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INCH-POUND

MIL-DTL-27426B
25 September 1997
SUPERSEDING
MIL-R-27426A
27 August 1996

DETAIL SPECIFICATION

RINGS, RETAINING, SPIRAL (UNIFORM CROSS SECTION)

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

1. SCOPE

1.1 Scope. This specification covers the procurement requirements for uniform cross section spiral retaining rings used on shafts and in bearing housing.

* 1.2 Classification. Retaining rings will conform to one of the following classifications and codes as specified (see 6.3).

Type 2A01 - Medium Duty External Rings
Type 2A02 - Heavy Duty External Rings
Type 2B01 - Medium Duty Internal Rings
Type 2B02 - Heavy Duty Internal Rings

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to : the Defense Industrial Supply Center, (Code DISC-EED), 700 Robbins Avenue, Philadelphia, PA 19111-5096, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5365

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SPECIFICATIONS

* FEDERAL

QQ-P-35 - Passivation Treatments for Austenitic, Ferritic, and Corrosion-Resisting Steel (Fastening Devices)
QQ-P-416 - Plating, Cadmium (Electrodeposited)
PPP-H-1581 - Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of. (Reference)

* DEPARTMENT OF DEFENSE

MIL-P-16232 - Phosphate Coating, heavy, Manganese or Zinc Base (for Ferrous Metals)
MIL-R-27426/1 - Rings, Retaining, Spiral (Uniform Cross Section) Medium Duty External
MIL-R-27426/2 - Rings, Retaining, Spiral (Uniform Cross Section) Heavy Duty External
MIL-R-27426/3 - Rings, Retaining, Spiral (Uniform Cross Section) Medium Duty Internal
MIL-R-27426/4 - Rings, Retaining, Spiral (Uniform Cross Section) Heavy Duty Internal

(Unless otherwise indicated, copies of specifications, standards and handbooks are available from the Standardization Document Order Desk, 700 Robbins avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted will be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issue of the documents cited in the solicitation (see 6.2).

* AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B27.6 - General Purpose Uniform Cross Section Spiral Retaining Rings. (for reference only)

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

(Application for copies should be addressed to the American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.)

* AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B194 - Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar (DoD Adopted)
ASTM E18 - Test for Rockwell Hardness of Metallic Materials (DoD Adopted)

(Copies of ASTM publication may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

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* SOCIETY OF AUTOMOTIVE ENGINEERS (For Reference Only)

AS3215	- Ring, Retaining-Spiral, Internal, Heavy Duty, CRES
AS3216	- Ring, Retaining-Spiral, External, Heavy Duty, CRES
AS3217	- Ring, Retaining-Spiral, Internal, Light Duty, CRES
AS3218	- Ring, Retaining-Spiral, External, Light Duty, CRES
AS3219	- Ring, Retaining, Spiral, Minimum Distortion, Dimensional and Acceptance Standard for
SAE 1070-1090	- Steel, Carbon, Strip, Cold Rolled, Hardened and Tempered, Spring Quality
SAE AMS 5515	- Steel, Corrosion Resistant, Sheet, Strip, and Plate 18Cr – 8.5Ni (302) Solution Heat Treated, High Ductility (UNS S30200)
SAE AMS 5866	- Steel, Corrosion Resistant, Flat Wire 18Cr – 9.0 Ni (SAE 30302) Spring Temper (UNS S30200)

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096-0001).

(Non-Government Standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services).

* 2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Materials. Material used in the manufacture of retaining rings shall be either carbon steel, corrosion-resisting steel, or copper-beryllium alloy as specified in the contract or purchase order (see 6.2).

3.1.1 Carbon steel. Carbon steel used in the manufacture of retaining rings shall conform to the requirements of SAE 1070-1090, AISI Grade designation C1070 through C1090 inclusive.

* 3.1.2 Corrosion-resisting steel. Corrosion-resisting steel used in the manufacture of retaining rings shall conform to the requirements of AMS 5866 or AMS 5515.

* 3.1.3 Copper-beryllium alloy. Copper-beryllium alloy used in the manufacture of retaining rings shall conform to ASTM B194, alloy number C17200.

3.2 Physical requirements. Retaining rings shall conform to the appropriate physical requirements specified in 3.2.1 through 3.2.3 for the type, material, and size of ring specified (see 6.2).

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* 3.2.1 Carbon steel rings. Carbon steel retaining rings shall have a tensile strength and a hardness conforming to ANSI B27.6 (reference).

* 3.2.2 Corrosion-resisting steel rings. Corrosion resisting steel retaining rings shall have a hardness conforming to ANSI B27.6 (reference).

3.2.3 Copper-beryllium alloy rings. Copper-beryllium alloy retaining rings shall have a hardness of 56 to 61 Rockwell 30N scale or equivalent, as required for material thickness.

3.3 Protective Finish. Protective finish shall conform to 3.3.1, 3.3.2 or 3.3.3 as specified in the contract or purchase order (see 6.2).

3.3.1 Cadmium plating. Cadmium plating shall be in accordance with QQ-P-416, Type II, Class 2. NOTE: Use of this finish is not recommended.

3.3.2 Phosphate coating. Phosphate coating shall be in accordance with DOD-P-16232, Type Z, Class 2.

3.3.3 Passivation. Corrosion-resisting steel rings shall be passivated in accordance with QQ-P-35.

* 3.4 Design. The design, shape, mechanical requirements, and dimensions of retaining rings furnished under this specification shall conform to all the requirements specified in 3.4.1 through 3.4.6 for the applicable type, class, and size of ring. When specified in contract or order (see 6.2), the rings shall be furnished in the open position.

* 3.4.1 Type 2A01 rings. Type 2A01 rings shall conform to the dimensions, tolerance and requirements specified in MIL-R-27426/1, ANSI B27.6, and AS3219 (reference).

* 3.4.2 Type 2A02 rings. Type 2A02 rings shall conform to the dimensions, tolerances and requirements specified in MIL-R-27426/2, ANSI B27.6 and AS3219 (reference).

* 3.4.3 Type 2B01 rings. Type 2B01 rings shall conform to the dimensions, tolerances and requirements specified in MIL-R-27426/3, ANSI B27.6 and AS3219 (reference).

* 3.4.4 Type 2B02 rings. Type 2B02 rings shall conform to the dimensions, tolerances and requirements specified in MIL-R-27426/4, ANSI B27.6 and AS3219 (reference).

3.4.5 Notches and slots. All rings shall be either notched in accordance with 3.4.5.1 or slotted to facilitate removal of the rings from the grooves, using a screwdriver or similar common type tool special removal tools shall not be required. Ring sizes 2.750 inches and smaller shall be notched. Unless specified in contract or order (see 6.2), ring sizes 2.812 inches and larger may be notched or slotted at the option of the manufacturer.

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3.4.5.1 Notches. Notches in the rings shall conform to AS3215 through AS3218 as appropriate to the type of ring.

* 3.4.6 Edges. The edges of the ring material shall conform to the requirements of ANSI B27.6 and AS3219 (reference).

3.5 Performance. Retaining rings shall pass the performance test of 4.2.3.2.

3.6 Workmanship. Workmanship shall be of a quality which will insure compliance with all the requirements of this specification. Each retaining ring shall be free from hanging burrs and slivers, gouges, porosity, cracks, objectionable scale, or any other defects which may adversely affect the rings serviceability.

4. VERIFICATION

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

a. Conformance inspection. (See 4.2).

4.2 Conformance inspection. Conformance inspection shall include the examination of 4.2.1 and 4.2.2.

4.2.1 Lot. A lot shall consist of all items of the same type, size, material, and finish manufactured under essentially the same conditions.

4.2.2 Examination. Sample retaining rings shall be selected from each lot in accordance with attachment “A”, C=0 sampling plan for examination in accordance with 4.2.3.1 and 4.2.3.2

4.2.3.1 Retaining rings. Sample retaining rings shall be visually and dimensionally examined to verify compliance with the requirements of sections 3.4 and 3.6 of this specification. The rings shall be accepted or rejected in accordance with the requirements of attachment “A”, C=0 sampling plan, using an AQL level as specified in attachment “B”.

4.2.3.2 Packaging inspection. The preservation, packing and marking shall be inspected to verify conformance to the requirements of section 5.

4.2.4 Tests. A sample shall be selected from each lot and tested in accordance to the requirements below. Acceptance will be a pass/fail criteria.

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4.2.4.1 Hardness test. Before applying any applicable protective finish, a sample of each lot of material to be used in the retaining rings shall be tested for conformance to the hardness requirements specified in 3.2. The samples shall be tested for hardness using the Test Method ASTM E18.

4.2.4.2 Performance. Retaining rings shall be capable of being inserted and removed from grooves conforming to the dimensions and tolerances of the grooves for which the ring was designed without showing indications of cracks, excessive permanent set or distortion or other conditions detrimental to use of the rings. Distortion or permanent interference fit between the ring diameter and the groove diameter, under the stack-up of tolerances is less than 0.003 times the groove diameter as specified in the tables, calculated as follows:

$$H = 0G - 0C > 0.0030C$$

Where:

H = Minimum interference fit between ring and groove after performance test.
0G = Maximum I. D. external ring as measured after performance test.
0G = Minimum O. D. internal ring as measured after performance test.
0C = Minimum groove diameter, external ring.
0C = Maximum groove diameter, internal ring.

4.2.4.3 Protective finish. When retaining rings are furnished with a plating or coating (see 3.3), the thickness of the plating or coating shall be determined in accordance with the applicable plating or coating specification.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to b performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activity within the Military Department of Defense Agency, or within the Military Department’s System Command. Packaging data retrievals available from the managing Military department’s of Defense Agency’s automated packaging files, CD-ROM products or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. Retaining rings covered by this specification are intended for internal and external retaining applications, such as positioning and retaining bearings springs in housings and on shafts, and for retaining shafts in housings.

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6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this inspection.
b. Type, material, and size of rings (see 1.2.3.1 and 3.4).
c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2).
d. Protective finish required (see 3.3).
e. Levels of preservation and packaging required (see 5.1).

6.3 DESIGN INFORMATION

a. Definitions:

1) A = Shaft or housing diameter (in)
2) C = Groove diameter (in)
3) C_1 = Percent change of ring diameter from free state to installed state/100.
4) D = Groove width (in)
5) Dg = Permanent groove deformation (in)
6) Dn = Free neutral ring diameter (in)
7) D_1 = Depth of groove (in)
8) E = Ring dial wall (in)
9) F = Ring thickness (in)
10) g = Ring free O. D. or I. D. (in)
11) I = Moment of inertia $T_1E^3/12$ (in^4)
12) K = Factor of safety (2-3)
13) L = Number of turns of ring
14) M = Modulus of elasticity (psi)
15) N = Speed (rpm)
16) Ps = Allowable shear load based on shear strength of material (lbs)
17) Pt = Thrust load (lbs)
18) Rg = Groove radius (in)
19) R_1 - Free inside ring radius (in)
20) Rn = Dn/2 = Free neutral ring radius (in)
21) Ro = Free outside ring radius (in)
22) S = Installation stress (psi)
23) Sc = Shear strength of groove material (psi)
24) Sy = Compressive yield strength of groove material (psi)
25) T_1 = Material thickness (in)
26) Y = Distance from groove from end of shaft or housing (in)
27) s = Allowable working stress (psi)
28) Æ = Allowable angle of deflection (deg)
29) t_1 = .019
30) t_2 = .032
31) g = Specific weight of material (in-lbs/in)

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b. Allowable thrust load capability of the rings where abutting components have square corners, can be found with the following equation:

Allowable thrust based on shear strength of ring material, lbs.

Shaft or housing diameter, in.

Ring thickness, in.

Shear strength, psi

$$P_s = \frac{A \quad F \quad S_s \quad p}{K}$$

Factor of Safety

c. Axial deflection. The maximum stress on a ring, which is subjected to a uniform twisting moment, is a tensile stress that occurs at the inner corner of the ring. This stress makes the ring have a tendency to grow in diameter and become dished. This moment is caused when the compressive yield strength of the groove material is exceeded as illustrated in Figure 2.

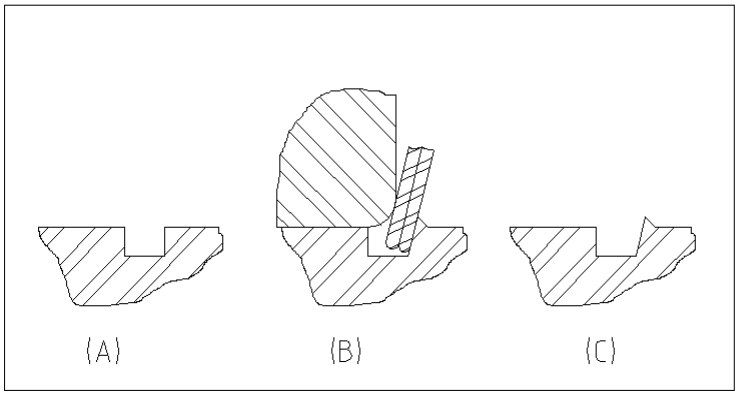

FIGURE 2. Axial deflection.

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To calculate allowable deflection of the ring the equations are:

For Internal Rings

Ring deflection, degrees
Mean groove radius, in.
Allowable working stress, psi
Ring cling to groove bottom
Ring modulus of elasticity, psi
Ring radial wall, in

$$f = 114.6 \; Rg \; \frac{s + \left[\frac{C_1 \; M \; E}{(1-C_1) \; D_n} \right]}{L \; M \; T_1}$$

Number of turns of ring
Mean ring material thickness, in.
Ring free neutral diameter, in.

Min. ring free O. D., in.
Mean groove diameter, in.

Where $C_1 = \frac{G - C}{G}$

$D_n = G - E \qquad Rg = \frac{C}{2}$

(For the above equations, use the calculated value of f if f is below 18°. If f is equal to or greater than 18°, use 18°.)

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For External Rings

Ring deflection, degrees
Mean groove radius, in.
Allowable working stress, psi
Ring cling to groove bottom
Ring modulus of elasticity, psi
Ring radial wall, in

$$f = 114.6 \; Rg \left[\frac{s - \left[\frac{C_1 \; M \; E}{(1+C_1) \; D_n} \right]}{M \; T_1} \right]$$

Mean ring material thickness, in.
Ring free neutral diameter, in.

Min. ring free O. D., in.
Mean groove diameter, in.

$$\text{Where } C_1 = \frac{G - C}{G}$$

$$D_n = G + E \qquad Rg = \frac{C}{2}$$

(For the above equations, use the calculated value of f if f is below 18°. If f is equal to or greater than 18°, use 18°.)

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d. The thrust load, based on groove yield, can be found with the following equation:

Thrust load, lbs.
Shaft or housing diameter,
Mean depth of groove, in.
Allowable angle of deflection, deg.

$$P_t = \frac{A \quad Sy \quad D_1 \quad Tan \quad f}{(0.073)K}$$

Factor of safety
Yield strength of groove material, psi

This equation is valid only if the load is applied through a retained part which applies the load very close to the shaft or bore diameter and where the load is of a static nature.

e. Minimum distance between outer groove wall and end of shaft should be three times the groove depth at a minimum.

(Y> 3D)

f. Centrifugal capacity: Proper functioning of an external retaining ring depends upon the ring remaining seated on the groove bottom. Centrifugal loading can overcome cling of the ring. To calculate allowable steady state speed of the retaining ring the equation is:

Min ring cling to groove bottom
Ring radial wall, in.
Speed, rpm
1/2

$$N = \left[\frac{0.466 \quad C_1 \quad E^3 \quad X \quad 10^{12}}{R_n^3 \quad (1+C_1)\ (R_o^3 - R_1^3)} \right]$$

Free neutral ring radius, in.
Free outside ring radius, in.
Free inside ring radius, in.

g. Rotation between parts: When a spiral ring retains a rotating part, rotation will be limited to one direction only and to applications involving light thrust loads. The ring is to be wound in the direction of rotation of the rotating part, in the case of external rings, or against the direction of rotation for internal rings, failure to follow these criteria will cause the ring to wind out of its groove.

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* 6.4 Part or identifying number. Procurement documents for ordering retaining rings will use the following part numbering technique for identification and ordering. Codes for variable characteristics are as specified below.

Designation	Code	Item Requirement	Specification Sheet	Old Item Designation
	1	Type 2A01	MIL-R-27426/1	Type A Class 1
	2	Type 2A02	MIL-R-27426/2	Type A Class 2
	3	Type 2B01	MIL-R-27426/3	Type B Class 1
	4	Type 2B02	MIL-R-27426/4	Type B Class 2
Material and Finish	A	Carbon steel plain		
	B	Carbon steel cadmium plated		
	C	Carbon steel phosphate coated		
	D	Corrosion resisting steel, passivated		
	E	Copper-beryllium alloy		

M 27426/X X X

- Material and finish code
- Dash no. indicating ring dimensions
- Specification sheet code identifier
- Specification number
- Prefix indicating MIL specification

(Spaces inserted for purposes of illustration clarity.)

EXAMPLE: M27426/4102B which is: Specification sheet MIL-R-27426/4 (type 2B02), housing diameter of 0.562 inch, carbon steel, cadmium plated ring.

* 6.5 Subject term (key word) listing.

Fasteners
Steel, carbon
Steel, corrosion resistant
Copper-beryllium alloy
Shafts
Housings

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6.6 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
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Navy - OS
Air Force - 99

Review activities:
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Preparing activity:
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I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-DTL-27426b	**2. DOCUMENT DATE (YYMMDD)** 25 September 1997

3. DOCUMENT TITLE RINGS, RETAINING, SPIRAL (UNIFORM CROSS SECTION)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON *(if applicable)*	**7.DATE SUBMITTED** (YYMMDD)

8. PREPARING ACTIVITY

a. NAME DEFENSE INDUSTRIAL SUPPLY CENTER CODE DISC-EED	b. TELEPHONE *Include Area Code)* (1) Commercial (2) AUTOVON
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