811 / 1.1809	2.8346 / 2.8344	1.4960	G	50	----
A006	134/2	7207D	1.3780 / 1.3778	2.8346 / 2.8344	1.3260	G	----	0.0001 / 0.0003
A007	134/2	7207D	1.3780 / 1.3778	2.8346 / 2.8344	1.3260	G	50	----
A008	134/2	7307D	1.3780 / 1.3778	3.1496 / 3.1494	1.6536	G	50	----
A009	134/2	7407D	1.3780 / 1.3778	3.9370 / 3.9368	1.9686	G	50	----
A010	134/2	7308D	1.5748 / 1.5746	3.5433 / 3.5431	1.8110	G	----	0.0003 / 0.0005
A011	134/2	7308D	1.5748 / 1.5746	3.54330 / 3.5431	1.8110	G	50	----

See footnotes at end of table.

TABLE III. Type 131, 133, and 134 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Lubricant [2]	Preload (pounds) [3]	Negative stickout (inches) [4]
			Bore max/min	Od max/min	Width max [1] (see 3.4.7)			
A012	134/2	7408D	1.5748 / 1.5746	4.3307 / 4.3305	2.1260	G	50	----
A013	134/2	7209D	1.7717 / 1.7715	3.3465 / 3.3463	1.4960	G	50	----
A014	134/2	7309D	1.7717 / 1.7715	3.9370 / 3.9368	1.9686	G	50	----
A015	134/2	7309D	1.7717 / 1.7715	3.9370 / 3.9368	1.9686	G	100	----
A016	134/1	7310	1.9685 / 1.9683	4.3307 / 4.3305	1.0630	G	----	----
A017	134/2	7310D	1.9685 / 1.9683	4.3307 / 4.3305	2.1260	G	100	----
A018	134/2	7310D	1.9685 / 1.9683	4.3307 / 4.3305	2.1260	G	----	0.0003 / 0.0005
A019	134/2	7410D	1.9685 / 1.9683	5.1181 / 5.1179	2.4410	G	----	0.0003 / 0.0005
A020	134/2	7211D	2.1654 / 2.1652	3.9370 / 3.9368	1.6536	G	----	0.0004 / 0.0006
A021	134/2	7211D	2.1654 / 2.1652	3.9370 / 3.9368	1.6536	G	100	----
A022	134/2	7311D	2.1654 / 2.1652	4.7244 / 4.7242	2.2834	G	----	0.0004 / 0.0006

See footnotes at end of table.

TABLE III. Type 131, 133, and 134 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Lubricant [2]	Preload (pounds) [3]	Negative stickout (inches) [4]
			Bore max/min	Od max/min	Width max[1] (see 3.4.7)			
A023	134/2	7311D	2.1654 / 2.1652	4.7244 / 4.7242	2.2834	G	200	----
A024	134/2	7312DB	2.3622 / 2.3620	5.1181 / 5.1179	2.4410	G	----	0.0004 / 0.0006
A025	134/2	7312DF	2.3622 / 2.3620	5.1181 / 5.1179	2.4410	G	0	0±0.0001
A026	134/2	7312D	2.3622 / 2.3620	5.1181 / 5.1179	2.4410	G	100	----
A027	134/2	7412D	2.3622 / 2.3620	5.9055 / 5.9053	2.7560	G	100	----
A028	134/2	7313D	2.5591 / 2.5589	5.5118 / 5.5116	2.5984	L	----	0.0005 / 0.0007
A029	134/2	7313D	2.5591 / 2.5589	5.5118 / 5.5116	2.5984	G	100	----
A030	134/2	7215D	2.9528 / 2.9526	5.1181 / 5.1179	1.9686	G	100	----
A031	134/2	7315D	2.9528 / 2.9526	6.2992 / 6.2990	2.9134	L	----	0.0009 / 0.0011
A032	134/2	7315D	2.9528 / 2.9526	6.2992 / 6.2990	2.9134	G	100	----
A033	134/2	7217D	3.3465 / 3.3462	5.9055 / 5.9053	2.2048	G	100	----

See footnotes at end of table.

TABLE III. Type 131, 133, and 134 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Lubricant [2]	Preload (pounds) [3]	Negative stickout (inches) [4]
			Bore max/min	Od max/min	Width max [1] (see 3.4.7)			
A034	134/2	7317D	3.3465 / 3.3462	7.0866 / 7.0863	3.2284	L	----	0.0014 / 0.0016
A035	134/2	7317D	3.3465 / 3.3462	7.0866 / 7.0863	3.2284	G	100	----
A036	131/1	318R	3.5433 / 3.5430	7.4803 / 7.4800	1.6929	G	----	----
A037	131/2	318RD	3.5433 / 3.5430	7.4803 / 7.4800	3.3858	G	500	----
A038	133/2	7318D	3.5433 / 3.5430	7.4803 / 7.4800	3.3858	G	500	----
A039	134/2	7319D	3.7402 / 3.7399	7.8740 / 7.8737	3.5434	G	----	0.0001 / 0.0003 [5]
A040	134/2	7319D	3.7402 / 3.7399	7.8740 / 7.8737	3.5434	G	100	----
A041	134/2	7319D	3.7402 / 3.7399	7.8740 / 7.8737	3.5434	G	600	----
A042	134/2	7319D	3.7402 / 3.7399	7.8740 / 7.8737	3.5434	G	1000	----

See footnotes at end of table.

TABLE III. Type 131, 133, and 134 bearings. - Continued

Standard part number M17931-	Type/class (see 1.2)	Navy code (see 1.3)	Dimensions (inches)			Lubricant [2]	Preload (pounds) [3]	Negative stickout (inches) [4]
			Bore max/min	Od max/min	Width max [1] (see 3.4.7)			
A043	133/2	7221D	4.1339 / 4.1336	7.4803 / 7.4800	2.8346	G	200	----
A044	134/2	7322DB	4.3307 / 4.3304	9.4488 / 9.4485	3.9370	G	2400	----

1 Maximum width for individual bearings of duplex pairs is one-half that listed.
2 L means preservative/lubricant shall be oil in accordance with MIL-L-6085.
G means lubricant shall be grease in accordance with DOD-G-24508.
3 Preload tolerance: plus or minus 10 percent.
4 Negative stickout: Two times the negative stickout corresponds to the unmounted axial end play of the clamped up duplex pair.
5 Stickout determined at 15 pounds thrust.

3.4.1 Types 111 and 120. Construction shall be in accordance with FF-B-171 and as specified herein. Bearings shall conform to the requirements of tables I and II.

3.4.2 Type 131, class 1; type 133, class 1; and type 134, class 1. Types 131, 133 and 134 shall support thrust loads in one direction in combination with radial loads. These types shall have one raceway shoulder of the outer ring cut away almost to the bottom of its raceway in such a manner as to permit side assembly of the inner ring and balls into the outer ring without damage to the component parts, yet provide retention to all parts in proper operating position during normal handling operations. These types, when manufactured for mounting as single bearings, shall be termed as class 1. Inner rings of these types shall have equal height raceway shoulders or have the raceway shoulder on the non-thrust side cut away in a manner similar to that employed on the outer ring, provided that the bearings are self-contained in handling operations. These types shall have a nominal inner ring raceway cross-sectional radius not larger than 52 percent of the ball diameter and a nominal outer ring raceway cross-sectional radius not larger than 53 percent of the ball diameter. Bearings shall conform to the requirements of table III.

3.4.2.1 Type 134, class 1. Manufacturer specified unmounted nominal contact angles shall be greater than 25 degrees to a maximum of 45 degrees. Radial internal clearance shall not be specified.

3.4.3 Types 131, class 2; type 133, class 2; and type 134, class 2. The construction of individual bearings of the duplex pairs shall conform to 3.4.2 and shall conform to the requirements of table III. Except for DB pairs (see 3.4.7), the bearing ring side faces shall be universal ground for the specified internal condition (see 3.4.8). The pairs shall be matched by the bearing manufacturer and the matched pairs shall be packaged together.

3.4.4 Balls. Balls for all type and class bearings shall be in accordance with MIL-B-1083 or AFBMA Standard 10, and as specified herein. Balls shall be grade 10 or better. Balls used in the same bearing shall be selected from the same unit container.

3.4.5 Cage. Ball bearings shall have cages for spacing the balls in their proper relationship within the bearings. Cages shall be designed and constructed so as that not to impede the primary function of the bearing. The cage shall admit the lubricant freely to the functional surfaces (see 6.4.1), of the bearing.

3.4.6 Shields and seals. Shields and seals, when utilized, shall not affect the dimensional tolerances specified herein. Contact seals (see 6.4.2) shall not inhibit the free rotation of the bearing rings.

3.4.7 Metrology. Bearings shall conform to the metrology requirements specified in tables I, II and III. Width tolerances of single bearings shall be plus 0, minus 0.002 inch. For duplex bearings, the total width tolerance of inner and outer rings shall be plus 0, minus 0.010 inch. Subsequent to establishing the bearing internal condition (see 3.4.8), DB pair outer ring non-thrust faces shall be ground to a total width tolerance of minus 0.008 to minus 0.010 inch. Additional metrology requirements, such as ring and raceway runouts and parallelism, shall comply with AFBMA Standard 20 - tolerance class ABEC-7.

3.4.8 Negative stickout or preload of duplex pairs. Bearings conforming to types 131, class 2; type 133, class 2; and type 134, class 2 shall be manufactured to the limits of negative stickout (see 6.4.3) stated in inches or axial preload (see 6.4.4) stated in pounds listed in table III. For negative stickout duplex pairs, under the minimum practicable thrust gauging load used to establish free end play, the inner and outer ring side faces of individual bearings shall lie in parallel planes within the limits specified in table III for negative stickout. For preloaded duplex pairs, a clamping force equal to the preload value of table III is required to bring the inner and outer ring side faces into flush contact.

3.5 Vibration. Bearings shall meet the vibration requirements specified in tables IV and V when tested as specified in 4.5.1.

TABLE IV. Vibration limits for individual bearings.

Industry bore code	Low band (anderons)	Middle band (anderons)	High band (anderons)
00	16	12	10
01	16	12	10
02	20	16	10
03	20	16	16
04	20	16	16
05	24	17	16
06	24	18	16
07	24	19	20
08	24	20	20
09	31	20	21
10	32	21	22
11	32	22	23
12	32	23	24
13	32	23	24
14	38	24	25
15	40	25	26
16	40	26	27
17	40	26	28
18	40	27	29
19	40	28	30
20	40	29	31
21	49	30	32
22	50	30	33
24	50	31	34
26	57	32	36
32	68	40	40

TABLE V. Vibration limits for all bearings (lot average).

Industry bore code	Low band (anderons)	Middle band (anderons)	High band (anderons)
00	12	10	10
01	12	10	10
02	14	12	10
03	15	12	10
04	16	12	12
05	17	13	12
06	18	14	12
07	20	15	16
08	20	16	16
09	23	16	17
10	24	17	18
11	24	18	19
12	24	19	20
13	24	19	20
14	30	20	21
15	32	21	22
16	32	22	23
17	32	22	24
18	32	23	25
19	32	24	26
20	40	25	27
21	40	26	28
22	40	26	29
24	40	27	30
26	49	28	32
32	60	34	36

3.6 Lubricant. Lubricant shall be as specified in tables I, II or III. Grease lubricated bearings shall be preserved and prelubricated with grease in accordance with DOD-G-24508. Oil lubricated bearings shall be preserved with oil in accordance with MIL-L-6085. When grease is specified, the bearing void (the airspace contained between the inner and outer ring of the assembled bearing) shall be 30 to 50 percent filled.

3.7 Marking. Each bearing shall be permanently marked with the following:

(a) The complete standard part number (see 1.2), manufacturer's name or symbol and complete bearing number, where space is available.
(b) A serial number marked on the outer ring face or back. For duplex pairs, use the same serial number for each bearing, designating one bearing as XXXA and the other as XXXB.
(c) An indication of direction of thrust load for all classes of types 131, 133 and 134.
(d) The high point of radial runout on both inner and outer rings of duplex pairs.
(e) Design preload (in pounds) for all duplex pairs.
(f) The symbol "NT4" on the outer ring.

3.8 Application requirements. Equipment designers and manufacturers shall comply with the appendix of this specification, to the extent specified therein.

3.9 Interchangeability. All complete bearings having the same standard part number shall be functionally and dimensionally interchangeable.

3.10 Workmanship. Bearing functional and nonfunctional surfaces (see 6.4.1 and 6.4.5) shall be free of contamination from foreign particle debris, rust, and dirt. Additionally, all functional surfaces shall be free from mechanical and physical damage which would be detrimental to bearing performance. Such damage would include but not be limited to tool marks, grinding scratches, pits, indentations, and cracks visible to the unaided eye.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

(a) Quality conformance inspection (see 4.3).
(b) Verification inspection (see 4.4).

4.3 Quality conformance inspection. The quality conformance inspection shall be in accordance with 4.3.2 through 4.3.4.

4.3.1 Certification of quality conformance. When specified in the contract or order, a certificate of quality conformance shall be prepared (see 6.2.2), for each lot offered for verification inspection.

4.3.2 Lot. A lot shall consist of assembled bearings of a particular standard part number assembled at the same time on the same assembly setup and processed through all final assembly operations as a single group. Any bearing of a lot, through its serial number, is to be traceable back to its assembly sequence. Assembled bearing lot traceability is to be maintained for 15 years.

4.3.3 Sampling for quality conformance inspection. Sampling shall be conducted to evaluate those characteristics listed in table VI. Sampling shall be conducted in accordance with the procedures of MIL-STD-105. Acceptable MIL-STD-105 quality levels shall be 0.65 for major defects and 2.5 for minor defects. Sampling of assembled bearings and bearing parts shall be in accordance with inspection level II.

TABLE VI. Classification of defects.

Category	Characteristics
Major:	
101	Bearing component is not new and unused (see 3.4).
102	Bearing component is not of the material specified (see 3.2).
103	Individual bearing shows evidence of corrosion (see 3.10).
104	Individual bearing shows evidence of contamination (see 3.10).
105	Bore diameter is not within required limit (see 3.4.7).
106	Outside diameter is not within required limit (see 3.4.7).
107	Width of individual ring is not within required limit (see 3.4.7).
108	Radial internal clearance is not within required limit (see 3.4.7).
109	Preload of bearing is not within required limit (see 3.4.8).
110	Duplex pair is not universal ground (see 3.4.3).
111	Contact seal inhibits the free rotation of the rings (see 3.4.6).
112	Cage is not of adequate construction, interferes with rotation of bearing or impedes entrance of lubricant (see 3.4.5).
113	Bearing lubricant is not as required (see 3.6).
114	Bearing is not marked as required (see 3.7).
115	Packaging, packing, and marking are not as required (see 5.1, 5.2, and 5.3).
116	Bearing vibration exceeds limits (see tables IV and V for vibration limits and 4.4.2 for rejection criteria).
Minor:	
201	Hardness of each ring is not within required limit (see 3.3.1).
202	Hardness of each ball is not within required limit (see 3.3.2).
203	Dimensional stability of components is not within required limit (see 3.3.3).
204	Each ball scheduled for assembly is not within required limits (see 3.4.4).
205	Radial runout of each ring is not within required limit (see 3.4.7).
206	Width variation of each ring is not within required limit (see 3.4.7).
207	Reference side runout with bore, inner ring, is not within the required limit (see 3.4.7).
208	Raceway runout with reference side, inner ring, is not within the required limit (see 3.4.7).
209	Outside cylindrical surface runout with reference side, outer ring, is not within the required limit (see 3.4.7).
210	Raceway runout with reference side, outer ring, is not within the required limit (see 3.4.7).

4.3.4 Acceptance and rejection. Acceptance or rejection of the parts or assembled bearing lot subjected to the sampling specified in 4.3.3 shall be in accordance with the procedures of MIL-STD-105. Defects shall be classified as specified in table VI.

4.4 Verification inspection. Verification inspection shall be conducted at the DTNSRDC, Annapolis, Maryland, unless otherwise specified by the command or agency concerned. Verification inspection shall be conducted on all lots of bearings offered for delivery. A lot shall not be delivered until results of the verification inspection have been received. Only lots of bearings which satisfy the requirements specified herein and have passed the quality conformance inspection of 4.3 shall be offered for verification inspection.

4.4.1 Sampling for verification inspection. From each lot of assembled bearings the Government quality assurance representative shall select a random sample in accordance with table VII.

TABLE VII. Sample size for verification inspection.

Lot size[1]	Sample size[1]	Acceptance number
Up to 13	All	1
14 to 90	13	1
91 to 150	20	2
151 to 280	32	3
281 to 500	50	5
501 to 1200	80	7
1201 to 3200	125	10
3201 to 10000	200	14

[1] Duplex pairs shall be counted as one bearing.

4.4.2 Acceptance and rejection. The following criteria shall be applied to determine the acceptance and rejection of bearings submitted for verification inspection.

4.4.2.1 Individual bearings. Any individual bearing with a low, middle or high band anderon level exceeding the vibration limits specified in table IV for that size shall be rejected. Any bearing which does not conform to a metrology requirement specified in 3.4.7 or 3.4.8 shall be rejected. Any individual bearing exhibiting mechanical or physical damage (as defined in 3.10) shall be rejected. Duplex pairs shall be accepted or rejected as a pair. An individual bearing can be rejected for more than one reason.

4.4.2.2 Bearing lots. Any lot of bearings shall be rejected when the results of the lot sample inspection indicate either of the following:

(a) The number of individual bearings failing the vibration limits of table IV exceeds the acceptance number listed in table VII.
(b) The number of individual bearings failing the metrology requirements of 3.4.7 or 3.4.8 exceeds the acceptance number listed in table VII.
(c) The number of individual bearings exhibiting mechanical or physical damage (as defined in 3.10) exceeds the acceptance number listed in table VII.
(d) The combined number of individual bearings failing vibration, metrology or exhibiting damage exceeds the acceptance number in table VII.
(e) The average vibration limit of the lot sample for any part of the spectrum (low, middle, or high) exceeds the anderon limit specified in table V for that size bearing.

4.4.3 Disposition of lot sample. Lot samples which have completed verification inspection are handled in the following manner: Acceptable lot sample greased bearings shall be relubricated, and included in the lot for delivery. Acceptable oil lubricated bearings shall be cleaned and relubricated, and included in the lot for delivery. Bearings that are not offered for delivery shall have the standard part number and the marking "NT4" obliterated.

4.4.3.1 Rejected lots. When the lot sample has failed the verification inspection, rejected bearings shall be repaired or replaced. If rejected bearings are repaired, they shall be included in the lot sample resubmitted for verification inspection. Once a lot sample has been rejected, the command or agency concerned shall have the option, in lieu of lot sample resubmittal, to conduct 100 percent verification inspection of the lot prior to delivery.

4.4.3.2 Repaired or replacement bearings. If the repaired or replacement bearings referred to in 4.4.3.1 are rejected, the number rejected shall be added to the total number of rejections for that lot sample and this cumulative total compared to the acceptance number of table VII.

4.5 Verification inspection test methods. Verification inspection shall consist of the tests specified in 4.5.1 through 4.5.2.

4.5.1 Vibration test. Bearing vibration shall be measured on the Bearing Analysis machine (see 6.3). Test parameters shall be in accordance with 4.5.1.1 through 4.5.1.5.

4.5.1.1 Physical quantity measured. The physical quantity measured shall be the anderon. The anderon shall be defined as the radial vibrational velocity of the bearing outer ring in microinches per second root mean square divided by the constant 297, as measured at 1800 revolutions per minute of the inner ring.

4.5.1.2 Frequency ranges. Bearing anderon values shall be measured in three frequency ranges: Low, 50 - 300 hertz (Hz); Middle, 300 - 1800 Hz; High, 1800 - 10,000 Hz.

4.5.1.3 Test lubricant. Sample bearings shall be shipped and tested with the operating lubricant.

4.5.1.4 Test load. An external thrust load in accordance with table VIII shall be applied to the bearing during the test.

TABLE VIII. Loads for vibration testing.

Bore code	Thrust load, pounds				
	Deep groove series		Angular contact series		
	200	300	7200	7300	7400
00	20	20	-	-	-
01	20	20	-	-	-
02	20	20	-	-	-
03	20	30	60	60	-
04	20	35	70	70	-
05	20	45	90	90	-
06	30	55	110	110	-
07	45	65	130	140	205
08	50	75	150	175	260
09	55	85	170	245	-
10	60	100	200	280	380
11	80	115	230	330	-
12	95	135	270	390	560
13	105	150	300	450	-
14	120	170	350	510	-
15	130	195	400	580	-
16	140	215	470	660	-
17	155	240	530	750	-
18	190	270	580	935	-
19	220	295	-	1040	-
20	250	355	-	-	-
21	280	385	775	-	-
22	315	455	-	1490	-
24	360	455	-	-	-
26	410	525	-	-	-
32	550	-	-	-	-

4.5.1.5 Test sequence. Each sample bearing shall be tested at one random location around the periphery of the stationary outer ring for each direction in which the bearing can accept operational thrust load. Therefore, types 111 and 120 require two sets of readings per bearing, whereas types 131, 133, and 134 require only one set per bearing. Grease lubricated bearings shall be run in and the excess grease allowed to purge. Oil, in accordance with MIL-L-17331 (2190 TEP), shall be added to oil lubricated bearings and the excess allowed to purge. Anderon levels recorded shall be the highest levels observed in each range, such as low, middle, and high, after the bearing has been run at test speed and load for a period of 5 minutes.

4.5.1.6 System calibration. The mechanical and electrical frequency response of the sensing system of the Bearing Analysis machine shall be in accordance with AFBMA Standard 13.

4.5.2 Metrology test. Metrological measurements on bearing bores, outside diameters, widths, and radial internal clearances shall be made on all sample bearings representing every fifth lot from the same contractor. The bearings shall not be disassembled. Additional measurements may be made at the option of the Government.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Preservation-packaging. Cleaning, drying, preservation, and unit packaging shall be in accordance with level A of MIL-B-197, method IA-19 only. Polyvinyl chloride is prohibited as a material for method IA-19. Lubricants shall be as specified in 3.6.

5.1.1 Unit marking. Individual bearings shall be permanently marked with the information indicated in 3.7.

5.2 Packing. Packing shall be in accordance with MIL-B-197, level A, B, or C, as specified (see 6.2.1).

5.3 Marking for shipment. Marking shall be in accordance with MIL-B-197.

6. NOTES

6.1 Intended use. The ball bearings covered by this specification are intended for use in low vibration machinery.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Standard part number (see 1.2).
(c) Level of packing required (see 5.2).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraph.

Paragraph no.	Data requirement title	Applicable DID no.	Option
4.3.1	Certification data/report	UDI-A-23264	----

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Bearing Analysis machine. The Bearing Analysis machine is a Navy designed and constructed test device, utilizing the commercially available Anderometer Amplimeter (manufactured by Bendix Automation and Measurement Division of Dayton, Ohio) and a mechanical drive/loading system mounted on a 2,000 pound seismic mass. The test bearing is mounted on a true-running spindle with flexible bearing seat and held in position by a thrust load transmitted through a cylindrical load ring. Bearing vibration is determined on the 3-band vibration analyzer of the Anderometer Amplimeter.

6.4 Definitions. The following definitions are provided to establish the intended meaning of terms used in this specification.

6.4.1 Functional surfaces. Functional surfaces are all ball and raceway surfaces (see 3.4.5 and 3.10).

6.4.2 Contact seal. Contact seal is a bearing seal that actually contacts one bearing ring with a predetermined pressure (see 3.4.6).

6.4.3 Negative stickout duplex pair. Negative stickout duplex pair is a duplex bearing having no internal loading which is independent of external radial or axial load, or both, carried by the bearing. A duplex pair has negative stickout when single bearing ring widths are modified during manufacture by relieving selected faces by a certain stickout (negative stickout) creating a non-preloaded (that is, free-running) condition when the pair is mounted (see 3.4.8).

6.4.4 Preloaded duplex pair. Preloaded duplex pair is a duplex bearing having internal loading which is independent of any external radial or axial load, or both, carried by the bearing. A duplex pair is preloaded when single bearing ring widths are modified during manufacture by relieving selected faces by a certain stickout (positive stickout) creating an internal preload when the pair is mounted (see 3.4.8).

6.4.5 Nonfunctional surfaces. Nonfunctional surfaces are all bearing surfaces not listed as functional surfaces (see 3.10).

6.5 Surplus bearings. Surplus bearings may be offered for acquisition, provided that:

(a) The bearings are submitted for verification inspection as specified herein.
(b) The contractor will furnish the Government representative the Government contract number under which the bearings were fabricated.

6.6 Subject term (key word) listing.

Bearings, ball annular
Bearing rings
Chromium - alloy, steel, ball bearings
Vibration, ball bearings

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - AV
Navy - SH
Air Force - 99

Review activities:
Air Force - 84
DLA - IS

User activity:
Army - AT

Preparing activity:
Navy - SH
(Project 3110-0729)

APPENDIX

QUIET BALL BEARING APPLICATION REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix provides application requirements for ball bearings acquired to MIL-B-17931. This appendix forms a mandatory part of MIL-B-17931 for equipment designed, or redesigned for new application, after 1 January 1987. The requirements of this appendix are not mandatory, but may be used, for the refurbishment or upgrading of, or manufacture of exact replacements for, equipment designed before 1987.

10.2 This appendix establishes acceptable standard application practices for the use of quiet ball bearings. It also serves to control the selection of quiet ball bearings for use in new or redesigned equipment.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Standards. The following standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

STANDARDS

MILITARY

MS19068 - Nuts, Plain, Round, Retaining, Ball and Roller Bearing, Regular Series.

MS19070 - Washers, Key Retaining, Ball and Roller Bearing, Regular Series.

(Copies of standards and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

20.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue of the document which is DoD adopted shall be that listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issue of document not listed in the DoDISS shall be the issue of the non-government document which is current on the date of the solicitation.

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

Standard 9 - Loading Rating and Fatigue Life for Ball Bearings.

(Application for copies should be addressed to the Anti-Friction Bearing Manufactures Association, 1101 Connecticut Avenue, N.W., Suite 700, Washington, DC 20036).

30. APPLICATION REQUIREMENTS

30.1 Fatigue life. Bearing fatigue life shall be calculated in accordance with AFBMA Standard 9. Bearing life adjustment factors shall not be used in the calculation, unless specifically permitted by the equipment specification.

30.2 Lubrication. Bearings shall be lubricated with grease in accordance with DOD-G-24508 unless otherwise approved by the cognizant design review activity. Grease-lubricated bearings shall be selected to have an ndm less than 350,000 (where n is speed of rotating bearing ring in revolutions per minute and dm is mean diameter of bearing in millimeters, that is, dm = $\frac{\text{bore diameter + outside diameter}}{2}$). If an ndm greater than 350,000 is unavoidable, or oil lubrication has a demonstrable advantage in a given application, lubicating oil in accordance with MIL-L-17331 (Military Symbol 2190 TEP) shall be used.

30.3 Temperature. Quiet ball bearings shall operate at the lowest temperature possible. Temperature limitations of cage and closure materials establish the maximum permissible temperature at 230°F for those parts (intermittent excursions to 300°F are acceptable). However, for normal steady-state operation, the bearing outer ring temperature (as measured on the outside diameter) shall not exceed 194°F (90°C).

30.4 Locknuts. A mounted bearing shall be secured against a shaft shoulder by a locknut/lockwasher combination or by a self-locking locknut. Applications in which bearings are not secured against shoulders by locknuts shall be approved by the design review and approval activity. Conventional locknuts and lockwashers shall be in accordance with MS19068 and MS19070. The appropriate MS19068 and MS19070 size number is the same as the bearing's bore code. Figure 1 shows the bearing mounting using a standard locknut and lockwasher. The key on the inner circumference of the lockwasher is fitted into a keyway (slot) machined into the shaft and one of the tongs on the outer circumference of the lockwasher is bent into one of the slots of the locknut.

30.4.1 Self-locking locknuts (see figure 2) sometimes referred to as prevailing torque retaining nuts, are essentially the same as MS19068 locknuts; however, they are equipped with a compression collar made of nylon, which has a temperature range of 300°F. The collar eliminates the need for a lockwasher. Prevailing torque retaining nuts are designed to permit convenient assembly and disassembly with expectation to stay in place. The resilient collar follows the metal threads in engagement in the assembly. This develops compression of the collar with the metal threads of the shaft eliminating space between the threads of the shaft and collar. This compression develops tension between the mating parts providing better locking action and more protection against loosening, especially from vibration.

30.5 Locknut torques. Regardless of the type of locknut used, locknut torques are standardized. Acceptable locknut torques for dry thread engagement are shown in table IX. Bearing locknuts shall be tightened using a torque wrench and a two-point-locknut wrench (see figure 3) or other suitable torque wrench adapter. Locknuts shall not be hammered or beat upon.

TABLE IX. Locknut torques.

Bore code	Locknut torque (foot-pounds)
00	10-20
01	10-20
02	10-20
03	10-20
04	12-35
05	23-50
06	32-60
07	39-70
08	50-80
09	64-90
10	67-100
11	82-125
12	99-150
13	131-175
14	152-200
15	173-250
16	197-275
17	222-325
18	248-375
19	277-425
20	345-475
21	380-550
22	380-550
24	380-550
26	380-550
32	380-550

30.6 Bearing fit-up. The size and physical condition of the shaft seat on which a quiet bearing is mounted and the housing in which a quiet bearing is mounted must be controlled. Achieving the correct magnitude of fit is the most important factor in the proper mounting of noise-quiet bearings. Tables X and XI present the required bearing inner ring bore to shaft seat fits and bearing outer ring outside diameter to housing bore fits, respectively, for quiet bearing use. Variations from the requirements of tables X and XI may be appropriate for certain special design applications and shall be submitted (with detailed technical justification) for approval of the cognizant design review activity and the NAVSEA Bearing and Seal Technology Branch. Such special applications include:

(a) Designs involving heavy radial loading of the bearing (as in some horizontal shaft machinery) may require a heavier interference fit of the bearing on the shaft. A heavier interference fit would, in turn, normally require a bearing with a larger radial internal clearance (such as standard part numbers M17931-G083 and M17931-G087).
(b) Designs with the bearing outer ring rotating and the inner ring stationary require a clearance fit at the bearing inner ring and an interference fit at the bearing outer ring.

TABLE X. Bearing-to-shaft fits (inner ring rotating).

Bearing bore code	Bearing bore diameter (inches)		Shaft seat diameter (inches)		Interference fit (inches)	
	Max	Min	Max	Min	Max	Min
00	0.3937	0.3935	0.3940	0.3938	0.0005	0.0001
01	0.4724	0.4722	0.4727	0.4725	0.0005	0.0001
02	0.5906	0.5904	0.5909	0.5907	0.0005	0.0001
03	0.6693	0.6691	0.6696	0.6694	0.0005	0.0001
04	0.7874	0.7872	0.7877	0.7875	0.0005	0.0001
05	0.9843	0.9841	0.9846	0.9844	0.0005	0.0001
06	1.1811	1.1809	1.1814	1.1812	0.0005	0.0001
07	1.3780	1.3778	1.3783	1.3781	0.0005	0.0001
08	1.5748	1.5746	1.5751	1.5749	0.0005	0.0001
09	1.7717	1.7715	1.7720	1.7718	0.0005	0.0001
10	1.9685	1.9683	1.9688	1.9686	0.0005	0.0001
11	2.1654	2.1652	2.1657	2.1655	0.0005	0.0001
12	2.3622	2.3620	2.3625	2.3623	0.0005	0.0001
13	2.5591	2.5589	2.5594	2.5592	0.0005	0.0001
14	2.7559	2.7557	2.7562	2.7560	0.0005	0.0001
15	2.9528	2.9526	2.9531	2.9529	0.0005	0.0001
16	3.1496	3.1493	3.1500	3.1497	0.0007	0.0001
17	3.3465	3.3462	3.3469	3.3466	0.0007	0.0001
18	3.5433	3.5430	3.5437	3.5434	0.0007	0.0001
19	3.7402	3.7399	3.7406	3.7403	0.0007	0.0001
20	3.9370	3.9367	3.9374	3.9371	0.0007	0.0001
21	4.1339	4.1336	4.1343	4.1340	0.0007	0.0001

TABLE X. Bearing-to-shaft fits (inner ring rotating). - Continued

Bearing bore code	Bearing bore diameter (inches)		Shaft seat diameter (inches)		Interference fit (inches)	
	Max	Min	Max	Min	Max	Min
22	4.3307	4.3304	4.3311	4.3308	0.0007	0.0001
24	4.7244	4.7241	4.7248	4.7245	0.0007	0.0001
26	5.1181	5.1177	5.1186	5.1182	0.0009	0.0001
32	6.2992	6.2988	6.2997	6.2993	0.0009	0.0001

TABLE XI. Bearing-to-housing fits (outer ring stationary).

Bearing od (inches)		Housing bore diameter (inches)		Clearance fit (inches)	
Max	Min	Max	Min	Max	Min
1.1024	1.1022	1.1029	1.1026	0.0007	0.0002
1.1811	1.1809	1.1816	1.1813	0.0007	0.0002
1.3780	1.3778	1.3785	1.3782	0.0007	0.0002
1.4567	1.4565	1.4572	1.4569	0.0007	0.0002
1.5748	1.5746	1.5753	1.5750	0.0007	0.0002
1.6535	1.6533	1.6540	1.6537	0.0007	0.0002
1.8504	1.8502	1.8509	1.8506	0.0007	0.0002
2.0472	2.0470	2.0479	2.0475	0.0009	0.0003
2.4409	2.4407	2.4416	2.4412	0.0009	0.0003
2.8346	2.8344	2.8353	2.8349	0.0009	0.0003
2.9528	2.9526	2.9535	2.9531	0.0009	0.0003
3.1496	3.1494	3.1503	3.1499	0.0009	0.0003
3.3465	3.3463	3.3474	3.3469	0.0011	0.0004
3.5433	3.5431	3.5442	3.5437	0.0011	0.0004
3.9370	3.9368	3.9379	3.9374	0.0011	0.0004

TABLE XI. Bearing-to-housing fits (outer ring stationary). - Continued

Bearing od (inches)		Housing bore diameter (inches)		Clearance fit (inches)	
Max	Min	Max	Min	Max	Min
4.3307	4.3305	4.3316	4.3311	0.0011	0.0004
4.7244	4.7242	4.7253	4.7248	0.0011	0.0004
5.1181	5.1179	5.1191	5.1186	0.0012	0.0005
5.5118	5.5116	5.5135	5.5123	0.0012	0.0005
5.9055	5.9053	5.9065	5.9060	0.0012	0.0005
6.2992	6.2990	6.3002	6.2997	0.0012	0.0005
6.6929	6.6926	6.6938	6.6934	0.0012	0.0005
7.0866	7.0863	7.0875	7.0871	0.0012	0.0005
7.4803	7.4800	7.4814	7.4809	0.0014	0.0006
7.8740	7.8737	7.8751	7.8746	0.0014	0.0006
8.4646	8.4643	8.4657	8.4652	0.0014	0.0006
8.8583	8.8580	8.8594	8.8589	0.0014	0.0006
9.4488	9.4485	9.4499	9.4494	0.0014	0.0006
10.2362	10.2359	10.2373	10.2368	0.0014	0.0006
11.0236	11.0233	11.0247	11.0242	0.0014	0.0006
11.4173	11.4170	11.4184	11.4179	0.0014	0.0006

30.6.1 Shaft seat and housing bore characteristics. The tolerance for shaft seat roundness and for housing bore roundness shall be one half the diametrical tolerances given in table X and table XI, respectively for the shaft and housing. Seat roundness applies to diameter measurements with a two point gauge. If seat roundness is measured with a dial indicator with the shaft or housing on centers, the tolerance shall be one fourth of that listed in tables X and XI. The surface finish requirement for all shaft seats is 32 Roughness Height Rating (rhr) or better and for all housings is 63 rhr or better. Shaft shoulders which contact the bearing ring side face shall be square to the shaft bearing seating surface within 0.0003 inch and shall not have axial runout exceeding 0.0003 inch. Bearing housing and cap surfaces which contact the bearing ring side face shall be perpendicular to the axis and bearing seating surface of the housing bore within 0.001 inch total indicated runout.

30.7 Installation guidance. The following relates U.S. Navy recommended practices for installation of quiet ball bearings:

30.7.1 Measurement practice. Dimensions for shaft seats and housing bores call for manufacturing and measuring accuracies to 0.0001 inch. These accuracies do not require clean room conditions; however, they require better gauges than standard hand-held micrometers. A dial-indicating comparative snap gauge is recommended for measuring shaft diameters and a dial-indicating bore gauge is recommended for measuring housing diameters.

30.7.2 Mounting practice. Quiet ball bearings are mounted with an interference fitted ring. Consequently, all mounting methods are based on obtaining the necessary interference without undue effort, and with no risk of damage to the bearing. The first and most important axiom in mounting (and dismounting) bearings is that the mounting pressure shall not be applied in such a manner that it is transmitted through the balls. The mounting force shall be applied directly to the interference fitted ring.

(a) Bearings shall be heated in a thermostatically controlled heating oven in preparation for mounting. Heat for 1 hour at 203 ± 10°F.
(b) Install locknuts while bearings are hot, torquing to the values given in table IX. Allow bearings to cool to room temperature, loosen locknut and retorque to the values of table IX.

40. SELECTION REQUIREMENTS

40.1 Bearing selection. Bearing designs shall be selected from the standard part numbers listed in table XII. This restriction is imposed to limit, and eventually reduce, the number of different bearing designs requiring acquisition and stocking. Bearing designs other than those listed in table XII shall not be used without specific approval of the cognizant design review activity and the NAVSEA Bearing and Seal Technology Branch. The proposed use of a bearing design not listed in table XII must include complete identification of bearing characteristics and technical justification of the need for its use.

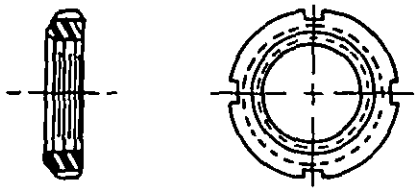
TABLE XII. Quiet ball bearings approved for new equipment use.

Standard part number	Navy code
M17931-G007	203
M17931-G013	204
M17931-G018	205
M17931-G023	206
M17931-G035	208
M17931-G039	209
M17931-G044	210
M17931-G050	211
M17931-G055	212
M17931-G074	217
M17931-G085	222
M17931-G088	232
M17931-G020	305
M17931-G025	306
M17931-G031	307
M17931-G036	308
M17931-G040	309
M17931-G045	310
M17931-G051	311
M17931-G057	312
M17931-G061	313
M17931-G068	315
M17931-G076	317
M17931-G079	319
M17931-G083	320
M17931-G087	322
M17931-G021	305Z
M17931-G026	306Z
M17931-G032	307Z
M17931-G037	308Z
M17931-G041	309Z
M17931-G046	310Z
M17931-G052	311Z
M17931-G058	312Z
M17931-G062	313Z
M17931-G069	315Z
M17931-C012	S3608
M17931-C014	S3609
M17931-C017	S3611
M17931-C010	S3607
M17931-C018	S3612
M17931-A017	7310D
M17931-A007	7207D
M17931-A021	7211D
M17931-A033	7217D
M17931-A011	7308D
M17931-A014	7309D

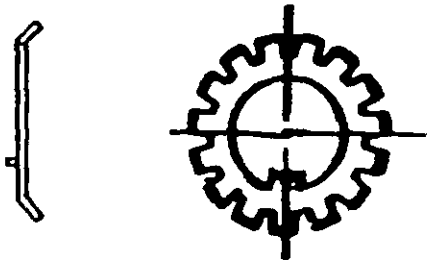
TABLE XII. Quiet ball bearings approved for new equipment use. - Continued

Standard part number	Navy code
M17931-A023	7311D
M17931-A025	7312DF
M17931-A029	7313D
M17931-A032	7315D
M17931-A035	7317D
M17931-A042	7319D
M17931-A044	7322DB
M17931-A026	7312D

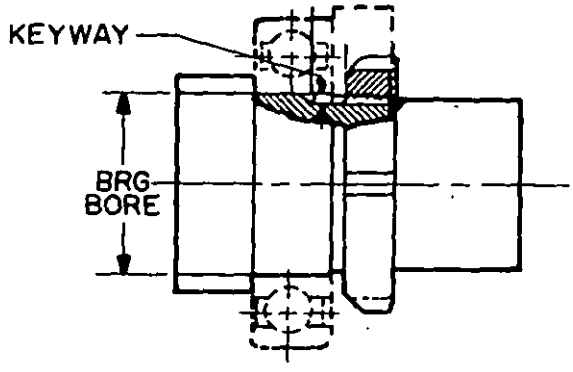
40.2 Bearing identification. Equipment drawings and parts lists shall, as a minimum, identify MIL-B-17931 bearings by type and class, Navy code, and standard part number.



(a) Standard locknut



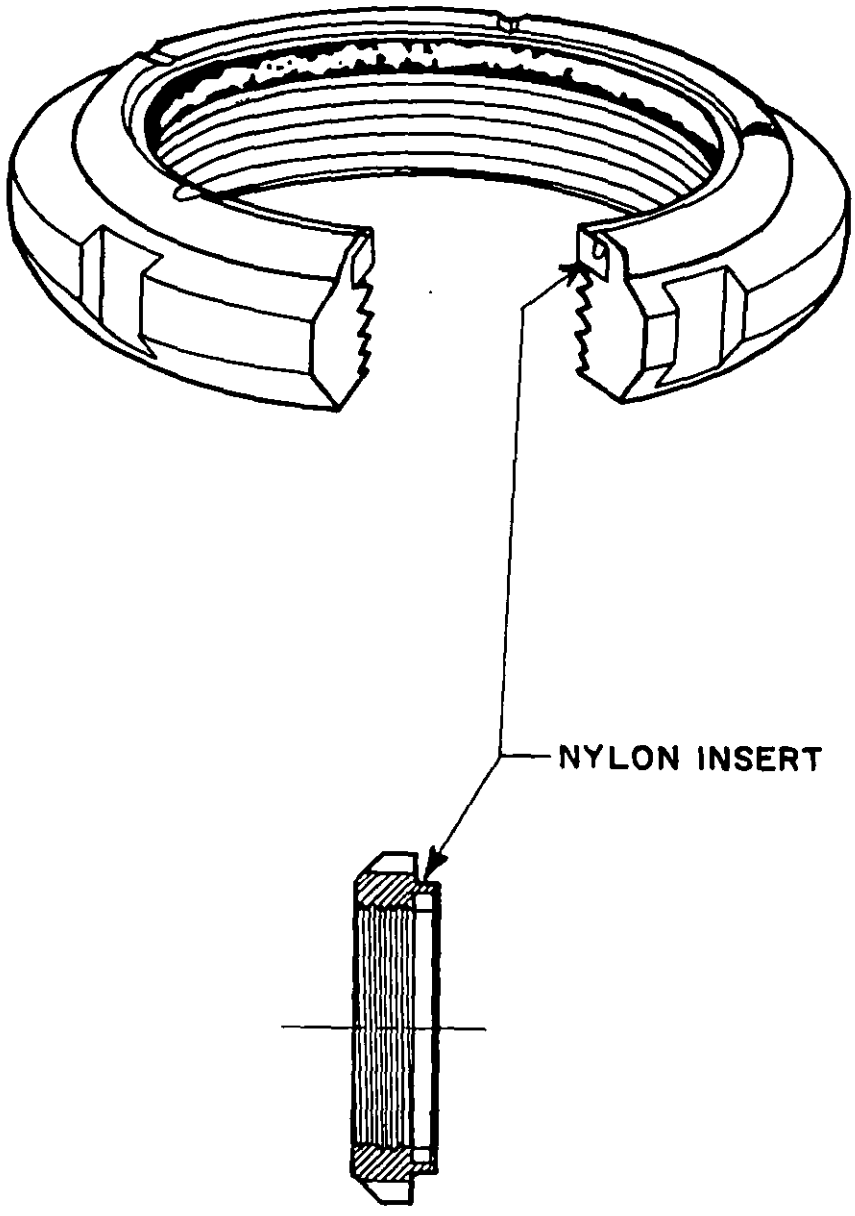
(b) Standard lockwasher



(c) Mounted locknut/lockwasher assembly

SH 13203078

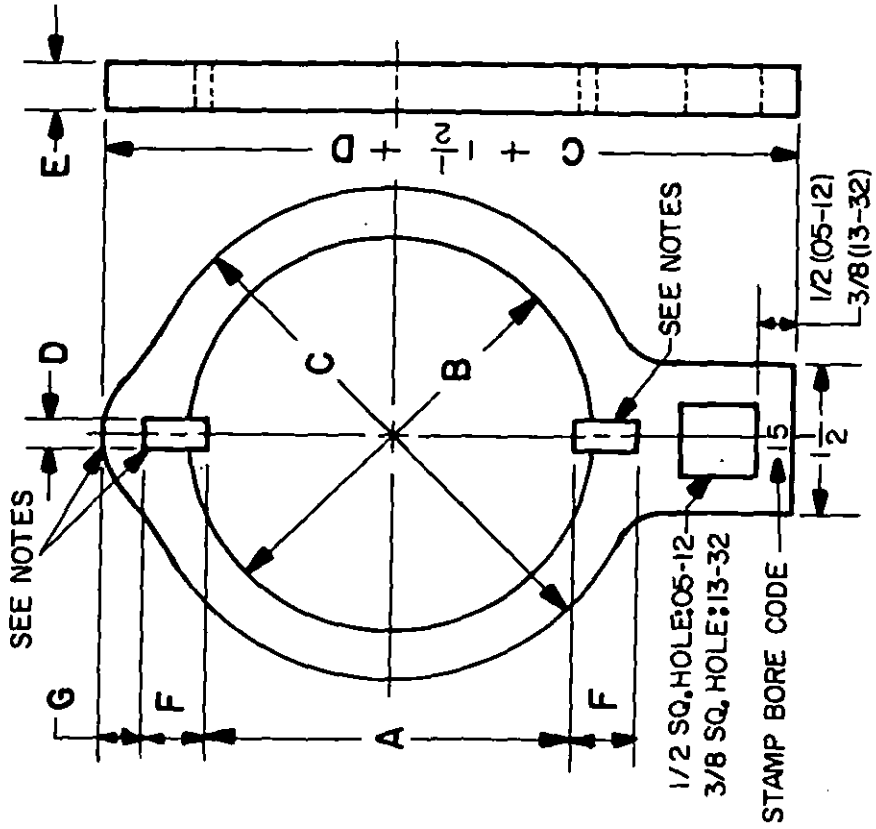
FIGURE 1. Conventional locknut/lockwasher mounting.



SH 13203079

FIGURE 2. Self-locking locknut.

BORE CODE	A +.010 -.000	B +.010 -.010	C .015	D +.000 -.010	E
05	1.406	1.625	2.625	.156	.375
06	1.594	1.813	2.813		
07	1.906	2.125	3.125	▼	
08	2.094	2.313	3.313	.188	
09	2.375	2.594	3.625		
10	2.531	2.750	3.750		
11	2.750	3.031	4.063		
12	2.938	3.219	4.250		▼
13	3.156	3.438	4.500		.500
14	3.406	3.688	4.750	▼	
15	3.656	3.938	5.000	.313	
16	3.938	4.219	5.374		
17	4.125	4.469	5.750		▼
18	4.375	4.719	6.000		.625
19	4.656	5.000	6.250		
20	4.906	5.250	6.500	▼	
21	5.094	5.500	7.000	.438	
22	5.375	5.750	7.500		
24	5.781	6.156	7.656	.438	
26	6.281	6.781	8.281	.562	
32	7.531	8.094	9.719	.562	▼



NOTES:
1. WELD TEETH INTO WRENCH F = 2D.
2. CONTOUR ABOUT TEETH SUCH THAT G D.

FIGURE 3. Drawing of locknut wrench.

INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge *(DO NOT STAPLE)*, and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362-5101

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-B-17931E	BEARINGS, BALL, ANNULAR, FOR QUIET OPERATION

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*:

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.