
PHILIPPINE AGRICULTURAL ENGINEERING STANDARD PAES 314: 2002
Engineering Materials – Washers for Agricultural Machines
– Specifications and Application

Foreword

The formulation of this National Standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This standard has been technically prepared in accordance with PNS 01-4:1998 (ISO/IEC Directives Part 3:1997) – Rules for the Structure and Drafting of International Standards. It provides specifications and proper application of washers for agricultural machines.

The word “shall” is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that certain course of action is preferred but not necessarily required.

In the preparation of this standard, the following references were considered:

Hummel, B. L. (Ed.) 1967. Machine design, Fastening and joining, Vol. 39 No. 34. Penton Publishing Co., Cleveland, Ohio.

JIS B 1251:1995, Spring lock washers

JIS B 1252:1995, Conical spring washers

JIS B 1255:1977, Toothed lock washers

JIS B 1156:1998, Plain washers

**Engineering Materials – Washers for Agricultural Machines
– Specifications and Applications**

1 Scope

This standard establishes specifications and provides technical information for the proper application of washers for agricultural machinery.

2 Reference

The following normative reference contains provisions which, through reference in this text, constitute provisions of this standard:

JIS B 1251:1995, Spring lock washers

3 Application

Washer applications include: increasing the bearing area, keeping fasteners tight, surface protection, spanning an oversize clearance hole, sealing, electrical connection, and spring tension take-up devices.

4 Classification

Classification and types of washers are shown in Table 1.

Table 1 – Types of washers

Classification	Type	Note	Uses
Spring lock washer	No. 1*	General use	Used to produce a predetermined pressure on adjacent members where sliding action is desired, or to serve as spring take-up devices in an assembly.
	No. 2**	Heavy load	
Conical spring washer	Class 1	1L	General use
		1H	
	Class 2	2L	Hexagon socket screws
		2H	
Toothed lock washer	Internal toothed (A)		Used with screws and nuts not only to effectively add spring take-up to the screw elongation but to increase the frictional resistance under the screw hard or nut face.
	External toothed (B)		
	Countersunk external toothed (C)		
	Internal-external toothed (AB)		
Plain washer	Small series-product grade A		Provides bearing surface for a nut or screw head, covers large clearance holes, and distribute fastener loads over large area, particularly on soft materials such as aluminum or wood.
	Normal series-product grade A		
	Normal series chamfered-product grade A		
	Normal series-product grade C		
	Extra large series-product grade C		
Hexagon socket screws		Hexagon bolt and hexagon nut and machine screws.	
Hexagon bolt and hexagon nut and machine screws.			
* Equivalent to No. 2 in JIS B 1251:1995			
** Equivalent to No. 3 in JIS B 1251:1995			

5 Nomenclature

Nomenclature and designation of dimensions of washers shall be as illustrated in Figures 1-4.

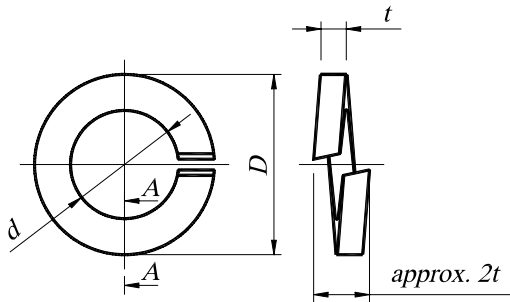


Figure 1 – Spring lock washer

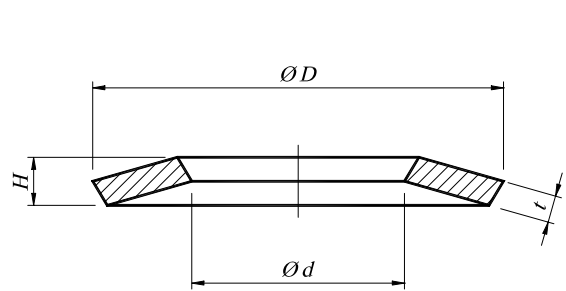
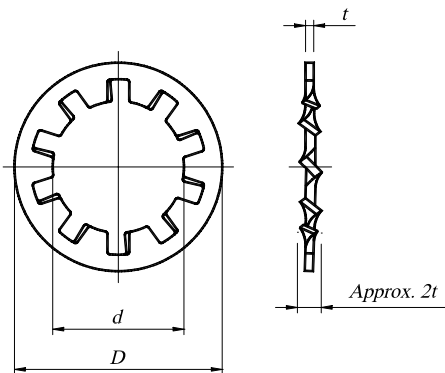
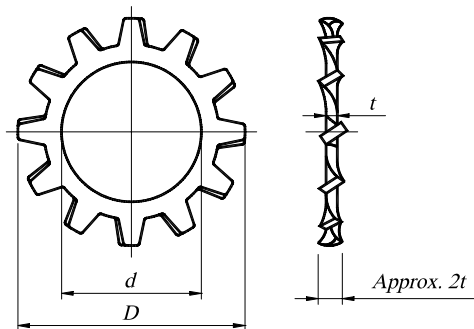


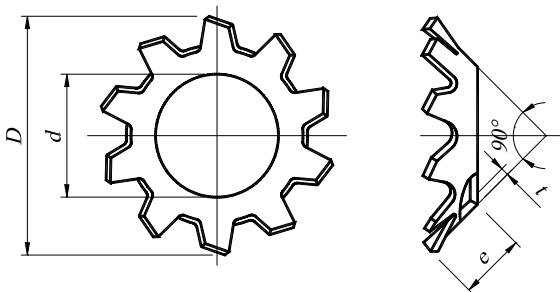
Figure 2 – Conical spring washer



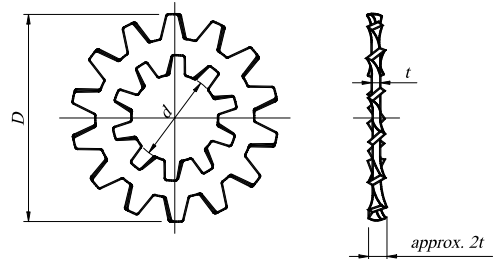
a. Internal toothed type



b. External toothed

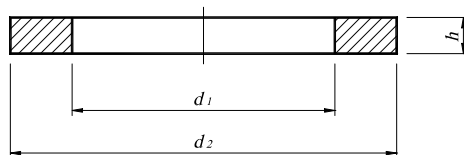


c. Countersunk external toothed type

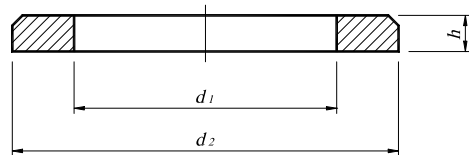


d. Internal-external toothed type

Figure 3 – Toothed lock washer



a. Regular



b. Chamfered

Figure 4 – Plain washer

6 Dimensions

Dimensions of washers shall comply with Tables 2-13

Table 2 – Dimensions of spring lock washers, mm

Nominal size	Inside diameter, d	Sectional size ($b \times t$)		Outer diameter, D	
		No. 1	No. 2	No. 1	No. 2
3	3.1	1.2 X 0.8		5.9	
4	4.1	1.5 X 1.2		7.6	
5	5.1	2.7 X 1.5		9.2	
6	6.1	2.8 X 1.6	2.7 X 1.9	12.2	12.2
8	8.2	3.2 X 2.0	3.3 X 2.5	15.4	15.6
10	10.2	3.7 X 2.5	3.9 X 3.0	18.4	18.8
12	12.2	4.2 X 2.0	4.4 X 3.6	21.5	21.9
16	16.2	5.2 X 4.0	5.3 X 4.8	28	28.2
20	18.2	6.1 X 5.1	6.4 X 6.0	33.8	34.4
24	24.5	7.1 X 5.9	7.6 X 7.2	40.3	41.3
30	30.5	8.7 X 7.5		49.9	
36	36.5	10.2 X 9		59.1	

Table 3 – Dimensions of Class 1 conical spring washers, mm

Nominal size	Inside diameter, d	Outside diameter, D	Light load (1L)		Heavy load (1H)	
			Thickness, t	Basic height, H	Thickness, t	Basic height, H
3	3.2	7	0.5	0.75	-	-
4	4.3	9	0.7	0.95	-	-
5	5.3	10	0.8	1.1	-	-
6	6.4	12.5	1.0	1.35	1.2	1.55
8	8.4	17	1.4	1.85	1.8	2.15
10	10.5	21	1.8	2.3	2.2	2.65
12	13	24	2.2	2.7	2.5	3.05
16	17	30	2.8	3.5	3.5	4.1
20	21	37	3.5	4.4	4.5	5.2
24	25	44	4.0	5.2	-	-
30	31	56	5.0	6.6	-	-

Table 4 – Dimensions of Class 2 conical spring washers, mm

Nominal size	Inside diameter, d	Outside diameter, D	Light load (2L)		Heavy load (2H)	
			Thickness, t	Basic height	Thickness, t	Basic height
4	4.3	7.5	0.45	0.7	0.8	0.95
5	5.3	9	0.55	0.85	1.0	1.2
6	6.4	10.5	0.6	0.95	1.2	1.4
8	8.4	13.5	0.9	1.3	1.4	1.75
10	10.5	16.5	1.1	1.6	1.8	2.2
12	13	19	1.2	1.75	2.0	2.5
16	17	25	1.6	2.3	2.5	3.3
20	21	31	2.0	2.8	3.5	4.25
24	25	37	2.5	3.5	4.5	5.3
30	31	46	3.0	4.3	-	-

Table 5 – Dimensions of internal and external toothed lock washers, mm

Nominal size	Inside diameter, d	Outside diameter, D	Thickness, t	Number of teeth	
				Internal	External
3	3.2	5.7	0.45	8	
4	4.3	7.5	0.45	8	8
5	5.3	9.5	0.6	8	9
6	6.4	10	0.6	9	10
8	8.4	13	0.88	9	12
10	10.5	15	0.9	9	12
12	12.5	18	1.0	10	12
16	16.5	23	1.2	12	14
20	21	29	1.4	12	14
24	25	35	1.6	14	16

Table 6 – Dimensions countersunk external toothed lock washers, mm

Nominal size	Inside diameter, d	Outside diameter, D	e (max.)	Thickness, t	Number of teeth
3	3.2	6	1.8	0.4	8
4	4.3	8	2.5	0.4	8
5	5.3	10	3.1	0.5	9
6	6.4	12	3.8	0.5	10
8	8.4	16	5.1	0.6	12

Table 7 – Dimensions of internal-external toothed lock washers, mm

Nominal size	Inside diameter, d	Outside diameter, D	Thickness, t	Number of teeth	
				Internal	External
4	4.3	15	0.6	8	12
5	5.3	15	0.6	8	12
6	6.4	17.5	0.8	9	12
8	8.4	22.5	0.9	9	12
10	10.5	26	1.0	9	14
12	12.5	29	1.0	10	14
14	14.5	32	1.2	10	14
16	16.5	35	1.4	12	16

Table 8 – Dimensions of small series product-grade A plain washers, mm

Nominal size	Inside diameter, d (min.)	Outside diameter, D (max.)	Thickness, t
3	3.2	6	0.5
4	4.3	8	0.5
5	5.3	9	1.0
6	6.4	11	1.6
8	8.4	15	1.6
10	10.5	18	1.6
12	13	20	2.0
14	15	24	2.5
16	17	28	2.5
20	21	34	3.0
24	25	39	4.0
30	31	50	4.0
36	37	60	5.0

Table 9 – Dimensions of normal series product-grade A plain washers, mm

Nominal size	Inside diameter, d (min.)	Outside diameter, D (max.)	Thickness, t
3	3.2	7	0.5
4	4.3	9	0.8
5	5.3	10	1.0
6	6.4	12	1.6
8	8.4	16	1.6
10	10.5	20	2.0
12	13	24	2.5
14	15	28	2.5
16	17	30	3.0
20	21	37	3.0
24	25	44	4.0
30	31	56	4.0
36	37	66	5.0

Table 10 – Dimensions of normal series chamfered-product grade A plain washers, mm

Nominal size	Inside diameter, d (min.)	Outside diameter, D (max.)	Thickness, t
5	5.3	10	1.0
6	6.4	12	1.6
8	8.4	16	1.6
10	10.5	20	2
12	13	24	2.5
14	15	28	2.5
16	17	30	3.0
20	21	37	3.0
24	25	44	4.0
30	31	56	4.0
36	37	66	5.0

Table 11 – Dimensions of normal series-product grade C plain washers, mm

Nominal size	Inside diameter, d (min.)	Outside diameter, D (max.)	Thickness, t
5	5.5	10	1.2
6	6.6	12	1.9
8	9	16	1.9
10	11	20	2.3
12	13.5	24	2.8
14	15.5	28	2.8
16	17.5	30	3.6
20	22	37	3.6
24	26	44	4.6
30	33	56	4.6
36	39	66	6

Table 12 – Dimensions of large series-product grades A and C plain washers, mm

Nominal size	Inside diameter, d (min.)		Outside diameter, D (max.)	Thickness, t
	Grade A	Grade C		
3	3.2	-	9	0.8
4	4.3	-	12	1.0
5	5.3	-	15	1.2
6	6.4	-	18	1.6
8	8.4	-	24	2.0
10	10.5	-	30	2.5
12	11.3	-	37	3.0
14	11.5	-	44	3.0
16	17	-	50	3.0
20	21	22	60	4.0
24	25	26	72	5.0
30	31	33	92	6.0
36	37	39	110	8.0

Table 13 – Dimensions of extra large series-product grade C plain washers

Nominal size	Inside diameter, d (min.)	Outside diameter, D (max.)	Thickness, t
5	5.5	18	2
6	6.6	22	2
8	9	28	3
10	11	34	3
12	13.5	44	4
14	15.5	50	4
16	17.5	56	5
20	22	72	6
24	26	85	6
30	33	105	6
36	39	125	8

7 Materials

Materials of washers shall be as given in Table 14.

Table 14 –Materials of washers

Washer type	Material	Specification	Nearest AISI Classification
Spring lock	Steel	SWRH 57 (A,B) to SWRH 77 (A, B)	–
	Stainless steel	SUS 304, 305, 316	304, 305, 306
Conical spring	Steel	S 50 CM to S 70 CM	1050-1070
Toothed lock	Steel	S 50 CM to S 70 CM	1050-1070
Plain	Mild Steel	–	1030 and below
	Austenitic stainless steel	SUS 304	304

8 Finishes and coatings

Coatings or special finishing for washers shall conform to Table 15. A protective coating shall be used only when the fastener is subjected to mildly corrosive conditions. For extremely corrosive conditions, a fastener made of metal that has inherent corrosion resistance should be specified.

Table 15 – Finishes and coatings

Coating or finish	Used on	Coating or finish	Used on
Black oxide, blued	Steel	Dull nickel	Most metals
Rust preventives	All metals	Bright nickel	Most metals
Electrogalvanized zinc	All metals	Black chromate	Zinc-plated or cadmium-plated steel
Hot-dip zinc	All metals		
Chromium plate	Most metals	Passivating	Stainless steel

9 Appearance

Washer surfaces shall be smooth, free from flaws and cracks, rough surface, rust, and free from sharp edges on outside periphery.

10 Designation

Washers shall be designated by the following data in the sequence shown: washer classification, type or its symbol, nominal size, material or its symbol (Symbols for materials shall be S for steel, SUS for stainless steel), and protective coating, if required.

EXAMPLE Conical spring, 1L, 8, S

11 Markings

The following information shall be marked on the packaging:

- a) Manufacturer's name, trademark and address
- b) Designation
- c) Manufacturing number