

Report of Parts and Fittings Division approved August 1922, revised by Parts and Fittings Committee January 1956 and last revised by Fasteners Committee February 1974. Conforms to American National Standard, ANSI B18.21.1—1972, Lock Washers.

1. Introduction

1.1 Scope—This SAE Standard covers the complete dimensional and general specifications, including physical properties and methods of testing, for those types of lock washers intended for use in automotive and general industrial applications.

1.1.1 It should be noted that the word “lock” appearing in the names of the products in this standard is a generic term historically associated with their identification and is not intended to imply an indefinite permanency of fixity in attachments where they are used.

1.1.2 The inclusion of dimensional data in this standard is not intended to

imply that all of the products described are stock production items. Consumers should consult with manufacturers concerning the availability of products.

1.2 Washer Types and Application—The two varieties of lock washers covered by this standard and their applications are described in the following:

1.2.1 HELICAL SPRING LOCK WASHERS—This standard includes helical spring lock washers of carbon steel, corrosion resistant steel, aluminum-zinc alloy, phosphor-bronze, silicon-bronze, and K-Monel in the series indicated in the respective detailed specifications. Helical spring lock washers are intended for general industrial applications and provide hardened bearing surfaces for the threaded fasteners used.

1.2.2 TOOTH LOCK WASHERS—This standard includes tooth lock washers of carbon steel having internal teeth, external teeth, and both internal and external teeth in two constructions designated Type A and Type B. Countersunk external tooth lock washers are provided for use with countersunk head screws, and heavy series internal tooth lock washers are available in nominal sizes over $\frac{1}{4}$ in. The internal-external tooth lock washers have a selection of outside diameters to satisfy various design requirements. Tooth lock washers are intended for general industrial applications and serve to increase the friction between fasteners and the component parts of an assembly. Where used on painted surfaces, the tooth lock washer provides electrical grounding by cutting through most finishes when put under tension.

1.3 Dimensions—All dimensions in this standard are given in inches, unless otherwise stated.

1.4 Responsibility for Modifications—The washer manufacturer shall not be held responsible for malfunctions of product determined to be due to plating or other modifications when such plating or modification is done by the purchaser or his designee.

2. Helical Spring Lock Washers

2.1 General Specifications—These General Specifications apply and are common to helical spring lock washers of the various materials covered by this standard. The additional requirements peculiar to washers of a specific material are presented in the detailed specifications under the respective materials which follow.

2.1.1 DIMENSIONS—The dimensions of helical spring lock washers shall be as specified in Table 2. Selection should be made from the regular, heavy, extra duty, or hi collar series to suit design requirements. It should be noted, however, that washers in certain materials are not produced in all series. For series in which washers are available, reference should be made to detailed specifications for respective materials.

2.1.2 WASHER SECTION—The section of finished washers shall be slightly trapezoidal in shape with the thickness at the inner periphery greater than the thickness at the outer periphery by an amount varying from a minimum of 0.0005 in. to a maximum of 0.001 in. per 0.0156 in. of the minimum section width. The minimum thickness specified in the table of dimensions represents the nominal mean thickness of the trapezoid. Reduced to formulas, the increase in thickness from the outer periphery to inner periphery is t_i minus t_o or $0.032 W$ (minimum) to $0.064 W$ (maximum). The tolerance on the nominal mean thickness of the trapezoid shall be plus and equal to the following:

Size 12 and smaller	0.006
Size $\frac{1}{4}$ to 13/16	0.010
Size 7/8 to 1-1/2	0.020

2.1.2.1 Corners—The corners at the outer and inner peripheries of washer shall be rounded sufficiently to avoid checks. However, the radius at corners shall not exceed the equivalent of 15% of the minimum width of washer section and need not necessarily be tangent to the face of the washer section.

2.1.3 COILING—Washers shall be coiled so that free height is approximately equivalent to twice the thickness of the washer section. The gap and relationship of the severed ends shall be such as to prevent the washers tangling and ensure that washers will compress flat. Washers which require extra operations, such as flattening to reduce free height, etc., shall be classified as specials.

2.1.4 FINISHES—Unless otherwise specified, washers shall be supplied with a natural (as processed) finish, unplated or uncoated. Where corrosion preventative treatment is required, washers shall be plated or coated as agreed upon between the manufacturer and the purchaser. However, where carbon steel washers are plated or coated and subject to hydrogen embrittlement, they shall be suitably treated subsequent to the plating or coating operation to obviate such embrittlement and subjected to an embrittlement test.

2.1.5 WORKMANSHIP—The flat faces of washers and the inner and outer peripheries shall be smooth and free from knurling, serrations, die marks, deep scratches, etc., although slight feed roll marks shall be permissible. Washers shall also be free from burrs, rust, pit marks, loose scale, and defects which might affect their serviceability.

2.1.6 DESIGNATION—Nominal washer sizes are intended for use with comparable nominal screw or bolt sizes. Helical spring lock washers shall be

designated by the following data, in the sequence shown: product name, nominal size (number, fraction, or decimal equivalent¹), series, material, and protective finish, if required. For example:

Helical spring lock washer, $\frac{1}{4}$ regular, phosphor bronze

Helical spring lock washer, .375 extra duty, steel, phosphate coated

Helical spring lock washer, $\frac{1}{2}$ hi-collar, steel

2.1.7 TESTS—Helical spring lock washers shall meet the requirements of the following tests:

2.1.7.1 Temper Test—After compressing to flat and releasing, the free height of a washer shall be at least two-thirds of the original free height.

2.1.7.2 Twist Test—The washer shall be gripped in vise jaws having sharp edges. The ends of the washers shall be free and an axis passing through the gap shall be parallel to and slightly above the top of the vise. A 90 deg segment of the free end of the washer shall be gripped in wrench jaws as shown in Fig. 1. Edges of the wrench jaws shall be sharp and in a plane parallel to the vise. Movement of the wrench in a direction that increases the free height of the spring lock washer shall twist carbon steel washers through an angle of 90 deg and corrosion resistant steel and nonferrous washers through an angle of 45 deg, without sign of fracture. When the washer fractures at a greater degree of twist, the structure at the point of fracture shall show a fine grain, and the washer up to the instant of fracture shall deliver a tough, springy reaction.

2.2 Carbon Steel Helical Spring Lock Washers—The following additional requirements peculiar to carbon steel helical spring lock washers supplement the requirements set forth in the General Specifications applying to all helical spring lock washers.

2.2.1 DIMENSIONS—Carbon steel washers are available in the four series specified in Table 2. Namely, regular, heavy, extra-duty, and hi-collar series.

2.2.1.1 When carbon steel helical spring lock washers are to be hot-dipped galvanized for use with hot-dipped galvanized bolts or screws, they shall be coiled to limits 0.020 in. in excess of those specified in Table 2 for minimum inside diameter and maximum outside diameter. Galvanizing on washers under $\frac{1}{4}$ in. nominal size is not recommended.

2.2.2 MATERIAL AND HARDNESS—Washers shall be made from carbon steel lock washer wire meeting the limits for decarburization shown in Table 1. They shall be heat treated to a hardness of Rockwell C45-51, or equivalent. The washer shall be prepared for checking the material hardness by grinding the sides flat and parallel sufficiently to assure the removal of a decarburized or plated surface. During the grinding operation, care shall be exercised to prevent the temperature of the washer from exceeding 250°F. Galvanized washers shall have a hardness of Rockwell C45-51, or equivalent, before galvanizing.

2.2.3 EMBRITTLEMENT TEST FOR PLATED WASHERS—Plated carbon steel washers shall not break after having been compressed flat between hardened and ground steel plates for a minimum period of 24 h.

¹Where specifying nominal size in decimals, zeros preceeding the decimal shall be omitted.

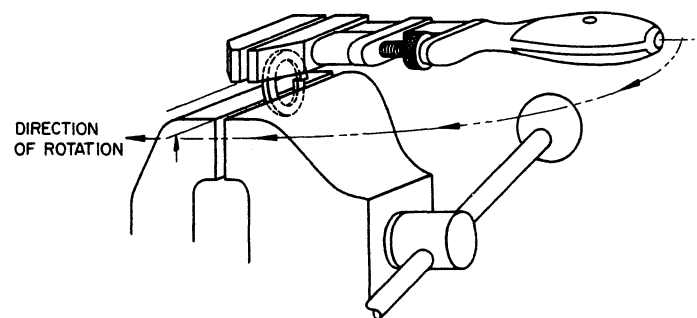


FIG. 1—WASHER TWIST TEST

TABLE 1—LIMITS FOR DECARBURIZATION

Diameter of Round Wire, or Sections of Equivalent Area	Max Depth Free Ferrite	Max Total Affected Depth (Free Ferrite Plus Partial Decarburization)
Up to 0.140, incl	0.002	0.006
Over 0.140 to 0.250, incl	0.003	0.008
Over 0.250 to 0.375, incl	0.004	0.010
Over 0.375 to 0.500, incl	0.006	0.012



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