



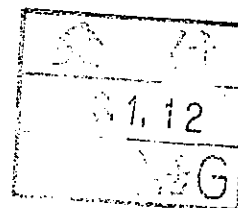
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JASO

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Japanese Automobile Standard

Bolts or screws and washer assemblies



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SI : THIRD PHASED STANDARD

(The standard where SI units and newly values are given and do not using
customary units, but it is excepted that the standards are represented in only
accustomed metric units as m, A, Hz etc.)

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Bolts or screws and washer assemblies

1. Scope

This standard specifies the bolts or cross-recessed head screws and washer assemblies (hereinafter referred to as "bolts and machine screws") for automobiles.

Remarks: 1. These bolts or machine screws are thread rolled after assembling washers into the blanks of screw bodies.
2. The applicable standards are given in Attached table 19.

2. Classes

The classes of the bolts or machine screws shall be the combinations of the screw bodies and various washers as shown in Table 1.

3. Mechanical properties

3.1 Mechanical properties of screw bodies

The mechanical properties of the screw bodies shall be as listed in Table 2.

Table 1

Screw body				Washer										Attached table
Shape of head		Property class		Plain washer		Spring lock washer			Conical spring washer		Plain washer (Finished circular) + Spring lock washer			
		Column I	Column II	Finished circular	Small circular	No. 2	No. 3	Wave	Light load	Heavy load	Spring lock washer			
											No. 2	No. 3	Wave	
Bolt	Upset type	4.8	4T	Class 1	Class 2	Class 3	—	Class 5	Class 6	—	Class 13	—	Class 15	1
		6.8	6T	Class 1	Class 2	—	Class 4	Class 5	Class 6	—	—	Class 14	Class 15	
		8.8	7T	Class 1	Class 2	—	Class 4	Class 5	—	Class 7	—	Class 14	Class 15	
	Trimmed type	4.8	4T	Class 1	Class 2	Class 3	—	Class 5	Class 6	—	Class 13	—	Class 15	
		6.8	6T	Class 1	Class 2	—	Class 4	Class 5	Class 6	—	—	Class 14	Class 15	
		8.8	7T	Class 1	Class 2	—	Class 4	Class 5	—	Class 7	—	Class 14	Class 15	

Table 1 (Continued)

Screw body				Washer											Attached table
Shape of head		Property class		Plain washer		Spring lock washer			Conical spring washer	Toothed lock washer		Plain washer (Finished circular) + Spring lock washer			
		Column I	Column II	Finished circular	Small circular	No. 2	No. 3	Wave	Light load	Counter sunk external tooth type	External tooth type	Spring lock washer			
No. 2	No. 3											Wave			
Machine screw	Cross-recessed head, upset type	4.8	4T	Class 1	Class 2	Class 3	—	Class 5	Class 6	—	—	Class 13	—	Class 15	2
	Cross-recessed head, trimmed type			Class 1	Class 2	Class 3	—	Class 5	Class 6	—	—	Class 13	—	Class 15	
	Pan head	4.8	4T	Class 1	Class 2	Class 3	—	Class 5	Class 6	—	Class 9	Class 13	—	Class 15	3
	Flat head			—	—	—	—	—	—	Class 8	—	—	—	—	4
	Oval counter-sunk head			—	—	—	—	—	—	Class 8	—	—	—	—	5
	Truss head			Class 1	—	Class 3	—	Class 5	Class 6	—	Class 9	Class 13	—	Class 15	6
	Binding head			Class 1	—	Class 3	—	Class 5	Class 6	—	Class 9	Class 13	—	Class 15	7

Remark: The shapes and dimensions of the washers shall be as listed in Attached tables 9, 10, 11, 12, 13, 14, 15, and 16.

Table 2 Mechanical properties

Property class		Column I	4.8	6.8	8.8	—	—	—	
Mechanical properties		Column II	—	—	—	4T	6T	7T	
Tensile strength of product N/mm ²		Nominal	400	600	800	—			
		Min.	420	600	800	392	588	686	
Wedge tensile strength			Minimum tensile strength equivalent						
Hardness	Vickers hardness HV	Min.	130	190	250	122	180	213	
		Max.	250	250	320	241	286	294	
	Rockwell hardness	HRB	Min.	71	89	—	68	87	—
		Max.	99.5		—	98	104	—	
	HRC	Min.	—		20	—		14	
		Max.	—		30	—		29	
Surface hardness HV		Max.	—		(⁶)	—			
Proof load stress H/mm ² (²)			310	440	580	—			
Head soundness			Crack shall not be produced at the under head fillet (⁴) —						
Decarburization of threaded portion (⁵)	Height of not decarburized part E	Min.	—		½H ₁	—			
	Depth of ferrite decarburized layer G mm	Max.	—		0.015	—			

Notes: (¹) Minimum value after heat treatment.

Notes: (1) Minimum value of tensile strength shall be applied to production bolts.

Further, the break of bolts shall be produced at the threaded portion or shank, but not be produced at the under head fillet.

(2) There shall be no permanent set against proof load stress.

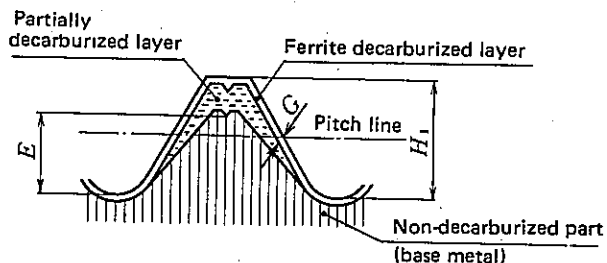
(3) Bolts shall endure load equal to the minimum value of tensile strength and the break may be produced at the threaded portion or shank, but shall not be produced at the under head fillet, provided that a complete screw thread shall be allowed in which cracks causing break occur at free threaded portion and expand into under head fillet or head.

(4) In case of continuous thread bolts, it is allowable that cracks are produced at the first thread of head side, but head is not wrested away.

(5) Refer to Fig. 1.

(6) There shall be no difference of 30HV or more in Vickers hardness (at test load of 0.3 kgf [2.94N]) between surface hardness and internal hardness.

Fig. 1 Decarburization of threaded portion



H₁: Height of external thread in maximum material condition

Reference: Combination of bolt and nut: Bolts and nuts shall be used by combinations listed in Table 3 by strength division, provided that bolts can be used in combination with the nuts classified into higher strength division.

Values of H₁ and E (minimum)

Pitch of threads P	0.8	1	1.25
H ₁	0.491	0.613	0.767
E (min.)	0.245	0.307	0.384

Unit: mm

Table 3

Combination	Bolt strength division						
	4.8	6.8	8.8	4T	6T	7T	
Combination	Nut strength division						
	5N	6N	8N	5N	6N	8N	

3.2 Mechanical properties of washers

The mechanical properties of washers shall meet the requirements (1) ~ (3) specified below.

(1) The hardness of washers shall be as listed in Table 4.

Table 4

Type	Hardness
Spring lock washer	No. 2, No. 3 HRC 42 ~ 50 or HV 412 ~ 513
	Wave HRC 40 ~ 48
Conical spring washer	HRC 40 ~ 48
Toothed lock washer	HRC 40 ~ 50
Plain washer	Not specified (7)

Note: (7) The hardness of plain washers shall be specified by purchases, if necessary.

Remark: Washers shall not have any remarkable decarburization.

(2) The spring action of washers shall be as given in the following.

(a) Spring lock washers (No. 2 and No. 3) shall have free height of $1\frac{2}{3}$ times or more thickness when test is conducted as specified in 10.2.

- (b) Wave spring lock washer shall have free height of 1.2 times or more thickness when test is conducted as specified in 10.2.
 - (c) Toothed lock washer shall have free height of $\frac{5}{6}$ times or more free height prior to compression when test is conducted as specified in 10.2.
 - (d) Conical spring washer shall have free height listed in Attached tables 13 and 14 when test is conducted as specified in 10.2.
- (3) The toughness of the washers shall be as specified in the following.
- (a) The toughness of the spring lock washers (No. 2 and No. 3), when subjected to the test in accordance with the specifications of 10.2, shall be such that these are not broken at less than 90 degrees in torsional angle.
 - (b) The toughness of the wave spring lock washers, when subjected to the test in accordance with the specifications of 10.2, shall be such that these are not broken at less than 90 degrees in torsional angle.
 - (c) The toughness of the toothed lock washers, when subjected to the test in accordance with the specifications of 10.2, shall be such that these are not broken.
 - (d) The toughness of the conical spring washers, when subjected to the test in accordance with the specifications of 10.2, shall be such that these are not broken.

4. Shape, dimensions, and geometrical tolerance

- (1) The shapes, dimensions, and geometrical tolerances of the screws other than cross-recessed head and bolts shall be as listed in Attached tables 1 ~ 7.
- (2) The shapes and dimensions of the cross-recess formed on the head of the machine screws shall be in accordance with the H-shaped cross-recess specified in JIS B 1012, provided that the wing length m of the cross-recess and the penetration depth q of depth gauge shall be as listed in Attached tables 2 ~ 7.
- (3) The shapes, dimensions, and geometrical tolerances of the washers shall be as listed on Attached tables 9 ~ 16.

5. Screw thread

The types and grades of the screw threads shall be given in Table 5, provided that the maximum allowable dimensions of the plated screw threads shall be the ones of 4h or grade 1 external threads.

Table 5

Nominal diameter of thread	Type	Grade
8 mm or less	JIS B 0205	6g in JIS B 0209 or Grade 2
10 mm or more	JIS B 0207	6g in JIS B 0211 or Grade 2

6. Appearance

The appearance of the bolts and machine screws shall comply with the following (1) ~ (4), in addition to compliance with the requirements specified in Section 9 for surface roughness.

- (1) The washers shall freely rotate and not easily fall off from the threaded portion.
 - (2) Defects on the surface of screw bodies shall satisfy the requirements specified in 7. (1) (Permissible limit of surface defects) of JASO F 101, provided that the machine screws shall apply to the requirements specified in 9. (1) (Permissible limit of surface defects) of JASO F 116.
 - (3) The surface of screw bodies shall be free from defects harmful to use, such as flushes, burrs, rough surface, and rust.
 - (4) The surface of the washers shall be smooth, crackless, and free from defects such as remarkable flaws, burrs, rough surface, and rust.
- Further, the cut ends of the spring lock washers shall be free from remarkable burrs, and any washer shall not cause lapping when it has been compressed completely.

7. Materials

7.1 Materials of screw bodies

The screw bodies shall be made of carbon steel, and their mechanical properties shall satisfy the requirements specified in Section 3.1.

7.2 Materials of washers

The materials of the washers shall, as a rule, be as listed in Table 6.

Table 6

Type	Material	
	Symbol	Applicable standard
Plain washer	SPHC	JIS G 3131
	SPCC	JIS G 3141
Spring lock washer	SWRH-57(A.B) ~ 77 (A.B)	JIS G 3506
Toothed lock washer	S50CM ~ S70CM	JIS G 3311
Conical spring washer	S50CM ~ S70CM	JIS G 3311

Table 7 Test methods for mechanical properties of screw bodies

Test item	Test method	
	Method of column I of property class	Method of column II of property class
Tensile strength of product	Test shall be in accordance with 4.2.2 in the text of JIS B 1051.	—
Wedge tensile strength	Test shall be in accordance with 4.2.3 in the text of JIS B 1051.	—
Hardness	Test shall be in accordance with 4.2.5 (1) in the text of JIS B 1051.	—
Surface hardness	Test shall be in accordance with 4.2.5 (2) in the text of JIS B 1051.	—
Proof load stress	Test shall be in accordance with 4.2.4 in the text of JIS B 1051.	—
Head soundness	Test shall be in accordance with 4.2.6 in the text of JIS B 1051.	—
Decarburized layer of threaded portion	Test shall be in accordance with 4.2.8 in the text of JIS B 1051.	—

Remarks: 1. In the hardness test, the hardness in the center part of screw body end shall be measured, provided that measurement may be made at the surface where the screw body has been cut by length approximately equal to outside diameter of the screw from the screw end or at the head side depending on agreement between the trading parties.
 2. In the head soundness test, the washers shall not be subjected to judgement.

8. Surface treatment

The bolts and machine screws shall, as a rule, be treated with surface treatment of MFZn5-C specified in JIS D 0201, provided that in the case where no surface treatment is applied or other surface processes are required, it shall be so designated by the purchaser. However, the bolts and machine screws which have been processed by the electrolysis plating shall, as necessary, be treated by removal of hydrogen embrittlement.

9. Surface roughness

The surface roughness of the bearing surfaces of the bolts and machine screws shall meet the requirements specified in 3.2 a of JIS B 0601, and the top face of the head and the shank shall meet the requirements specified in 6.3 a. However, the threaded portion shall be finished smooth.

10. Test methods for mechanical properties

10.1 Test methods for mechanical properties of screw bodies

The test methods for the mechanical properties of the screw bodies shall be as listed in Table 7, provided that the bolts and machine screws shall be tested with the washers being assembled.

10.2 Test methods for mechanical properties of washers

The test methods for the mechanical properties of the washers shall be as listed in Table 8, provided that testing shall be conducted after the washer has been dismounted from the shank.

Table 8 Test methods for mechanical properties of washers

Type of washer		Mechanical properties to be investigated	Test item	Test method
Spring lock washer	No. 2, No. 3	Hardness	Hardness test	Test shall be in accordance with 10.1 of JIS B 1251.
		Spring action	Compression test	Test shall be in accordance with 10.2 of JIS B 1251.
		Toughness	Torsion test	Test shall be in accordance with 10.3 of JIS B 1251.
	Wave	Hardness	Hardness test	Test shall be in accordance with 9.1 of JASO F 302.
		Spring action	Compression test	Test shall be in accordance with 9.2 of JASO F 302.
		Toughness	Torsion test	Test shall be in accordance with 9.4 of JASO F 302.
Conical spring washer	Light load, Heavy load	Hardness	Hardness test	Test shall be in accordance with 10.1 of JIS B 1252.
		Spring action	Compression test	Test shall be in accordance with 10.2 of JIS B 1252.
		Toughness	Clamping test	Test shall be in accordance with 10.3 of JIS B 1252.
Toothed lock washer	Countersunk head, type External tooth type	Hardness	Hardness test	Test shall be in accordance with 10.1 of JIS B 1255.
		Spring action	Compression test	Test shall be in accordance with 10.1 of JIS B 1255.
		Toughness	Torsion test	Test shall be in accordance with 10.3 of JIS B 1255.

Remarks: 1. In hardness test, hardness may be measured after lightly grinding the washer surface.

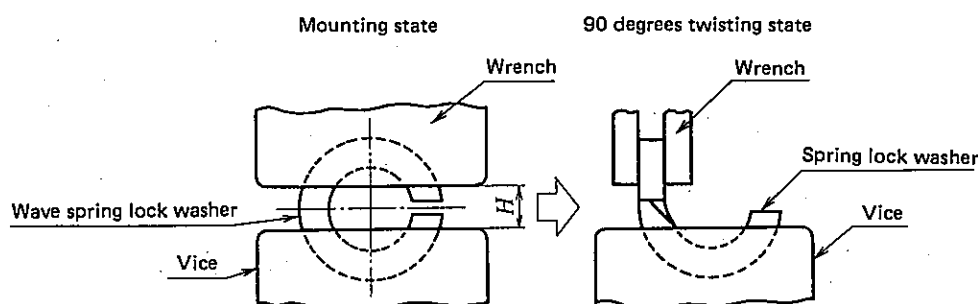
2. In the torsion test for the wave spring lock washer, the distance between the vice and wrench shall be as given below. (Refer to Fig. 2.)

Distance between vice and wrench

Unit: mm

Nominal size of screw thread	M3	M4	M5	M6	M8	M10	M12
H	3	3.5	4.5	6	7	8.5	10.5

Fig. 2 Mounting state



11. Inspection

The inspection of bolts and washers shall be in accordance with the following, provided that sampling type in lot inspection shall depend on agreement between the trading parties.

11.1 Inspection of mechanical properties

11.1.1 Inspection of mechanical properties of screw bodies

The inspection of the mechanical properties of bolts shall be conducted according to Section 10.1 based on the inspection programme of Table 9, and the measurements shall meet the requirements specified in Section 3.1.

Table 9 Inspection programme

Inspection item		Property class					
		Column I			Column II		
		4.8	6.8	8.8	4T	6T	7T
Tensile strength of product ⁽⁸⁾		○	○	○	—	—	—
Wedge tensile strength		●	●	●	●	●	●
Hardness ⁽⁹⁾	Min.	○	○	○	●	●	●
	Max.	○	○	○	●	●	●
Surface hardness		—	—	○	—	—	—
Proof load stress		●	●	●	—	—	—
Head soundness ⁽¹⁰⁾		○	○	○	—	—	—
Decarburized layer of threaded portion ⁽¹¹⁾		—	—	●	—	—	—

Note ⁽⁸⁾: This inspection may be omitted for the bolts subjected to wedge tensile strength test.

⁽⁹⁾: Hardness of the core part shall be tested in either of Vickers or Rockwell hardness, provided that defective or nondefective is determined with reference to measurement of Vickers hardness when a doubt arises about measurement data.

To simplify the test procedure, the tensile strength test of those marked with ● shall be replaceable by inspecting the minimum hardness of the core part, provided that the final determination of defective or nondefective shall be made by the wedge tensile strength inspection.

⁽¹⁰⁾: This inspection shall be applied to the bolts and machine screws to which the wedge tensile strength test cannot be conducted due to lack of nominal length.

⁽¹¹⁾: The inspection of the decarburized layer using hardness shall be applied only to the bolts of 8.8 in strength division having the pitch of 1.25 mm and more.

Remarks: 1. Inspection items to determine defective or nondefective about mechanical properties shall correspond to those marked with ●.

2. The inspection items marked with ○ shall be conducted as required, and shall not correspond to those to determine defective or nondefective about mechanical properties unless otherwise specifically designated.

3. In case the tensile strength test can not be performed due to dimensions such as lack of nominal length, the hardness test shall be conducted to determine defective or nondefective in place of tensile strength test.

11.1.2 Inspection of mechanical properties of washers

The inspection of the mechanical properties of washers shall be performed in accordance with Section 10.2, and the results shall conform to the requirements specified in Section 3.2.

11.2 Inspection of shape, dimensions and geometrical tolerance

- (1) The inspection of the shape and dimensions for the screws other than the cross-recessed head screws conducted in accordance with the measuring method for dimensions of each part and geometric deviation specified in JIS B 1071 or by alternative methods, and the results shall conform to the requirements specified in Sections 4. (1) and (3).
- (2) In the inspection of the shape and dimensions for the cross-recessed head screws, the penetration depth (q) of depth gauge shall be measured in accordance with Section 3.2.2 (Penetration depth q of depth gauge of the H type cross-recess) of JIS B 1012, and the results shall conform to the requirements

specified in Section 4. (2). However, the wing length (m) of the cross-recess shall not be inspected.

Further, the inspection of chamfer between the cross-recess and the gauge shall be conducted in accordance with Section 3.2.3 (Chamber between H type cross-recess and gauge) of JIS B 1012. The screw shall be determined to be non-defective if it does not fall down due to its own weight. However, this inspection shall not be applied to the screws of which the nominal length (l) is 4.5 times or more as the nominal diameter (d).

11.3 Inspection of screw threads

The inspection of the screw threads shall be conducted in accordance with the measuring method for the accuracy of external threads specified in JIS B 1071 or alternative method, and the results shall conform to the requirements specified in Section 5.

11.4 Appearance inspection

The appearance inspection shall be conducted in accordance with the following (1) ~ (4), and the results shall conform to the require-

ments specified in Section 6.

- (1) Rotation and falling of washers shall be visually inspected.
- (2) Surface defects of bolt body shall be detected by visual inspection or by use of a magnifying glass. The width and depth of the defects shall be measured with a microscope. The depth shall be measured in the section as required. Further, for the plated bolts and machine screws, this inspection shall be conducted after removal of plating.
- (3) The surface roughness shall be inspected in accordance with the measuring method for surface roughness specified in JIS B 1071 or by alternative method, and the results shall conform to the requirements specified in Section 9.
- (4) Defects such as flushes, burrs and rust shall be visually inspected.

11.5 Inspection of surface treatment

The inspection of the surface treatment shall be conducted in accordance with JIS D 0201, and the results shall conform to the requirements specified in Section 8. However, the threaded portion shall not be inspected.

12. Designation of product

The designation of the bolts and machine screws shall be in accordance with the specification number, specification name, class, nominal size (d) x nominal length (l) x length of threaded portion (b), grade of thread, property class, surface treatment, and designated items.

Example

Bolt and washer assembly	Hexagon head bolt					
	Class 5	M6 x 35 x 18	-6 g	8.8	upset type	
JASO F 109	Pan head, Class 13	M5 x 20	-2	4T	MFZn5-B	
Specification number or specification name	Class	Nominal size (d) x nominal length (l) x length of threaded portion (b)	Grade of thread	Property class	Surface treatment or designated item	

13. Marking of strength division

The bolts of 6 mm or more in nominal diameter shall be marked with property class on the top of head according to Table 10. In general, the bolts of 6 mm or more in nominal diameter which belong to 8.8 and 7T of property class shall be marked with manufacturer's identification symbol.

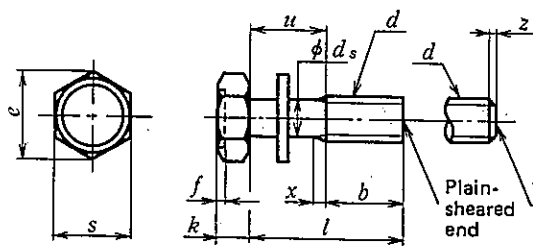
Table 10 Marking symbol

Strength division	4.8	6.8	8.8	4T	6T	7T
Marking symbol	4.8	6.8	8.8	4	6	7

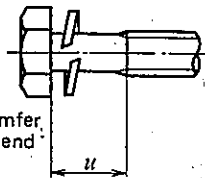
- Remarks: 1. The decimal point in marking symbol may be omitted. When low carbon martensite steel is applied to 8.8 and 7T of property class, they shall be marked with underline such as 8.8 and 7T.
2. Marking symbols may be either embossed or stamped, but they shall be clearly marked. The style and size of characters shall be in general at manufacturer's option.
3. The marking symbols other than those specified above shall correspond to the agreement between the trading parties.

Attached table 1 Shape and dimensions of bolts and washer assemblies

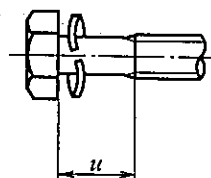
Class 1 and Class 2 upset type



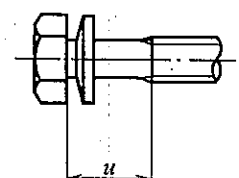
Class 3 and Class 4



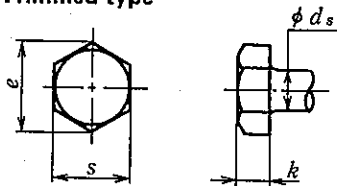
Class 5



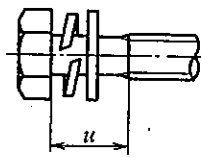
Class 6 and Class 7



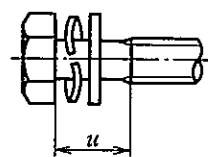
Trimmed type



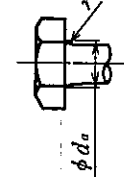
Class 13 and Class 14



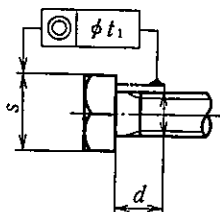
Class 15



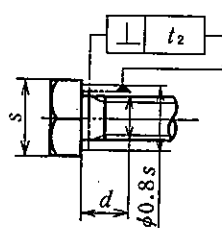
Under head fillet



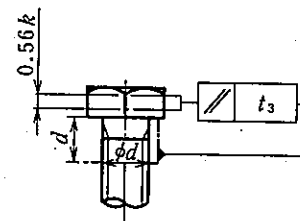
Concentricity



Squareness



Parallelism

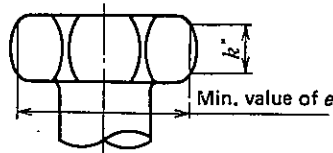


Unit: mm

Unit: mm													
Nominal size of thread (d)	Pitch (P)	k		k''	s		e	r	d _a	z	t ₁	t ₂	t ₃
		Basic dimension	Tolerance	Min.	Basic dimension	Tolerance	Min.	Min.	Max.	Approx.	Max.	Max.	Max.
M5	0.8	3.5	±0.15	1.4	8	0	8.87	0.2	5.6	0.9	0.3	0.11	0.03
M6	1.0	4.0		1.6	10	-0.2	11.05	0.25	6.7	1.0		0.14	0.04
M8	1.25	5.5	±0.2	2.2	12	0 -0.25	13.25	0.4	8.9	1.2	0.4	0.18	0.05
M10 × 1.25		7		2.8	14		15.5		11.5	0.5	0.24	0.07	
M12 × 1.25		8		3.2	17		18.9		0.6	13.5	2.0	0.7	0.27

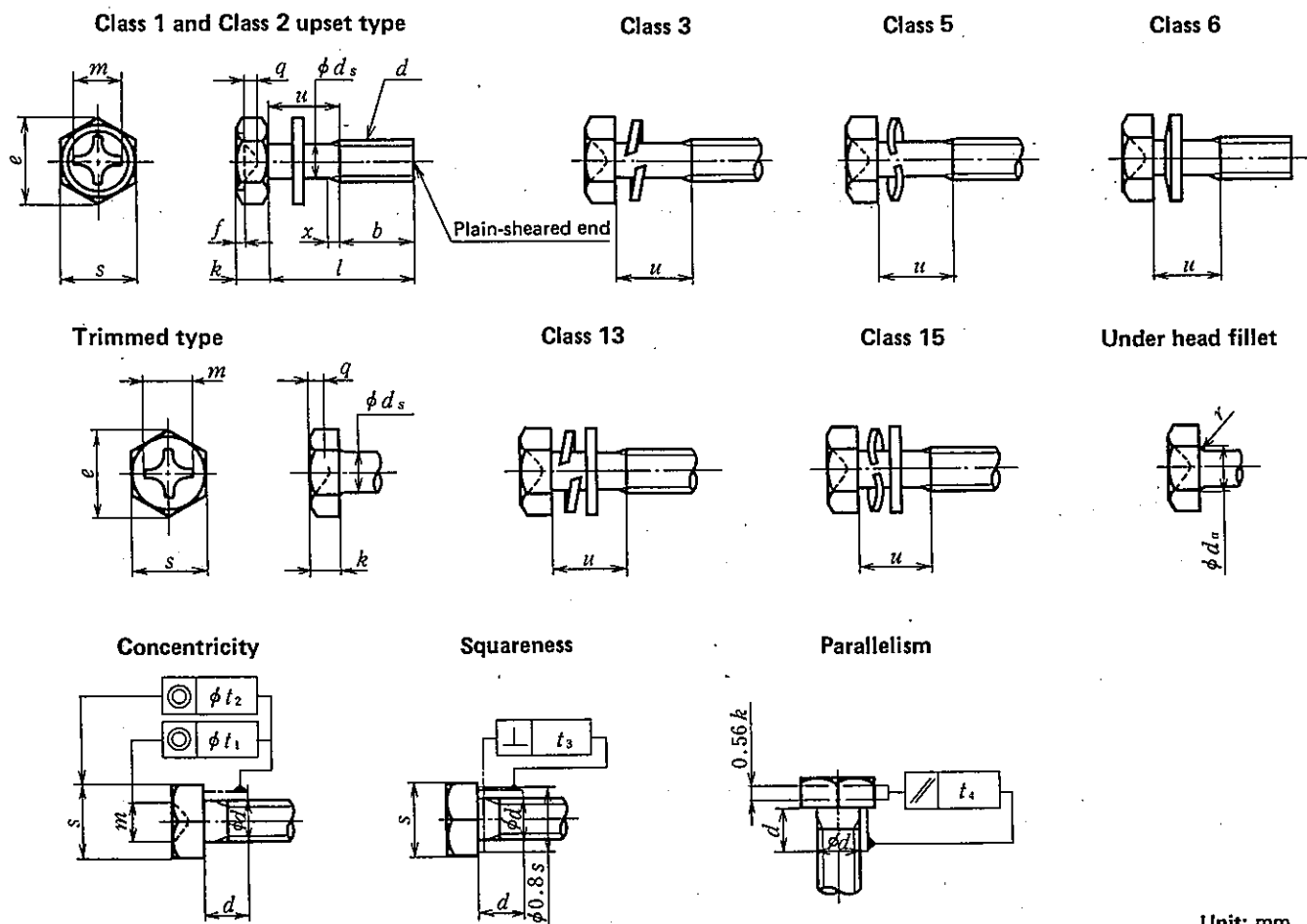
- Remarks: 1. Shape and dimensions of washers shall be in accordance with Attached tables 9, 10, 11, 12, 13, and 14.
 2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 17.
 3. The value of the diameter (d_s) of non-threaded portion shall be in general roughly the same as the pitch diameter of thread.
 4. x shall be in general incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface to complete thread part in complete thread screw shall be in accordance with Attached table 8.
 5. Form of bolt end shall be in general plain-sheared end for M10 bolt and smaller, and chamfered end for M12 bolt.
 6. Depth (f) of recess on the top face of upset head shall be $\frac{1}{3}k$ or less. The shapes and dimensions of the other portions shall be at manufacturer's option. Further, the dimension k'' of the upset head, which is related to the dimension e (min.), shall be in accordance with the figure.

Fig.



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Attached table 2 Shape and dimensions of cross-recessed head machine screws and washer assemblies



Unit: mm

Nominal size of thread (d)		Pitch (P)	Number of cross-recess	m	q ⁽¹¹⁾		k		k''	s		c	r	d _a	t ₁	t ₂	t ₃	t ₄
				Reference	Max.	Min.	Basic dimension	Tolerance	Min.	Basic dimension	Tolerance	Min.	Min.	Max.	Max.	Max.	Max.	
Upset type	M4	0.7	2	4.0	1.93	1.40	2.8	±0.1	1.1	7	0	7.74	0.2	4.4	0.2	0.3	0.09	0.03
	M5	0.8		4.8	2.73	2.19	3.5	±0.15	1.4	8	-0.2	8.8		5.6			0.11	
	M6	1.0	3	6.2	2.86	2.31	4.0		1.6	10	0	11.05	0.25	6.7	0.3	0.4	0.14	0.04
	M8	1.25		7.2	3.86	3.24	5.5		2.2	12	-0.25	13.25	0.4	8.9		0.5	0.18	0.05
Trimmed type	M4	0.7	2	4.4	2.33	1.79	2.8	±0.1	—	7	0	7.74	0.2	4.4	0.2	0.3	0.09	0.03
	M5	0.8		5.0	2.93	2.58	3.5	±0.15	—	8	-0.2	8.87		5.6			0.11	
	M6	1.0	3	6.6	3.26	2.70	4.0		—	10	0	11.05	0.25	6.7	0.3	0.4	0.14	0.04
	M8	1.25		8.3	4.98	4.42	5.5		—	12	-0.25	13.25	0.4	8.9		0.5	0.18	0.05

Note (11): q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks: 1. Shape and dimensions of washers shall be in accordance with Attached tables 9, 10, 11, 12, and 13.

2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.

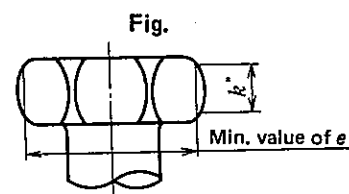
3. The value of diameter (d_s) of non-threaded portion shall be in general nearly the same as the pitch diameter of thread.

4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from the bearing surface to the complete thread part in complete thread screw shall be in accordance with Attached table 8.

5. Form of bolt end shall be plain-sheared end.

6. Depth (f) of recess on the top face of upset head shall be $\frac{1}{3}k$ or less. The shapes and dimensions of the other portions shall be at manufacturer's option. Further, the dimension k'' of the upset head, which is related to dimension e (min.), shall be in accordance with the figure.

7. Class 6 shall be applied to the screws of M5 or more in nominal size of thread.



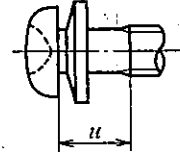
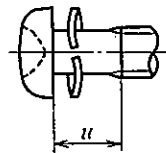
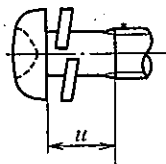
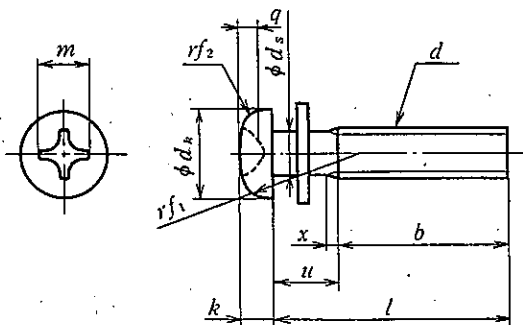
Attached table 3 Shape and dimensions of pan head machine screws and washer assemblies

Class 1 and Class 2

Class 3

Class 5

Class 6

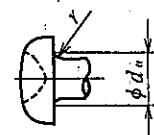
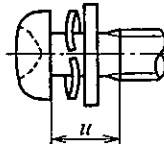
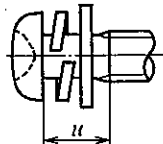
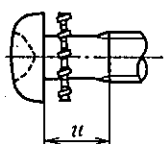


Class 9

Class 13

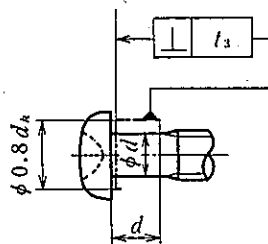
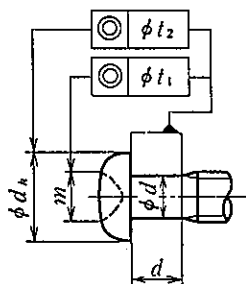
Class 15

Under head fillet



Concentricity

Squareness



Unit: mm

Nominal size of thread (d)	Pitch (P)	Number of cross-recess	m	q ⁽¹¹⁾		d _k		k		r _{f1}	r _{f2}	r	d _g	t ₁	t ₂	t ₃
				Max.	Min.	Basic dimension	Tolerance	Basic dimension	Tolerance	Approx.	Approx.	Min.	Max.	Max.	Max.	Max.
M3	0.5	2	3.6	1.43	0.86	5.5	0 -0.5	2	±0.15	7	1.0	0.1	3.4	0.5	0.4	0.15
M4	0.7		4.2	2.03	1.45	7	0 -0.6	2.6		9	1.3	0.2	4.4	0.6		0.2
M5	0.8		4.9	2.73	2.14	9	0 -0.7	3.3		12	1.6		5.6	0.7	0.5	0.25
M6	1.0	3	6.3	2.86	2.26	10.5	0 -0.8	3.9	±0.2	14	1.9	0.25	6.7	0.8	0.6	0.29
M8	1.25		7.8	4.36	3.73	14	0 -0.8	5.2		18	2.6	0.4	8.9	1.0	0.8	0.39

Note ⁽¹¹⁾: q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks: 1. Shape and dimensions of washers shall be in accordance with Attached tables 9, 10, 11, 12, 13, and 16.

2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.

3. Diameter (d_g) of non-threaded portion shall be in general roughly the same as pitch diameter of thread.

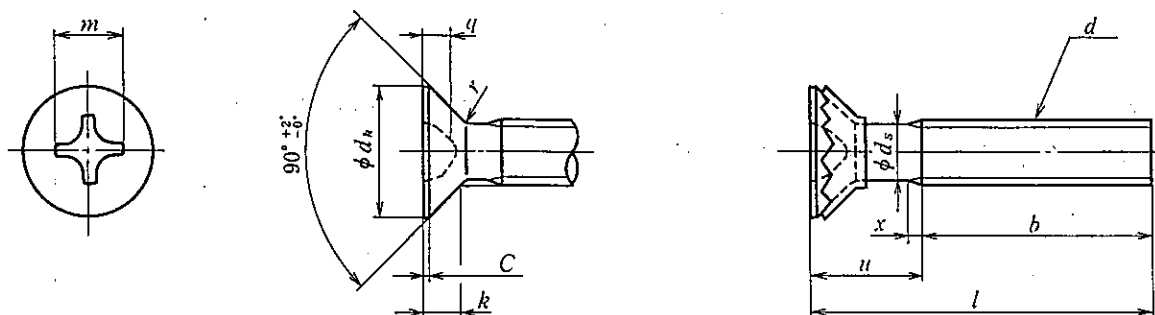
4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface in complete thread part in complete thread screw shall be in accordance with Attached table 8.

5. Form of bolt end shall be plain-sheared end.

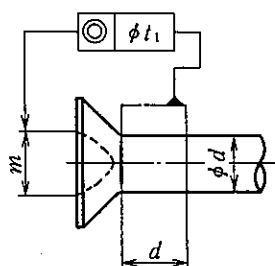
6. Class 6 shall be applied to screws of M5 or more in nominal size of thread.

Attached table 4 Shape and dimensions of flat head machine screws and washer assemblies

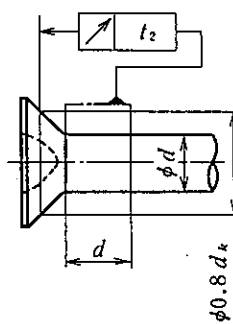
Class 8



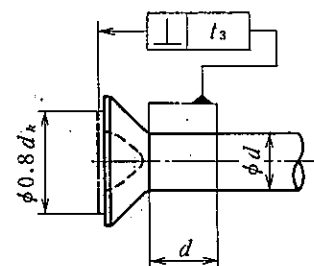
Concentricity



Runout of conical surface



Squareness of top face



Unit: mm

Nominal size of thread (d)	Pitch (P)	Number of cross-recess	m Reference	q ⁽¹¹⁾		d _k		k		c Approx.	r Max.	t ₁ Max.	t ₂ Max.	t ₃ Max.
				Max.	Min.	Basic dimension	Tolerance	Basic dimension	Tolerance					
M3	0.5	2	3.6	1.43	0.91	6	0 -0.5	1.75	0 -0.3	0.25	0.3	0.5	0.28	0.17
M4	0.7		4.5	2.33	1.79	8		2.3						0.22
M5	0.8	3	5.1	2.93	2.38	10	0 -0.6	2.8	0 -0.4	0.3	0.4	0.5	0.6	0.35
M6	1.0		6.7	3.26	2.70	12.5	0 -0.7	3.4						0.34
M8	1.25		8.4	4.96	4.36	16	0 -0.8	4.4						0.45

Note ⁽¹¹⁾: q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks: 1. Shape and dimensions of washers shall be in accordance with Attached table 15.

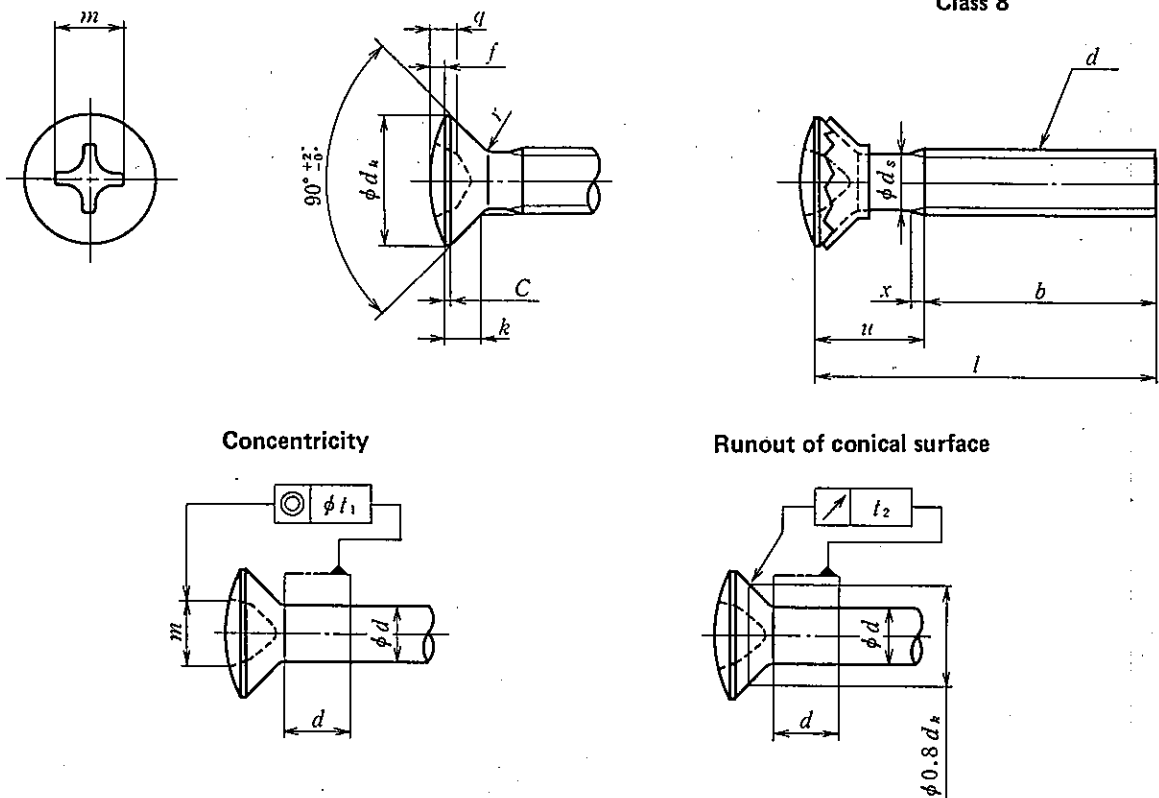
2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.

3. Value of diameter (d_s) of non-threaded portion shall be in general roughly the same as pitch diameter of thread.

4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface in complete thread part in complete thread screw shall be in accordance with Attached table 8.

5. Form of bolt end shall be plain-sheared end.

Attached table 5 Shape and dimensions of oval countersunk head machine screws and washer assemblies



Unit: mm

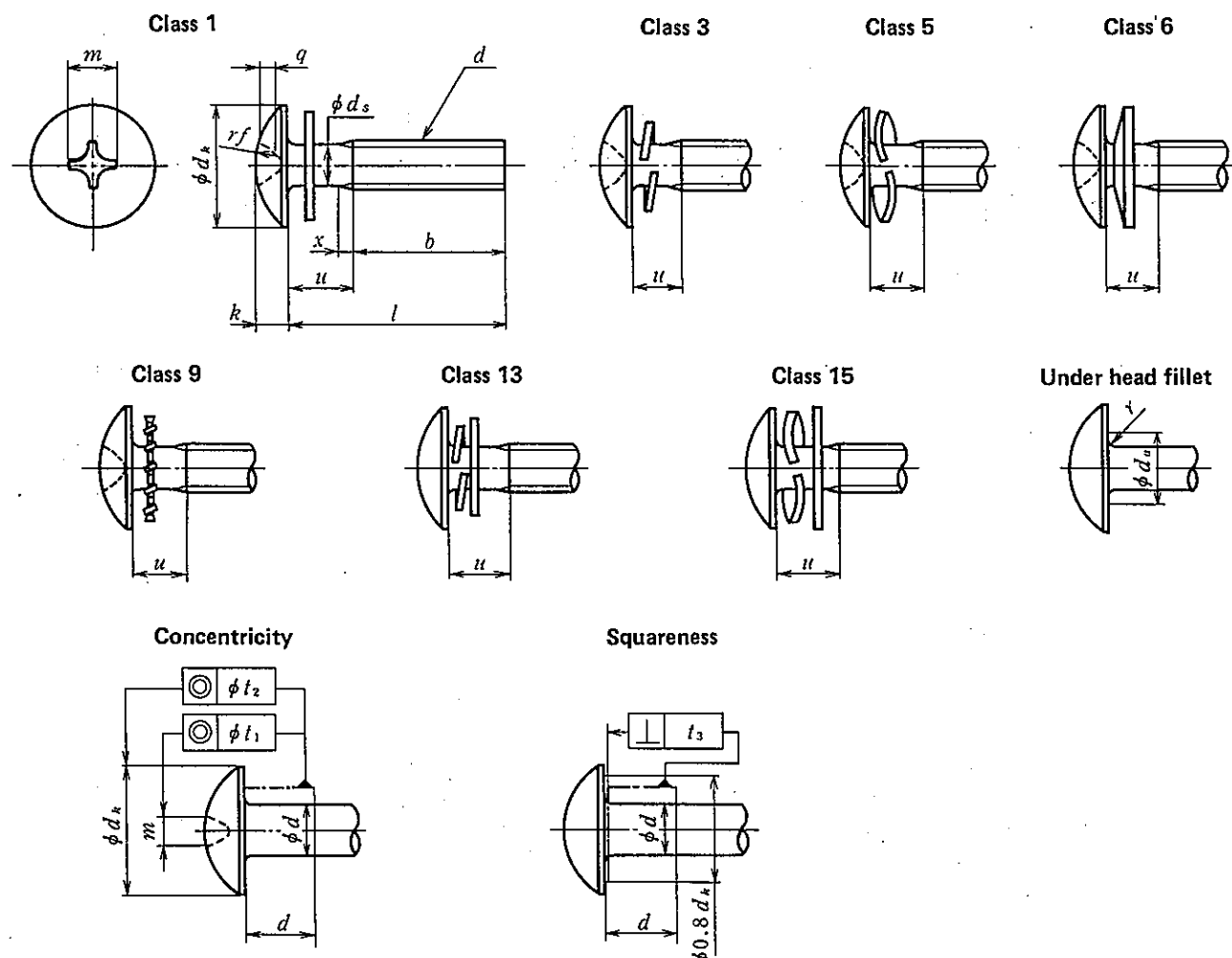
Nominal size of thread (d)	Pitch (P)	Number of cross-recess	m			q ⁽¹⁾		dk		k		c	f	k + f		r	t ₁	t ₂
			Reference	Max.	Min.	Basic dimension	Tolerance	Basic dimension	Tolerance	Basic dimension	Tolerance	Approx.	Approx.	Max.	Max.	Max.	Max.	Max.
M3	0.5	2	3.8	1.63	1.11	6	0	1.75	0	0.25	0.7	2.45	0	0.3	0.5	0.28	0.4	0.6
M4	0.7		4.7	2.53	1.99	8	-0.5	2.3										
M5	0.8		5.3	3.13	2.58	10	-0.6	2.8										
M6	1.0	3	6.9	3.46	2.90	12	-0.7	3.4	0	0.4	1.4	4.8	0	0.6	0.8	0.42	0.8	1.0
M8	1.25		8.6	5.16	4.56	16	-0.8	4.4										

Note ⁽¹⁾: q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks:

1. Shape and dimensions of washers shall be in accordance with Attached table 15.
2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.
3. Value of diameter (d_s) of non-threaded portion shall be in general roughly the same as pitch diameter of thread.
4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface in complete thread part in complete thread screw shall be in accordance with Attached table 8.
5. Form of bolt end shall be plain-sheared end.

Attached table 6 Shape and dimensions of oval countersunk head machine screws and washer assemblies



Unit: mm

Nominal size of thread (d)	Pitch (P)	Number of cross-recess	m	q ⁽¹¹⁾		d _k		k		r ₁	r	d _a	t ₁	t ₂	t ₃
				Max.	Min.	Basic dimension	Tolerance	Basic dimension	Tolerance						
M3	0.5	1	2.9	1.72	1.34	6.9	0 -0.5	1.9	±0.15	4.6	0.1	3.4	0.5	0.4	0.19
M4	0.7	2	4.3	2.13	1.60	9.4	0 -0.6	2.5		6.1	0.2	4.4	0.6	0.4	0.26
M5	0.8		5.0	2.83	2.29	11.8	0 -0.7	3.1		7.7	0.2	5.6	0.7	0.5	0.33
M6	1	3	6.3	2.86	2.31	14	0 -0.7	3.7	±0.2	9.1	0.25	6.7	0.8	0.6	0.39
M8	1.25		7.8	4.36	3.78	17.8	0 -0.8	4.8		11.7	0.4	8.9	1.0	0.8	0.50

Note ⁽¹¹⁾: q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks: 1. Shape and dimensions of washers shall be in accordance with Attached tables 9, 11, 12, 13, and 16.

2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.

3. Value of diameter (d_s) of non-threaded portion shall be in general roughly the same as pitch diameter of thread.

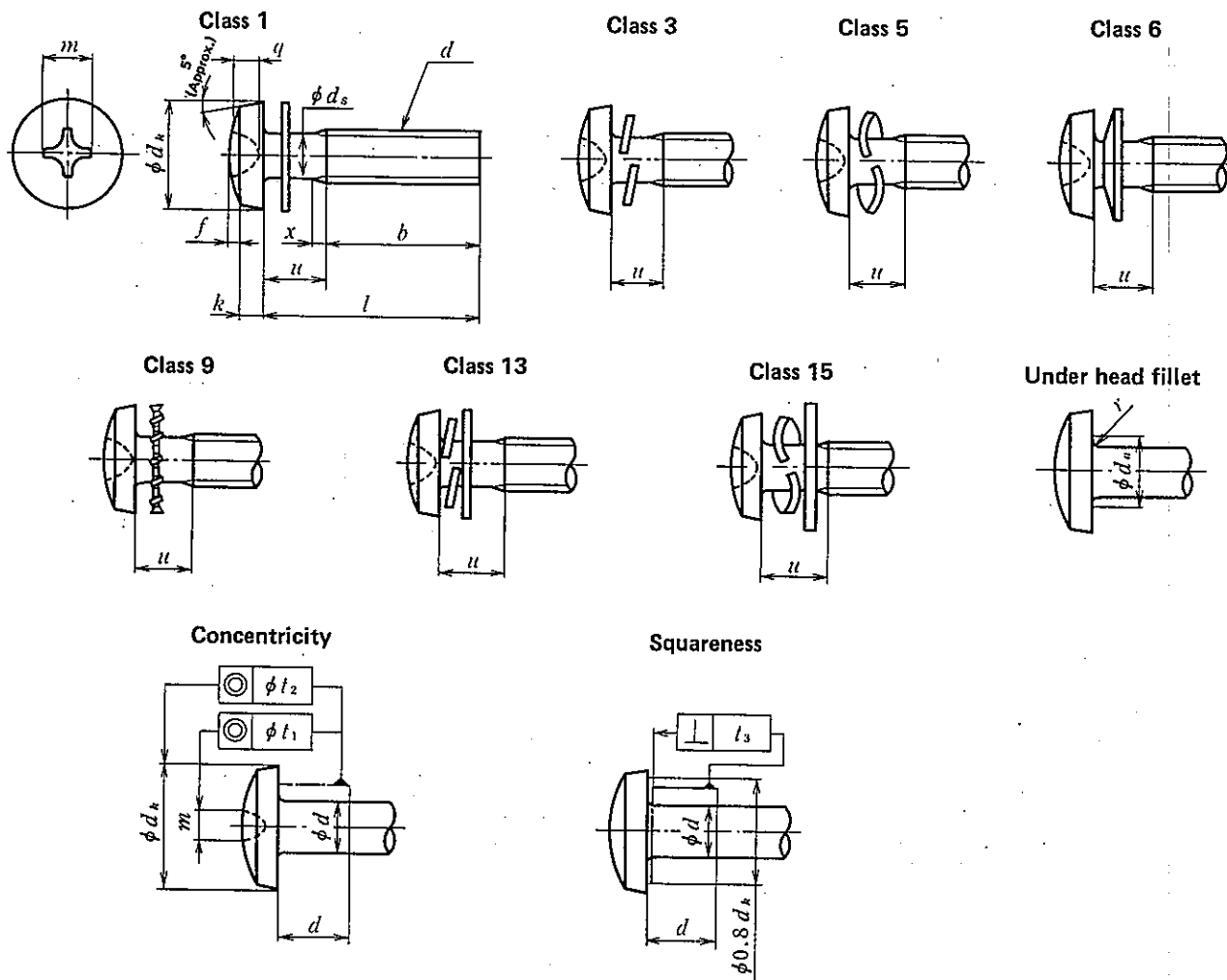
4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface in complete thread part in complete thread screw shall be in accordance with Attached table 8.

5. Form of bolt end shall be plain-sheared end.

6. Class 6 shall be applied to screws of M5 or more in nominal size of thread.

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Attached table 7 Shape and dimensions of binding head machine screws and washer assemblies



Unit: mm

Unit: mm																		
Nominal size of thread (d)	Pitch (P)	Number of cross-recess	m	q ⁽¹¹⁾		d _k		k		f		k + f		r	d _a	t ₁	t ₂	t ₃
			Reference	Max.	Min.	Basic dimension	Tolerance	Ap-prox.	Basic dimension	Tolerance	Basic dimension	Tolerance	Min.	Max.	Max.	Max.	Max.	
M3	0.5	2	3.7	1.53	1.01	6.3	0 -0.5	1.3	0.6	±0.1	1.9	±0.15	0.1	3.4	0.5	0.4	0.18	
M4	0.7		4.3	2.13	1.60	8.3	0 -0.6	1.7	0.8	±0.15	2.5	±0.2	0.2	4.4	0.6	0.4	0.23	
M5	0.8	3	5.0	2.83	2.29	10.3	0 -0.7	2.1	1	±0.15	3.1	±0.2	0.2	5.6	0.7	0.5	0.29	
M6	1		6.3	2.86	2.31	12.4	0 -0.8	2.4	1.3	±0.2	3.7	±0.3	0.25	6.7	0.8	0.6	0.35	
M8	1.25		7.8	4.36	3.78	16.4	0 -0.8	3.1	1.7	±0.2	4.8	±0.3	0.4	8.9	1.0	0.8	0.46	

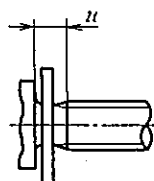
Note ⁽¹¹⁾: q shall be the penetration depth of depth gauge of the H-shaped cross-recess.

Remarks:

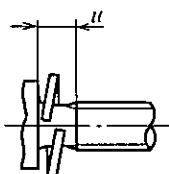
1. Shape and dimensions of washers shall be in accordance with Attached tables 9, 11, 12, 13, and 16.
2. Nominal length (l) and thread length (b) shall be in accordance with Attached table 18.
3. Value of diameter (d_s) of non-threaded portion shall be in general roughly the same as pitch diameter of thread.
4. x shall be length of incomplete thread part, and shall be roughly equal to length of two threads, provided that the maximum dimension (u) from bearing surface in complete thread part in complete thread screw shall be in accordance with Attached table 8.
5. Form of bolt end shall be plain-sheared end.
6. Class 6 shall be applied to screws of M5 or more in nominal size of thread.

Attached table 8 Dimension from bearing surface to complete thread part

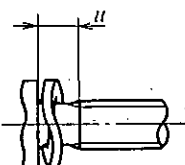
Class 1 and Class 2



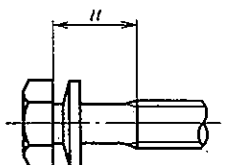
Class 3 and Class 4



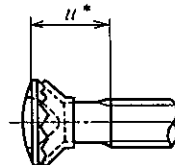
Class 5



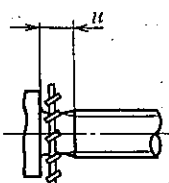
Class 6 and Class 7



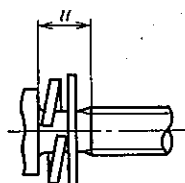
Class 8



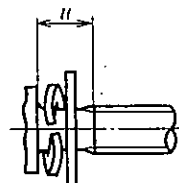
Class 9



Class 13 and Class 14



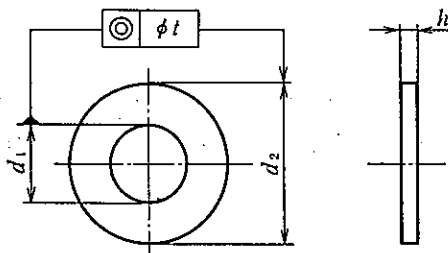
Class 15



		Unit: mm						
Nominal size of thread		M3	M4	M5	M6	M8	M10	M12
u (Max.)	Class 1	1.5	2.2	2.6	3.6	4.1	4.5	5.0
	Class 2	1.5	2.2	2.6	3.6	4.1	4.5	5.0
	Class 3	2.4	3.4	4.2	5.0	6.5	7.5	8.5
	Class 4	—	—	—	5.8	7.5	8.5	9.7
	Class 5	1.9	2.4	2.9	3.6	4.7	4.9	5.2
	Class 6	—	—	2.8	3.4	4.4	4.9	5.3
	Class 7	—	—	—	3.6	4.6	5.3	5.6
	Class 8	3.4	4.6	5.4	6.6	8.3	—	—
	Class 9	1.9	2.3	2.8	3.2	4.1	4.3	4.5
	Class 13	2.9	4.2	5.2	6.6	8.1	9.5	11.1
	Class 14	—	—	—	7.4	9.1	10.5	12.2
	Class 15	2.4	3.2	3.9	5.2	6.3	6.9	7.7

Remark: In case of countersunk head machine screws, dimension u^* shall be distance from top face.

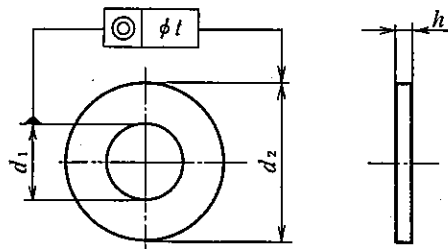
Attached table 9 Shape and dimensions of finished circular plain washers to be assembled



Unit: mm

Nominal diameter	Inside diameter, d_1 Min. (Reference)	d_2		h		t
		Basic dimension	Tolerance	Basic dimension	Tolerance	Max.
3	2.68	7	0 -0.35	0.5	±0.05	0.30
4	3.56	9		0.8	±0.1	
5	4.5	10		1.0		
6	5.4	12.5	0 -0.4	1.6	±0.15	0.36
8	7.35	17				
10	9.35	21	0 -0.5	2.0	±0.2	0.42
12	11.35	24		2.5	±0.25	

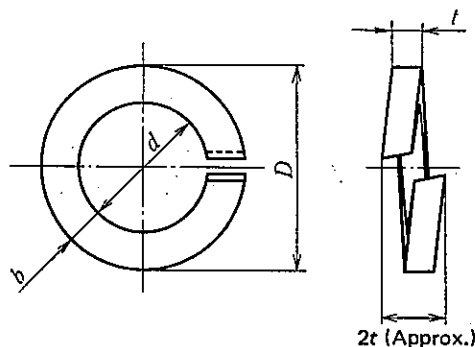
Attached table 10 Shape and dimensions of small circular plain washers to be assembled



Unit: mm

Nominal diameter	Inside diameter, d_1 Min. (Reference)	d_2		h		t
		Basic dimension	Tolerance	Basic dimension	Tolerance	Max.
3	2.68	6	0 -0.3	0.5	±0.05	0.24
4	3.56	8	0 -0.35	0.8	±0.1	0.3
5	4.5	10		1.0		
6	5.4	11.5	0 -0.4	1.6	±0.15	0.36
8	7.35	15.5				
10	9.35	18		2.0	±0.2	
12	11.35	21	0 -0.5	2.5	±0.25	0.42

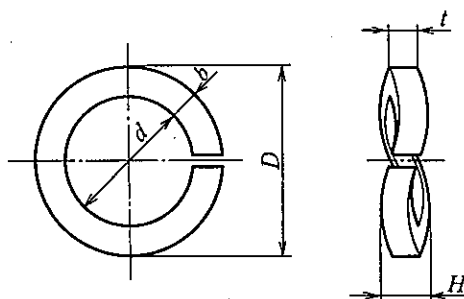
Attached table 11 Shape and dimensions of spring lock washers to be assembled



Unit: mm

Nominal diameter	Inside diameter, <i>d</i> Min. (Reference)	Width <i>b</i> x Thickness <i>t</i> (Min.)		Outside diameter <i>D</i> , Max.		Free height after compression test		Test load (kN)
		No. 2	No. 3	No. 2	No. 3	No. 2 (Min.)	No. 3 (Min.)	
		<i>b</i> x <i>t</i>	<i>b</i> x <i>t</i>					
3	2.68	1.1 x 0.7	—	5.5	—	1.2	—	1.03
4	3.56	1.4 x 1	—	7	—	1.7	—	1.77
5	4.5	1.7 x 1.3	—	8.5	—	2.2	—	2.94
6	5.4	2.7 x 1.5	2.7 x 1.9	11.5	11.4	2.5	3.2	4.12
8	7.35	3.2 x 2	3.3 x 2.5	14.5	15	3.35	4.2	7.45
10	9.35	3.7 x 2.5	3.9 x 3	17.5	18	4.2	5	11.8
12	11.35	4.2 x 3	4.4 x 3.6	20.5	21	5	6	17.7

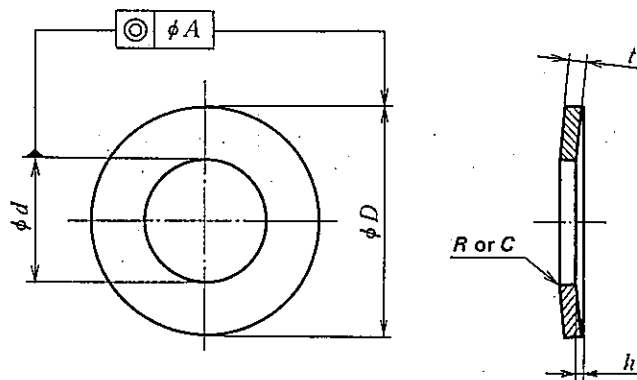
Attached table 12 Shape and dimensions of wave spring lock washers to be assembled



Unit: mm

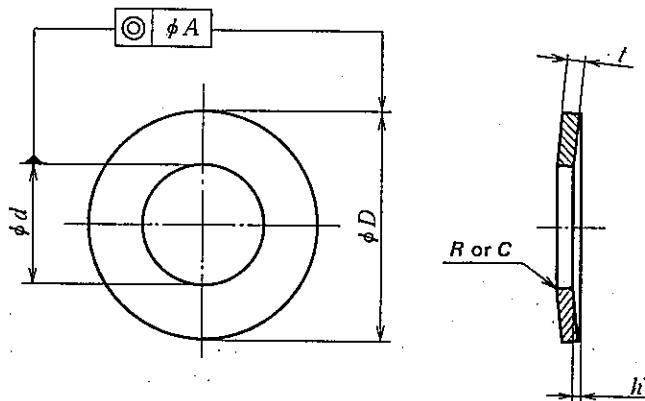
Nominal diameter	Inside diameter, d Min. (Reference)	Width b		Thickness t		Outside diameter, D Max.	Free height H Approx. $1.5t$	Test load (kN)
		Basic dimension	Tolerance	Basic dimension	Tolerance			
3	2.68	1.3	± 0.1	0.7	± 0.1	5.7	1.05	1.47
4	3.56	1.5		0.8		7.06	1.2	2.94
5	4.5	1.8		1.0		8.76	1.5	4.9
6	5.4	2.5	± 0.15	1.2	± 0.15	11.15	1.8	6.86
8	7.35	3.0		1.6		14.05	2.4	12.7
10	9.35	3.5	± 0.2	1.8	± 0.15	17.2	2.7	21.6
12	11.35	4.0		2.1		20.3	3	31.4

Attached table 13 Shape and dimensions of conical spring washers to be assembled (for light load)



Unit: mm											
Nominal diameter	Inside diameter, d Min. (Reference)	Outside diameter <i>D</i>		Thickness <i>t</i>		<i>A</i> Max.	Height <i>h</i>		Height <i>H'</i> after test <i>h'</i> Min.	<i>R</i> or <i>C</i> approx.	Test load (kN)
		Basic dimension	Tolerance	Basic dimension	Tolerance		Basic dimension	Tolerance			
5	4.5	12	0 −0.3	0.8	±0.08	0.18	0.35	+0.2 0	0.1	0.2	2.94
6	5.4	14	0 −0.4	1.0	±0.12		0.4	+0.25 0	0.15	0.3	4.12
8	7.35	18		1.4			0.5		0.2	0.4	7.45
10	9.35	22		1.8	±0.17	0.21	0.55		0.2	0.4	11.8
12	11.35	26	0 −0.5	2.2			0.6		0.2	0.6	17.7

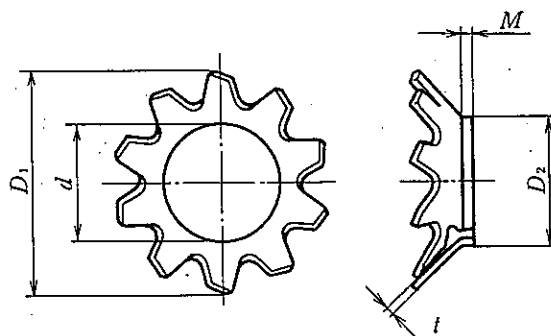
Attached table 14 Shape and dimensions conical spring washers to be assembled (for heavy load)



Unit: mm

Nominal diameter	Inside diameter, d Min. (Reference)	Outside diameter D		Thickness t		A Max.	Height h		Height H' after test h' Min.	R or C approx.	Test load (kN)
		Basic dimension	Tolerance	Basic dimension	Tolerance		Basic dimension	Tolerance			
6	5.4	14	0 -0.4	1.2	± 0.12	0.18	0.4	+0.25 0	0.1	0.3	8.24
8	7.35	18		1.6	± 0.15		0.5		0.15	0.4	14.7
10	9.35	22		2.2	± 0.17	0.21	0.55		0.15	0.4	23.5
12	11.35	26	0 -0.5	2.5	± 0.18		0.6		0.2	0.6	34.3

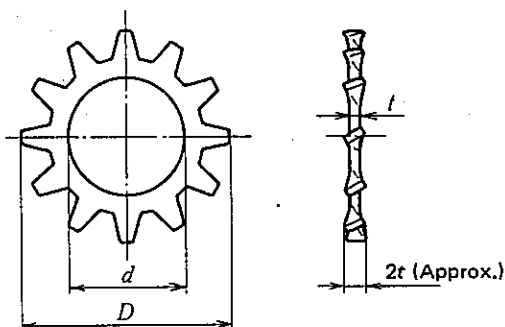
Attached table 15 Shape and dimensions of countersunk external tooth type toothed lock washers to be assembled



Unit: mm

Nominal size	Inside diameter, d Min. (Reference)	D_1 Approx.	t		M Max.	D_2 Max.	Number of teeth
			Basic dimension	Tolerance			
3	2.68	6	0.4	± 0.03	0.7	3.4	8
4	3.56	8			0.9	4.5	
5	4.5	10	0.5	± 0.035	1.0	5.5	12
6	5.4	12			1.2	6.5	
8	7.35	16	0.6	± 0.04	1.45	8.8	

Attached table 16 Shape and dimensions of external tooth type toothed lock washers to be assembled



Unit: mm

Nominal size	Inside diameter, d Min. (Reference)	D		t		Number of teeth (¹²)
		Basic dimension	Tolerance	Basic dimension	Tolerance	
3	2.68	6.5	0 -0.4	0.45	± 0.035	8
4	3.56	8.5				9
5	4.5	10				10
6	5.4	11	0 -0.5	0.6	± 0.04	12
8	7.35	15				
				0.8	± 0.05	

Note(¹²): The number of teeth shows recommended value, and somewhat increase or decrease in the value shall be allowable.

Attached table 17 Nominal length (l) and length of threaded portion (b) of bolts

Unit: mm

Nominal size of thread (d)	M5	M6	M8	M10 x 1.25	M12 x 1.25	Nominal size of thread (d)
Nominal length (l)	Length of thread part (b)					Nominal length (l)
6						6
8						8
10						10
12						12
14						14
16						16
(18)						(18)
20						20
(22)						(22)
25						25
(28)						(28)
30	16	18				30
(32)						(32)
35			22			35
(38)						(38)
40				26		40
45						45
50					30	50
55						55
60						60

- Remarks: 1. Nominal length (l) shall be shown within the frame enclosed by heavy lines, and the continuous thread bolts shall be shown within the range drawn by oblique line.
 2. Numeric values within the frame show length of threaded portion (b).
 3. Numeric values in parentheses in nominal length (l) column shall not be used so far as possible.
 4. Tolerance of nominal length (l) shall be given in the next table.

Unit: mm

Division of l	Tolerance of l
50 or less	± 0.5
Over 50	± 0.7

5. Tolerance of length of threaded portion (b) shall be between $+3P$ and 0 , provided that P shows pitch.

Attached table 18 Nominal length (l) threaded portion (b) of machine screws

Unit: mm

Nominal size of thread (d)	M3	M4	M5	M6	M8	Nominal size of thread (d)
$l \backslash b$	12	16	20	25	30	$b \backslash l$
6	*					6
8		*				8
10			*			10
12				*		12
14						14
16						16
20						20
25						25
30						30
35						35

- Remarks: 1. Nominal length (l) shall be shown to the values within the frame enclosed by the heavy line.
 Nominal length (l) marked with * shall not be applied to flat head machine screws and oval countersunk head machine screws.
2. Tolerance of nominal length (l) shall be as given in the table below.

Unit: mm

Division of d	M4 and under	M5 and over
Division of l		
10 or less	0 -0.6	0 -0.8
Over 10 to 20 incl.	0 -0.6	0 -1
Over 20	0 -0.8	0 -1

3. In case of $(l - k) \leq b$ for flat head machine screws and oval countersunk head machine screws, and $l \leq b$ for the other machine screws, length up to bottom face of washer to be assembled shall be threaded.
4. Tolerance of length of threaded portion (b) shall be between + 3P and 0, provided that P shows pitch.

Attached table 19 Applicable standards

Standard number	Standard name
JIS B 0101	Glossary of terms relating to fasteners
JIS B 0205	Metric coarse screw threads
JIS B 0207	Metric fine screw threads
JIS B 0209	Limits of sizes and tolerances for metric coarse screw threads
JIS B 0211	Limits of sizes and tolerances for metric fine screw threads
JIS B 0601	Definitions and designation of surface roughness
JIS B 1012	Cross-recesses for screws
JIS B 1051	Mechanical properties of steel bolts and screws
JIS B 1071	Method of verification for size and geometry of threaded fasteners
JIS B 1251	Spring lock washers
JIS B 1252	Conical spring washers
JIS B 1255	Toothed lock washers
JIS D 0201	General rules of electroplating for automobile parts
JIS G 3131	Hot-rolled mild steel plates, sheets, and strip
JIS G 3141	Cold rolled carbon steel sheets and strip
JIS G 3311	Cold rolled special steel strip
JIS G 3506	High carbon steel wire rods
JASO F 101-88	Hexagon head bolts
JASO F 116-89	Hex lobular wrenching fasteners
JASO F 302-86	Waved washers for automobiles

Explanatory note on JASO F 109-91 Bolts or screws and washer assemblies

In this explanatory note the matters specified in the text of this standard and the matters related to the above are explained and this note is not part of the standard.

Preface

JASO F 101-88 of screws and washer assemblies body has been greatly revised due to revision of JIS B 1051 and the combinations of washers and screws were established 15 years ago, therefore it is required to review the standard. The following revision has been made.

Major revisions

1. Mechanical properties

Previously four kinds of property class, i.e. 4.8, 6.8, 4T and 6T were specified, however due to tendency of higher strength of screw body two kinds, i.e. 7T and 8.8 have been newly added.

2. Shape and dimensions

The forms of the attached tables have been greatly revised. Previously screw bodies and washers were specified in the same tables, accordingly the same washers were repeatedly specified in each table. This time shape and dimensions of screws bodies and washers are listed on the other table, and their combinations are specified as kinds of screws and washer assemblies. Since geometrical tolerance has been introduced into JIS, each shape and dimension have been revised to geometric deviation, however as for deviation value the previous values are introduced as they are.

3. Surface defects

Previously surface defects were specified in the text of the standard, however since it is determined that surface defects will be established in JIS in the future and it is expected that revision of F 101-88 will be accompanied with the above, when they are specified in the text of the standard, confusion may possibly occur. Accordingly JASO F101-88 has been revised so as to be applied

as it is when JASO 101 is revised in the future.

4. Kinds of combinations

(1) Shape of head

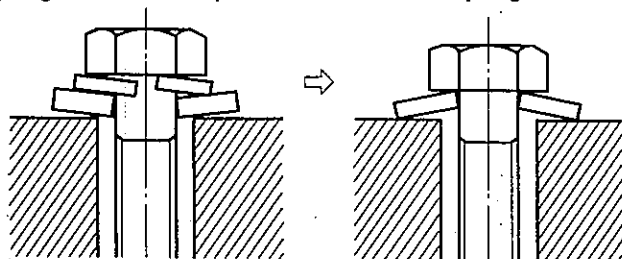
Kinds of screw bodies are same, however cross-recessed hexagon head bolts (upset type, trimmed type) are classified into machine screws as only cross-recessed bolts.

(2) Kinds of washers

Internal tooth type of toothed lock washers scarcely has had the actual results of use for bolts and machine screws, therefore this type has been eliminated this time. Since toothed lock washers (external tooth type) are scarcely used in hexagon head bolts, they have been remained only for machine screws. The quantity of use of conical spring washers recently increases and the washers are specified in JASO F 118 (Nuts and washers assemblies), therefore two kinds for light load and heavy load has been added. The characteristics of conical spring washers are listed as follows,

- (a) Their spring reaction is greater than those of spring lock washers, toothed lock washers and wave spring lock washers and the washers are designed so as to suit for clamping force of screw threads.
- (b) Due to two parts assembly using bolt and conical spring washer three parts in case of other spring washers are not required in case of conical spring washer, therefore weight can be reduced.
- (c) Even in the case where bolt hole diameter of the mating bearing surface is larger, this washer has no reverse opening during tightening it (refer to the figure).

Spring lock washer + plain washer Conical spring washer



Purpose of establishment of this standard

This standard aims at securing cost reduction and adequate quality by mass production effect of bolts or screws and washer assemblies.

The following is explanation of the items which seem to particularly require supplementary explanation in this standard (the item numbers are same as those in the text of the standard).

1. Scope

It has been decided that the applicable standards are included into the scope of application, therefore it has been specified in Remark.

2. Kind

Two kinds of conical spring washers have been added and toothed lock washers (internal tooth type) have been eliminated, therefore the table form has been changed and also nominals of kinds of combinations have been added or amended so that new and previous nominals do not overlap each other.

3. Mechanical properties

3.1 Mechanical properties of screw body

JASO F 101 is quoted for mechanical properties of screw body and 7T and 8.8 in property class are added. Unit of stress such as tensile strength, proof load was changed to SI unit only in April 1990, therefore the previous unit has been eliminated. Tolerance of permanent set in proof load is previously 12.5 μm is JASO F 101 as well. The tolerance has been decided to be changed due to revision of JIS B 1051 in 1991, accordingly the provisions in Note (2) of Table 2 have been changed.

3.2 Mechanical properties of washers

Since conical spring washers are added, the relevant items have been specified. Hardness, spring action and toughness for spring lock washers, wave spring lock washers, toothed lock washers and conical spring washers have been specified. Spring action of wave spring lock washers was previously $1\frac{1}{3}$ times or over thickness in free height, however since this value cannot satisfy the standard, the value has been decided to be 1.2 times or over thickness in free height referring to DIN 128 and JASO F 302.

Free height in spring action of conical spring washers is calculated on the basis of allowable stress of 1370 N/mm² on tensile side of the washers as described in the explanatory note of JIS B 1252 and such value has been decided to be free height after testing.

4. Shape, dimensions and geometrical tolerance

(1) Screw body

Fillet transition diameters, d_a and $\gamma_{\min}$ have been introduced: When d_a in JASO F 101-88 is introduced as it is, it may possible interfere with washers, therefore maximum value of d_a is calculated using the previous maximum value of r and $\gamma_{\min}$ is quoted from the value in JASO F 101.

Designations of eccentricity, inclination and runout have been decided to be designated by geometric tolerance in JIS B 1021, provided that tolerance has been quoted from JASO F 101 for bolts and JASO F 116 for machine screws.

(2) Shape and dimensions of cross-recess

Revision of the expression has been accompanied with the revision in JIS B 1012 to use H type.

(3) Shape and dimensions of washers

Inside diameter of washers have not been specified so far, accordingly the minimum values have been specified as reference value this time after somewhat amending them based on the results.

Designation of width b x thickness t of wave spring lock washers has been changed from the minimum value to the median referring to DIN 128 (Curved and wave spring lock washers). Furthermore thickness of nominal 12 has been changed from 2.0 to 2.1 in accordance with DIN 128. Geometrical tolerance has been introduced meeting screw parts.

6. Appearance

As to surface defects the provision in the text of the standard have been omitted by quoting Section 7. of JASO F 101.

7. Materials

The materials of toothed lock washers and spring lock washers have been revised so as to meet the actual condition. The material for conical spring washers has been added. As to the materials of screw bodies including additional 7T and 8.8 in strength division, JASO F 101 has been quoted as it is.

8. Surface treatment

MFZn5-B has been eliminated in accordance with JASO F 101.

9. Surface roughness

Maximum roughness has been specified as average roughness in accordance with JASO F 101.

10. Testing method for mechanical properties

Addition and revision of the testing methods for the mechanical properties conducted respectively in accordance with JIS and JASO have been accompanied by addition and revision of the mechanical properties for screw bodies and washers.

11. Inspection

The expressions have been changed in accordance with the revised standard accompanied by the revision of the preceding section by introducing the measuring method of geometric deviation, etc.