METRIC HARDENED STEEL WASHERS

IFI
542
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IFI Note:

IFI-542 is an interim standard covering hardened steel circular washers designed for use with metric fasteners with nominal thread diameters M12 thru M100. IFI-542 is currently being used by ASTM Committee F-16 as the basis for an ASTM standard which when finalized will be published as ASTM F436M. Its release is expected in 1983. When F436M is published, IFI will withdraw IFI-542 and support the ASTM standard. Copies of F436M will be available from ASTM, 1916 Race St., Philadelphia, PA 19103.

It is anticipated that the dimensions for washers now included in IFI-542 will, in time, be added into ANSI B18.22M, page I—8.

1. Scope.

1.1 This Standard covers the chemical, mechanical, and dimensional requirements for metric hardened steel washers for use with fasteners having nominal thread diameters M12 through M100. These washers are intended for general-purpose mechanical and structural use with bolts, nuts, studs, and other internally and externally threaded fasteners. These washers are suitable for use with fasteners covered in such specifications as A325M (page E—9), A490M (page E—12), A563M (page B—10) and fasteners of F568 property classes 8.8 and higher (page B—1).

1.2 The types of washers covered in this Standard are:

1.2.1 Type 1 — Washers made of carbon steel.

1.2.2 Type 3 — Washers made of steel having atmospheric corrosion resistance and weathering characteristics comparable to that of steels covered in Specification A588, Specification A242, and Specification A709 (these steels have atmospheric corrosion resistance approximately two times that of carbon structural steel with copper).

1.3 The styles of washers covered in this Standard are:

1.3.1 Circular Washers. Circular washers, in nominal sizes 12 mm through 100 mm, are suitable for applications where sufficient space exists and angularity permits.

1.3.2 Beveled Washers. Beveled washers are square and rectangular washers, in nominal sizes 12 mm through 36 mm, with a beveled 1:6 surface for use with American Standard beams and channels.

1.3.3 Clipped Washers. Clipped washers are circular or beveled washers for use where space limitations necessitate that one side be clipped.

2. Applicable Documents.

For titles and source of availability of referenced documents refer to page J—48.

3. Ordering Information.

3.1 Orders for washers shall include the following:

3.1.1 Quantity.

3.1.2 Name of product, (that is, circular washer, beveled washer, clipped circular washer, or clipped beveled washer).

3.1.3 Coating if required (that is, hot-dip galvanized, mechanically galvanized, etc.).

3.1.3.1 When galvanized washers are specified, the type of galvanizing, i.e., hot dip or mechanical. (See 6.1 and 6.3.)

3.1.3.1.1 When the type of galvanizing is not specified, the manufacturer, at his option, may furnish hot dip or mechanically galvanized washers.

3.1.4 Dimensions, nominal size, and other dimensions if modified from those covered in this specification.

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3.1.5 Material type of washer (that is, Type 1 or Type 3).

3.1.5.1 When the type is not specified, either Type 1 or Type 3 washers may be supplied when permitted by the purchaser.

3.1.5.2 When atmospheric corrosion resistance is required, Type 3 washers shall be specified by the purchaser.

3.1.6 Surface roughness control, see S1.

3.1.7 IFI designation and date of issue (refer to Introductory IFI Note).

3.1.8 Any special requirements.

4. Materials and Manufacture.

4.1 Steel used in the manufacture of washers shall be that produced by the open-hearth, basic-oxygen, or electric-furnace process.

4.2 All washers in nominal sizes 12 mm through 36 mm, shall be through quenched and tempered. Washers in nominal sizes larger than 36 mm may be either through quenched and tempered or carburized, quenched and tempered at the manufacturer's option.

4.3 Hot dip galvanized washers shall be hot-dip galvanized in accordance with the requirements for Class C of Specification A153. Mechanically galvanized washers shall be mechanically zinc coated and the coating and coated washers shall conform to the requirements for Class 50 of Specification B695.

4.4 If washers are heat treated by a subcontractor, they shall be returned to the manufacturer for testing prior to shipment to the purchaser.

5. Chemical Requirements.

5.1 Type 1 and Type 3 washers shall conform to the chemical composition requirements specified in Table 1.

5.2 Product analysis may be made by the purchaser from finished material representing each lot of washers. The chemical composition shall conform to the requirements of 4.1 and 5.1.

Table 1 Chemical Requirements

Element	Composition, percent	
	Type 1	Type 3[a]
Phosphorus, max		
Heat analysis	0.040	0.040
Product analysis	0.050	0.045
Sulfur, max		
Heat analysis	0.050	0.050
Product analysis	0.060	0.055
Silicon		
Heat analysis	...	0.15-0.35
Product analysis	...	0.13-0.37
Chromium		
Heat analysis	...	0.45-0.65
Product analysis	...	0.42-0.68
Nickel		
Heat analysis	...	0.25-0.45
Product analysis	...	0.22-0.48
Copper		
Heat analysis	...	0.25-0.45
Product analysis	...	0.22-0.48

[a]Type 3 steel washers may also be manufactured from any of the steels listed in Table 2 of ASTM F568, page B—3.

5.3 Individual heats of steel are not identified in the finished product.

5.4 Chemical analyses shall be performed in accordance with A751.

6. Mechanical Requirements.

6.1 Through quenched and tempered washers shall have a Rockwell hardness of C38 to C45, except when hot-dip galvanized, in which case they shall have a Rockwell hardness of C26 to C45.

6.2 Carburized, quenched and tempered washers shall be carburized to a minimum depth of 0.40 mm and shall have a Rockwell hardness of A69 to A73.

6.3 When mechanically galvanized, washers shall have the same hardness range as non-coated washers.

7. Test Methods.

7.1 Hardness tests shall be performed in accordance with the test methods specified in ASTM F606, page B—59.

8. Sampling and Number of Tests and Retests.

8.1 The requirements of this Standard shall be met in continuous mass production for stock, and the manufacturer shall make sample inspections to ensure that the product conforms to the specified requirements. Additional tests of individual shipments of material are not ordinarily necessary.

8.2 When specified in the purchase order, the manufacturer shall furnish a test report certified to be the last complete set of mechanical tests for each stock size in each shipment.

8.3 When the purchaser requires that additional tests be performed by the manufacturer to determine that the properties of products in an individual shipment are within specified limits, the purchaser shall specify the testing requirements, including the sampling plan and basis of acceptance, in the inquiry and purchase order.

8.3.1 When the purchaser does not specify the sampling plan and basis of acceptance the following shall apply:

8.3.1.1 The lot, for purposes of selecting samples, shall consist of all washers offered for inspection and testing, at one time, that are the same type, style, nominal size, and surface finish.

8.3.1.2 From each lot, samples shall be selected at random and tested for each requirement, except as specified in 8.3.1.3, in accordance with the following plan:

Number of Pieces in Lot	Acceptance Criteria		
	Number of Tests	Acceptance Number	Rejection Number
800 and less	1	0	1
801 to 8,000	2	0	1
8,001 to 22,000	3	0	1
over 22,000	5	0	1

8.3.1.3 When determining the weight of coating of plated and coated washers, the sampling plan as defined in 8.3.1.2 shall apply, except that in no case shall the sample consist of less than three washers.

9. Dimensions and Tolerances.

9.1 Circular and clipped circular washers shall conform to dimensions given in Table 2. All dimensions apply prior to plating or coating.

9.1.1 The axis of the inside hole shall be located at true position with respect to the axis of the washer circumference within a tolerance zone having a diameter of 0.6 mm for washers of nominal sizes 16 mm and smaller and 0.9 mm for washers of nominal sizes 20 mm and larger.

9.1.2 Washers shall be flat within 0.01 mm per mm outside diameter.

9.1.3 As a result of the punching process, the inside diameter of the washer generally consists of three distinct sections. On the punch entry side of the washer there is some drawing in of the material resulting in a rounded corner section, following which is a substantially parallel section, and finally at the exit side a tapered breakout may occur. (See Fig. 1, page I—10.) The parallel sided section of the washer inside diameter shall be within the limits specified in Table 2, however, the specified maximum inside diameter may be exceeded at the washer face on the breakout side by a maximum taper allowance of 25 percent of the specified maximum washer thickness for each size.

9.2 Beveled washers shall conform to dimensions given for beveled washers in IFI-534, page I—16.

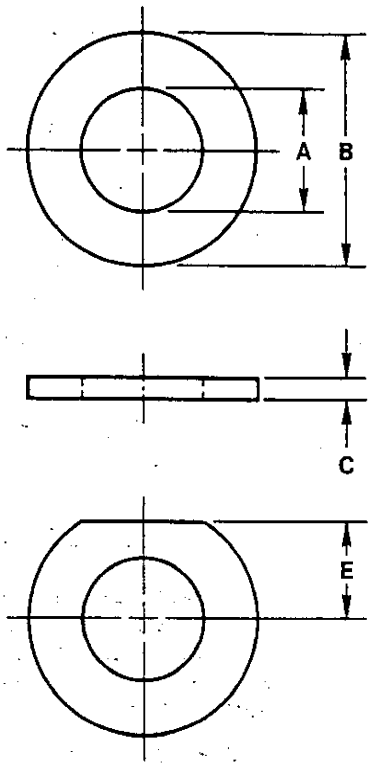
9.3 Clipped beveled washers shall conform to dimensions given for beveled washers in IFI-534, except that one edge may be clipped off not closer than 0.875 times the washer nominal size from the center of the hole.

10. Workmanship.

10.1 Washers shall be free of excess mill scale, excess coatings and foreign material on bearing surfaces. Arc and gas cut washers shall be free of metal spatter.

Table 2 Dimensions of Circular Washers

Nom Washer Size	A		B		C		E
	Inside Dia		Outside Dia		Thickness		Clipped Width
	Max	Min	Max	Min	Max	Min	Min
12	14.4	14.0	27.0	25.7	4.6	3.1	10.5
14	16.4	16.0	30.0	28.7	4.6	3.1	12.2
16	18.4	18.0	34.0	32.4	4.6	3.1	14.0
20	22.5	22.0	42.0	40.4	4.6	3.1	17.5
22	24.5	24.0	44.0	42.4	4.6	3.4	19.2
24	26.5	26.0	50.0	48.4	4.6	3.4	21.0
27	30.5	30.0	56.0	54.1	4.6	3.4	23.6
30	33.6	33.0	60.0	58.1	4.6	3.4	26.2
36	39.6	39.0	72.0	70.1	4.6	3.4	31.5
42	45.6	45.0	84.0	81.8	7.2	4.6	36.7
48	52.7	52.0	95.0	92.8	7.2	4.6	42.0
56	62.7	62.0	107.0	104.8	8.7	6.1	49.0
64	70.7	70.0	118.0	115.8	8.7	6.1	56.0
72	78.7	78.0	130.0	127.5	8.7	6.1	63.0
80	86.9	86.0	142.0	139.5	8.7	6.1	70.0
90	96.9	96.0	159.0	156.5	8.7	6.1	78.7
100	107.9	107.0	176.0	173.5	8.7	6.1	87.5
See Note 1							2



NOTES:
1. Nominal washer sizes are intended for use with fasteners of the same nominal thread diameter.
2. Washers may be clipped on one side not closer to the center of the washer than width E.
3. All dimensions are in mm.

11. Marking.

11.1 Washers shall be marked with a symbol, or other distinguishing marks, to identify the manufacturer.

11.2 Additionally, washers shall be marked to identify them as being of a metric size. Preferably, the metric marking shall be the symbol 'M," but may be of other distinguishing design as determined by the manufacturer.

11.3 Additionally, Type 3 washers shall be identified with the symbol '3.'

11.4 Additional identification or distinguishing marks, or both, may be used by the manufacturer.

11.5 All marking symbols shall be depressed on one face of the washer.

11.6 It is possible that during the clipping of circular washers the marking symbols may be removed. This is acceptable providing the majority of washers in the lot still display the identification marks.

SUPPLEMENTARY REQUIREMENTS.

The following supplementary requirements shall apply only when specified by the purchaser in the contract or order. Details of these supplementary requirements shall be agreed upon in writing between the manufacturer and purchaser. Supplementary requirements shall in no way negate any requirement of the specification itself.

S1. Surface Roughness.

S1.1 Washers shall have a multidirectional lay with a surface roughness not exceeding 19 μm in height including any flaws in or on the surface.

S1.2 Burrs shall not exceed 0.25 mm in height.