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SRI LANKA STANDARD 239 : 1973

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SPECIFICATION FOR STEEL SPRING WASHERS FOR GENERAL ENGINEERING PURPOSES

(METRIC UNITS)

ලංකා ප්‍රමිති කාර්යාංශය

BUREAU OF CEYLON STANDARDS

SPECIFICATION FOR STEEL SPRING WASHERS FOR GENERAL ENGINEERING PURPOSES (METRIC UNITS)

S.L.S. 239 : 1973

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BUREAU OF CEYLON STANDARDS
53, DHARMAPALA MAWATHA,
COLOMBO - 3.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This Standard does not purport to include all the necessary provisions of a contract.

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SRI LANKA STANDARD SPECIFICATION FOR STEEL SPRING WASHERS FOR GENERAL ENGINEERING PURPOSES (METRIC UNITS)

FOREWORD

This Sri Lanka Standard Specification for steel spring washers for general engineering purposes has been prepared by the Drafting Committee on Washers for general engineering purposes. It was approved by the Mechanical Engineering Divisional Committee of the Bureau of Ceylon Standards and was authorised for adoption and publication by the Council of the Bureau on 5th December 1973.

In the light of the country's proposal to adopt the Metric System the Committee decided the specification include only metric size spring washers.

This standard provides for single coil, rectangular and square section metric series spring washers of helical construction suitable for use with metric threaded fasteners within the range 2 mm (M 2) to 52 mm (M 52) diameter intended for general engineering purposes.

The use of material other than those specified in this standard is to be the subject of agreement between the manufacturer and the purchaser.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value observed or calculated, expressing the results of a test, shall be rounded off in accordance with C.S. 102 : Presentation of Numerical Values. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

The assistance derived from the publications of the British Standards Institution and the Deutcher Normenausschuss in the preparation of this standard is acknowledged.

1. SCOPE

1.1 This standard specifies the dimensions, tolerances and general requirements for metric series spring washers of helical construction, suitable for use with metric threaded fasteners within the range 2 mm (M2) to 52 mm (M 52) diameter. Dimensions and tolerances are specified for the following types.

Type A — Single Coil square section — Table 1

Type B — Single Coil rectangular section (with normal ends) } Table 2

Type C — Single Coil rectangular section (with deflected ends) }

Note: Washers supplied in accordance with this specification are for use in right hand threads, unless otherwise specified by the purchaser (see clause 10).

2. MATERIAL

2.1 Unless otherwise specified, spring washers complying with the provisions of this standard shall be manufactured from spring steel.

2.2 Chemical Composition—Suitable steels for the manufacture of spring washers shall be selected from the following Table.

	Chemical Composition Per cent				
	C	Si	Mn	P	S
Type 1	0.39 to 0.46	0.15 to 0.35	0.30 to 0.60	0.040 Max	0.040 Max
Type 2	0.39 to 0.46	0.15 to 0.35	0.60 to 0.90	0.040 Max	0.040 Max
Type 3	0.35 to 0.42	1.4 to 1.6	0.50 to 0.80	0.050 Max	0.050 Max
Type 4	0.60 to 0.90	0.35 Max	0.30 to 0.90	0.050 Max	0.050 Max

2.3 Mechanical Properties

2.3.1 The spring washers shall be made from suitable spring steel having a minimum tensile strength of 690 MPa (70 kgf/mm^2) after normalizing and at least 15 per cent elongation on a gauge length of $5.65\sqrt{\text{area}}$ when tested in accordance with either C.S. 76* or C.S. 12† whichever is applicable.

2.4 Heat Treatment

2.4.1 Spring washers after coiling shall be suitably heat treated so as to result in the finished washer having a hardness in the range 400 to 500 HV with 5 kgf load. This corresponds to Rockwell Hardness of HRC 40 to 48.

3. FINISH

3.1 Unless otherwise specified spring washers complying with the standard shall be of a natural 'selfcolour' finish, smooth and free from scale and burrs.

3.2 If washers are required to have a protective or decorative finish, this shall be specified by the purchaser in his enquiry or order, till such time a Ceylon standard on coating is made available.

3.3 The springness of washers shall not be impaired by any protective coating and where necessary any hydrogen embrittlement shall be removed.

4. SHAPE

4.1 The spring washers shall be evenly wound with uniform pitch and during use the washers shall remain circular and their section shall be such as not to cause them to spread when set down by a nut, under normal service conditions.

Note: The dimensions given in Tables 1 and 2 are based on the use of standard square and rectangular wire sections. After coiling these produce washers of trapezoidal section with the inner periphery thicker than the outer, but with the limiting dimensions in accordance with the dimensions given in the appropriate Tables.

*C.S. 76 — Method for tensile testing of steel wire.

†C.S. 12 — Method of tensile testing of steel products other than sheet strip, wire and tube.

5. ENDS

5.1 The ends of washers shall not abut when the washer is in the closed condition.

6. TANGLING

6.1 Single coil washers shall be so severed to prevent tangling or linking together when in the free condition.

7. DIMENSIONS

7.1 The dimensions of spring washers complying with the standard shall be in accordance with Tables 1 and 2 in the uncoated condition.

8. FUNCTIONAL TESTS

8.1 Spring washers complying with this standard shall show no cracks, imperfections or fractures after being subjected to the functional tests in clauses 8.2, 8.3 and 8.4.

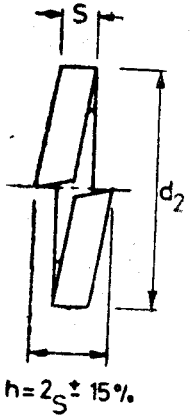
8.2 Load Test—The spring washers for testing should be loaded with the following weights for three minutes:

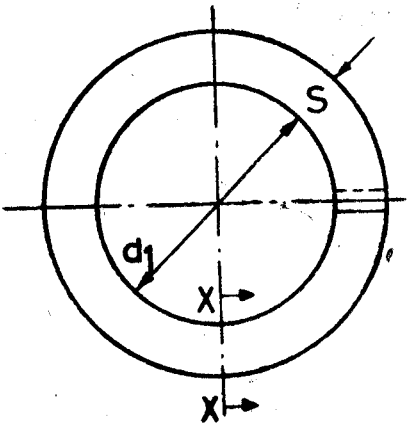
Nominal dimension mm	Load kg
upto 3	10
From 3.5 to 4	20
From 5 to 6	50
From 7 to 12	100
From 14 to 22	200
From 24 to 27	300
Over 27	500

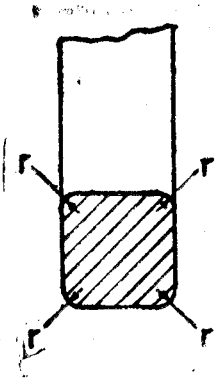
After the load has been removed the spring height $h_1 = 2S + 2k^*$, $h_2 = 2S^*$, shall be measured and shall agree with the calculated value within $\pm$ 15 per cent.

* S without taking the tolerance into account.

TABLE 1—SINGLE COIL SQUARE SECTION SPRING WASHERS METRIC SERIES (TYPE A)







Section xx
(See Note to clause 5)

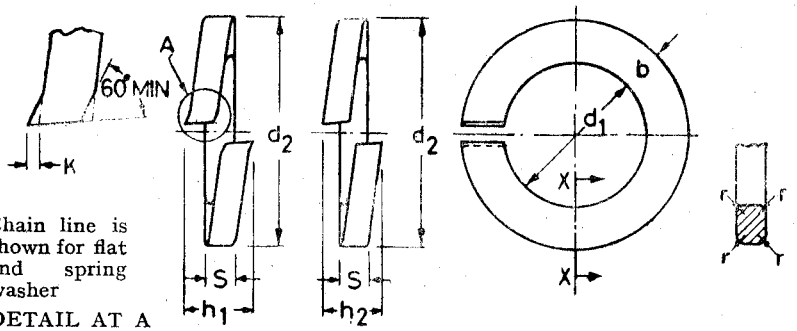
All dimensions in millimetres

1	2	3	4	5	6
Nominal size and thread diameter d	Inside diameter d_1		Thickness and width s	tside meter d_2 max	Radius r max.
	max.	min.			
M 3	3.3	3.1	1 ± 0.1	5.5	0.3
M 3.5	3.8	3.6	1 ± 0.1	6.0	0.3
M 4	4.4	4.1	1.2 ± 0.1	6.95	0.4
M 5	5.4	5.1	1.5 ± 0.1	8.6	0.5
M 6	6.4	6.1	1.5 ± 0.1	9.6	0.5
M 8	8.6	8.2	2 ± 0.1	12.8	0.7
M 10	10.6	10.2	2.5 ± 0.2	15.9	0.8
M 12	12.6	12.2	2.5 ± 0.2	17.9	0.8
M 14	14.7	14.2	3 ± 0.2	21.1	1.0
M 16	16.9	16.3	3.5 ± 0.2	24.3	1.2
M 18	19.0	18.3	3.5 ± 0.2	26.4	1.2
M 20	21.1	20.3	4.5 ± 0.2	30.5	1.5
M 22	23.3	22.4	4.5 ± 0.2	32.7	1.5
M 24	25.3	24.4	5 ± 0.2	35.7	1.7
M 27	28.5	27.5	5 ± 0.2	38.9	1.7
M 30	31.5	30.5	6 ± 0.2	43.9	2.0
M 33	34.6	33.5	6 ± 0.2	47.0	2.0
M 36	37.6	36.5	7 ± 0.3	52.1	2.3
M 39	40.8	39.6	7 ± 0.3	55.3	2.3
M 42	43.8	42.6	8 ± 0.3	60.3	2.7
M 45	46.8	45.6	8 ± 0.3	63.3	2.7
M 48	50.0	48.8	8 ± 0.3	66.5	2.7

TABLE 2—SINGLE COIL RECTANGULAR SECTION SPRING WASHERS —METRIC SERIES (TYPES B & C.)

Spring washer with deflected ends

Spring washer (Flat ends)



Chain line is shown for flat end spring washer

DETAIL AT A

Type C Type B

Section xx
(See Note to clause 5)

All dimensions in milimetres

1	2	3	4	5	6	7	8
Nominal size and thread diameter d	Inside diameter d_1		Width b	Thickness s	Outside diameter d_2 max.	Radius r max.	k For deflected ends only
	max.	min.					
M 2	2.3	2.1	0.9 ± 0.1	0.5 ± 0.1	4.3	0.2	—
M 2.2	2.5	2.3	1.0 ± 0.1	0.6 ± 0.1	4.7	0.2	—
M 2.5	2.8	2.6	1.0 ± 0.1	0.6 ± 0.1	5.0	0.2	—
M 3	3.3	3.1	1.3 ± 0.1	0.8 ± 0.1	6.1	0.3	—
M 3.5	3.8	3.6	1.3 ± 0.1	0.8 ± 0.1	6.6	0.3	0.2
M 4	4.4	4.1	1.5 ± 0.1	0.9 ± 0.1	7.6	0.3	0.2
M 5	5.4	5.1	1.8 ± 0.1	1.2 ± 0.1	9.2	0.4	0.2
M 6	6.4	6.1	2.5 ± 0.2	1.6 ± 0.1	11.7	0.5	0.2
M 8	8.6	8.2	3 ± 0.2	2 ± 0.1	14.9	0.7	0.3
M 10	10.6	10.2	3.5 ± 0.2	2.2 ± 0.2	18.0	0.7	0.3
M 12	12.6	12.2	4 ± 0.2	2.5 ± 0.2	21.0	0.8	0.4
M 14	14.7	14.2	4.5 ± 0.2	3 ± 0.2	24.1	1.0	0.4
M 16	16.9	16.3	5 ± 0.2	3.5 ± 0.2	27.3	1.2	0.4
M 18	19.0	18.3	5 ± 0.2	3.5 ± 0.2	29.4	1.2	0.4
M 20	21.1	20.3	6 ± 0.2	4 ± 0.2	33.5	1.3	0.4
M 22	23.3	22.4	6 ± 0.2	4 ± 0.2	35.7	1.3	0.4
M 24	25.3	24.4	7 ± 0.3	5 ± 0.2	39.8	1.7	0.5
M 27	28.5	27.5	7 ± 0.3	5 ± 0.2	43.0	1.7	0.5
M 30	31.5	30.5	8 ± 0.3	6 ± 0.3	48.0	2.0	0.8
M 33	34.6	33.5	10 ± 0.3	6 ± 0.3	55.1	2.0	0.8
M 36	37.6	36.5	10 ± 0.3	6 ± 0.3	58.1	2.0	0.8
M 39	40.8	39.6	10 ± 0.3	6 ± 0.3	61.3	2.0	0.8
M 42	43.8	42.6	12 ± 0.3	7 ± 0.3	68.3	2.3	0.8
M 45	46.8	45.6	12 ± 0.3	7 ± 0.3	71.3	2.3	0.8
M 48	50.0	48.8	12 ± 0.3	7 ± 0.3	74.5	2.3	0.8
M 52	54.1	52.8	14 ± 0.3	8 ± 0.3	82.6	2.7	1.0

Next the spring washer is subjected to ten further applications of the same load (short duration loading). After the test also the spring height h_1 or h_2 shall not differ from the calculated value by more than $\pm$ 15 per cent.

8.3 Permanent Load Test– Ten spring washers interspaced by flat washers, shall be fully compressed on a bolt for 192 hours. They shall not break nor shall their unloaded height be less than 85 per cent of h_1 or h_2.

where

$$h_1 = 2s + 2k$$
$$h_2 = 2S$$

8.4 Twisting Test– The spring washers shall not break when twisted through 90° (Fig. 1). It shall be slowly and evenly bent (not jerkily) taking precautions to prevent injuries through flying splinters. The Vice jaws should be about $0.5\,d_2$ (d_2 = spring washer diameter) apart Fig. 2.

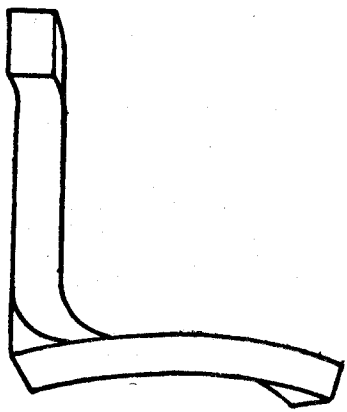


Fig. 1

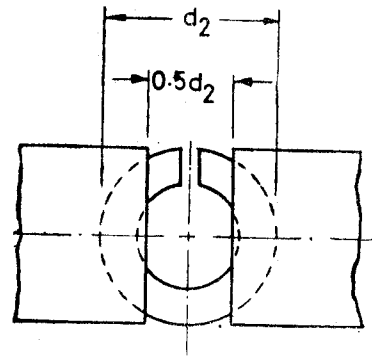


Fig. 2

9. DESIGNATION

9.1 Spring washers shall be designated by the name, size, number of this standard and material.

9.2 Examples

(1) Single coil rectangular section steel spring washers (normal ends to suit 10 mm (M 10) daimeter bolts or screws could be designated;

'Steel spring washers M 10 – B C.S. . . . .'

(2) Single coil squre section steel spring washers to suit 3 mm (M 3) diameter bolts or screws could be designated;

'Steel spring washers M3 – A C.S. . . . .'

10. MARKING

10.1 The package of washers shall be attached with label or other suitable means for clear indication of the following particulars.

(1) Designation
(2) Type
(3) Nominal size
(4) Material
(5) Quantity
(6) Name of manufacturer or registered trade mark.

10.1.1 In case washer is intended for use with left hand thread, the designation shall be modified as follows:

'Steel spring washers LH M 10 – B C.S. . . . .'
'Steel spring washers LH M3 – A C.S. . . . .'

11. SAMPLING

11.1 Lot– All steel spring washers of the same size, type and manufactured under similar processes of production shall constitute a lot.

11.2 The number of spring washers to be selected from a lot shall depend upon the size of the lot and shall be in accordance with Table 3. All these spring washers shall be taken at random from the lot.

11.3 If the spring washers in the lot are packed in different bags/cases a suitable number of bags/cases (not less than 20 per cent of the total in the lot subject to a minimum of 2) shall be chosen at random. From each of the bags/cases so chosen, an approximately equal number of spring washers shall be picked up from its different parts so as to obtain the required number of spring washers specified in Table 3.

TABLE 3—SCALE OF SAMPLING AND CRITERIA FOR CONFORMITY

Lot Size	Visual Characteristics					Dimensional Characteristics							Hardness and Functional Characteristics*				
	Sample	Sample size	Cumulative Sample size	AC	Re	Sample	Sample size	Cumulative sample size	For Inside diameter		For Other dimensions		Sample	Sample size	Cumulative sample size	AC	Re
									AC	Re	AC	Re					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	15)	(16)	(17)	(18)
Up to 100	first	20	20	2	5	first	8	8	0	2	0	3	first	3	3	0	2
	second	20	40	6	7	second	8	16	1	2	3	4	second	3	6	1	2
101 to 300	first	32	32	3	7	first	13	13	0	3	1	4	first	5	5	0	2
	second	32	64	8	9	second	13	26	3	4	4	5	second	5	10	1	2
301 to 500	first	50	50	5	9	first	20	20	1	4	2	5	first	5	5	0	2
	second	50	100	12	13	second	20	40	4	5	6	7	second	5	10	1	2
501 to 1,000	first	80	80	7	11	first	32	32	2	5	3	7	first	8	8	0	2
	second	80	160	18	19	second	32	64	6	7	8	9	second	8	16	1	2
1,001 to 3,000	first	125	125	11	16	first	50	50	3	7	5	9	first	8	8	0	2
	second	125	250	26	27	second	50	100	8	9	12	13	second	8	16	1	2
3,001 to 10,000	first	200	200	11	16	first	80	80	5	9	7	11	first	13	13	0	3
	second	200	400	26	27	second	80	160	12	13	18	19	second	13	26	3	4
10,001 to 35,000	first	315	315	11	16	first	125	125	7	11	11	16	first	13	13	0	3
	second	315	630	26	27	second	125	250	18	19	26	27	second	13	26	3	4
over 35,000	first	500	500	11	16	first	200	200	11	16	11	16	first	20	20	1	4
	second	500	1,000	26	27	second	200	400	26	27	26	27	second	20	40	4	5

AC - Acceptance Number **Re** - Rejection Number

*Clauses 2.4 and 8.

11.4 Visual Characteristics—All the Spring Washers drawn under clause 11.2 shall be first examined for visual characteristics according to clauses 3, 4, 5 and 6. If in the first sample, the number of defective spring washers is less than or equal to the corresponding acceptance number given in column 5 of Table 3, the lot shall be declared as conforming to the requirements for the visual characteristics. If the number of defectives is greater than or equal to the corresponding rejection number given in column 6 of Table 3, the lot shall be deemed as not meeting the requirements for the visual characteristics. If the number of defectives is greater than the acceptance number but less than the rejection number, a second sample of the same number of washers selected as the first sample, shall be taken to determine the comformity or otherwise of the lot. The number of defectives found in the first and second samples shall be combined and if the combined number of defectives is less than or equal to the corresponding acceptance number, the lot shall be declared as conforming to the requirements; otherwise not.

11.5 Dimensional Characteristics—The lot which has been found satisfactory in respect of visual characteristics (see clause 11.4) shall next be tested for dimensional characteristics according to clause 7. The spring washers for this purpose shall be taken at random from these already drawn (see clause 11.2 and Column 1 of Table 3) in accordance with columns 7 and 8 of Table 3, and tested for dimensional characteristics. If the number of spring washers failing to satisfy the requirements for these characteristics is less than or equal to the corresponding acceptance number given in column 10 or 12 of Table 3, the lot shall be declared to have met the requirements of the specification in respect of these characteristics. If the number of defectives is greater than or equal to the rejection number, given in column 11 or 13 of Table 3, the lot shall be deemed as not conforming to these characteristics. In case the number of defectives lies in between the acceptance and rejection numbers, a second sample of the same size shall be taken and inspected for the dimensional characteristics and inference drawn accordingly.

11.6 Hardness and Functional Characteristics—The lot which has been found satisfactory in respect of visual and dimensional characteristics (see clauses 11.4 and 11.5) shall next be tested for hardness and functional characteristics according to clauses 2.4 and 8 respectively. The washers for this purpose shall be taken at random from these already drawn (see clause 11.2 and

column 1 of Table 3) in accordance with columns 14 and 15 of Table 3, and tested for hardness and functional characteristics. If the number of washers failing to satisfy the requirements for these characteristics is less than or equal to the corresponding acceptance number given in column 17 of Table 3, the lot shall be declared to have met the requirements of the specification in respect of these characteristics. If the number of defectives is greater than or equal to the rejection number, given in column 18 of Table 3, the lot shall be deemed as not conforming to these characteristics. In case the number of defectives lies in between the acceptance and rejection numbers, a second sample of the same size shall be taken and inspected for hardness and functional characteristics and inference drawn accordingly.

12. EXAMINATION AND TESTS

12.1 The samples drawn in accordance with the sampling procedure shall be tested in the following order:

(*a*) Visually examined for manufacturing defects

(*b*) Examined for dimensional characteristics

(*c*) Hardness and functional tests.

13. CONFORMITY TO STANDARD

13.1 A lot shall be declared as conforming to this specification if it has been declared satisfactory in clauses 11.4, 11.5 and 11.6.

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