

Automotive Parts - Bolts or screws and washer assemblies

1. Scope

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

NOTE: These bolts and machine screws are thread rolled after washers are assembled onto the blanks of the screw bodies.

2. Normative reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

JASO F101	Automotive parts hexagon head bolts and hexagon head screws
JASO F116	Automotive Parts - Hex lobular wrenching fasteners
JIS B0101	Screw threads and fasteners - Vocabulary
JIS B0103	Glossary of terms used in springs
JIS B0205-2:2001	ISO general purpose metric screw threads - Part 2: General plan
JIS B0601:2001	Geometrical Product Specification (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters
JIS B1012:1985	Cross Recesses for Screws
JIS B1051: 2000	Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, screws and studs
JIS B1071: 1985	Method of Verification for Size and Geometry of Threaded Fasteners
JIS B1091	Fasteners - Acceptance inspection
JIS B1251:2001	Spring lock washers
JIS B1256:2008	Plain washers
JIS D0201:1995	Automobile parts - General rules of electroplating
JIS G3131:2005	Hot-rolled mild steel plates, sheets and strips
JIS G3141	Cold-reduced carbon steel sheets and strips
JIS G3311:2004	Cold rolled special steel strips
JIS G3506:2004	High carbon steel wire rods
JIS G4802:2005	Cold-rolled steel strips for springs

3. Definitions

Definitions of main terms used in this standard shall be based on **JIS B0101** and **JIS B0103**.

4. Class

The class of the bolt or machine screw is determined by the combination of screw body and washer, as indicated in **Table 1, Annex A** and **Annex B**.

Table 1 Class (Bolts)

Screw body		Washer											Table
Head profile		Strength category	Plain		Spring action					Spring action + Plain washer (Regular)			
			Regular	Small	Spring		Wave spring	Conical spring		Spring		Wave spring	
					General use	Heavy load		Light load	Heavy load	General use	Heavy load		
Bolt	Upset	4.8	1	2	3	-	5	6	-	13	-	15	A.1
		6.8	1	2	-	4	5	6	-	-	14	15	
		8.8	1	2	-	4	5	-	7	-	14	15	
	Trimmed	4.8	1	2	3	-	5	6	-	13	-	15	
		6.8	1	2	-	4	5	6	-	-	14	15	
		8.8	1	2	-	4	5	-	7	-	14	15	

Table 1 Class (Machine Screws)

Screw body		Washer												Table
Head profile		Strength category	Plain washer		Spring action						Spring action + Plain washer (Regular)			
			Regu- lar	Small	Spring		Wave spring	Conical spring	Toothed lock		Spring		Wave spring	
					General use	Heavy load			Pan	External toothed	General use	Heavy load		
Machine screw	Upset - cross recessed	4.8	1	2	3	-	5	6	-	-	13	-	15	A.2
	Trimmed - cross recessed		1	2	3	-	5	6	-	-	13	-	15	A.3
	Pan	4.8	1	2	3	-	5	6	-	9	13	-	15	
	Countersunk		-	-	-	-	-	-	8	-	-	-	-	A.4
	Raised countersunk		-	-	-	-	-	-	8	-	-	-	-	A.5
	Truss		1	-	-	-	5	6	-	9	13	-	15	A.6
	Binding		1	-	3	-	5	6	-	9	13	-	15	A.7

5. Mechanical properties

5.1 Mechanical properties of screw bodies

Mechanical properties of screw bodies shall be in accordance with strength categories **4.8**, **6.8**, and **8.8** of **JIS B1051**.

5.2 Mechanical properties of washers

Mechanical properties of washers shall be in accordance with **a)** through **c)** below.

- a)** The hardness of the washer shall be as specified in **Table 2-1**. Also, washers shall be free of noticeable decarburization.

Table 2-1 Washer hardness

Washer Type		Hardness
Spring lock	For general use, heavy loads	42 to 50 HRC or 412 to 513 HV
Conical spring		40 to 48 HRC or 392 to 484 HV
Toothed		40 to 50 HRC or 392 to 513 HV
Wave spring		40 to 48 HRC or 392 to 484 HV
Plain washer		Not specified ^{a)}
Note: ^{a)} The user may specify the material and hardness of the washer, taking into consideration sinking and other conditions. In such case, the material and hardness shall be selected from Table 5 or Table 9 of JIS B1256 . However, the hardness category shall be 200 HV, and the material category shall be steel.		

- b) The spring action of the washer shall be in accordance with **Table 2-2**.

Table 2-2 Washer spring action

Washer Type	Test Item	Evaluation Item	Requirements
Spring (general use, heavy load)	Compression test according to 12.2	Free height after test	Indicated in Table A.11
Conical spring			Indicated in Table A.13 and Table A.14
Toothed			At least 5/6 of free height before test
Wave spring			Indicated in Table A.12

- c) The toughness of the washer shall be in accordance with **Table 2-3**.

Table 2-3 Washer toughness

Washer Type	Test Item	Evaluation Item	Requirements
Spring (general use, heavy load)	Torsion test according to 12.2	Condition of washer surface after test	No damage with twist angle less than 90°
Conical spring	Clamping test according to 12.2		No cracks or breakage. If agreed between parties concerned, may omit test for conical spring washers with no electroplating.
Toothed	Torsion test according to 12.2		No damage
Wave spring			No damage with twist angle less than 90°

6. Shape, dimensions, and geometric tolerance

- a) The shape, dimensions, and geometric tolerance of bolts and screws other than cross-recessed-head machine screws shall be in accordance with **Tables A.1 through A.7**.
- b) The shape and dimensions of cross recesses formed on the heads of machine screws shall be in accordance with the H-type cross recesses specified in **JIS B1012**. However, cross-recess wing length m and gauge's sunken depth q shall be in accordance with **Tables A.2 through Table A.7**.
- c) The shape, dimensions, and geometric tolerance of washers shall be in accordance with **Table A.9 through Table A.16**.

7. Threads

The threads of bolts or screws and washer assemblies shall be in accordance with **JIS B 0205-2**, and the pitch shall be in accordance with **Table 3**.

Table 3 Thread pitch

Nominal size		3	4	5	6	8	10	12
Pitch p	Coarse	0.5	0.7	0.8	1.0	1.25	-	-
	Fine	-	-	-	-	-	1.25	1.25

Unit: mm

8. Appearance

The appearance of bolts and machine screws shall be in accordance with **a)** through **d)**, while the surface roughness shall be as specified in **11**.

- a)** Washers shall turn freely and shall not easily disengage from the threaded section.
- b)** Defects on the surface of the screw body meet the provisions in **8. a)** (Tolerance limits for surface defects) of **JASO F101**. Machine screws, however, shall be in accordance with **9** (Surface conditions) of **JASO F116**.
- c)** The surface of the screw body shall be free of flashes, burrs, roughness, rust, and other defects detrimental to practical usage.
- d)** The surface of the washer shall be smooth and free of cracks, noticeable flaws, burrs, roughness, rust, and other defects.

Furthermore, the cut surface of a spring washer shall be free of noticeable burrs, and no portion shall overlap when the washer is fully compressed.

9. Material

9.1 Screw body material

Screw bodies shall be made of carbon steel and its mechanical properties shall be in accordance with **5.1**.

9.2 Washer material

Washers shall normally be made from the materials indicated in **Table 4**.

Table 4 Washer material

Washer Type	Material	
	Symbol	Applicable Standard
Spring	SWRH 57 (A.B) to 77 (A.B)	JIS G3506
Conical spring	S 50 CM to S 70 CM	JIS G3311
	S 50 C - CSP to S 70 C - CSP, SK 85 - CSP	JIS G4802
Toothed	S 50 CM to S 70 CM	JIS G3311
	S 50 C - CSP to S 70 C - CSP	JIS G4802
Wave spring	SWRH 57 (A.B) to 77 (A.B)	JIS G3506
Plain	SPHC	JIS G3131
	SPCC	JIS G3141

10. Surface treatment

Bolt and machine screw surfaces shall normally be provided with hexavalent chromium-free surface treatment equivalent to Ep-Fe/Zn 5 C as specified in **JIS D0201**.

If, however, the surface is not treated or another surface treatment is provided, the user shall specify it.

Furthermore, hydrogen embrittlement removal treatment shall be provided for plated bolts and machine screws as needed. This requirement may be omitted, however, when patenting material is used for the washer.

11. Surface roughness

The surface roughness shall be $3.2\ \mu\text{m}$ Ra_{75} for the bearing surface of bolts and machine screws, and $6.3\ \mu\text{m}$ Ra_{75} for the crown and cylindrical sections as specified in **JIS B0601**.

Furthermore, the threaded section shall be smoothly finished.

12. Mechanical property tests method

12.1 Test method for mechanical property of screw body

The mechanical properties of screw bodies shall be tested as indicated in **Table 5**. Bolts and machine screws shall be tested with washers attached.

Table 5 Test method for mechanical property of screw body

Test Item	Test Method
Product tensile strength	JIS B1051, 8.2 (Tensile tests for bolts, screws, and studs in product condition)
Hardness	JIS B1051, 8.4 (Hardness tests)
Proof load stress	JIS B1051, 8.5 (Proof load tests)
Wedge tensile strength	JIS B1051, 8.6 (Wedge tensile tests for bolts and screws in product condition [Not applicable to studs])
Head impact strength	JIS B1051, 8.8 (Too short to perform wedge tensile test. Nominal diameter of 10 mm. Head impact test for following bolts and screws.)
Decarburized layer of threaded section	JIS B1051, 8.9 (Decarburization tests: Evaluations of surface carbon condition)
The supplemental explanation for Table 5 is as follows: a) The hardness test shall check the hardness at the centre portion of the screw body thread end. However, upon agreement between the parties concerned, measurements can be taken at either the side of the head or at a face formed by cutting the screw at a distance from the tip approximately equal to the screw diameter. b) During the head impact test, the washer shall not be taken into consideration.	

12.2 Test method for mechanical property of washer

The mechanical properties of washers shall be tested as indicated in **Table 6**. Washers shall be tested after the shaft section has been removed from the screw body.

Table 6 Test method for mechanical property of washer

Washer Type		Property to be Checked	Test Item	Test Method
Spring	General use, heavy load	Hardness	Hardness test	JIS B1251, 12.1 (Hardness test)
		Spring action	Compression test	JIS B1251, 12.2 (Compression test)
		Toughness	Torsion test	JIS B1251, 12.3 (Torsion test)
Conical spring	Light load, heavy load	Hardness	Hardness test	JIS B1251, 12.1
		Spring action	Compression test	JIS B1251, 12.2
		Toughness	Clamping test	JIS B1251, 12.4 (Clamping test)
Toothed	Countersunk, external toothed	Hardness	Hardness test	JIS B1251, 12.1
		Spring action	Compression test	JIS B1251, 12.2
		Toughness	Torsion test	JIS B1251, 12.3
Wave spring		Hardness	Hardness test	JIS B1251, 12.1
		Spring action	Compression test	JIS B1251, 12.2
		Toughness	Torsion test	JIS B1251, 12.3

13. Inspections

The screw body and washer shall be inspected as specified hereinafter. However, the acceptance inspection shall be performed in accordance with **JIS B1091** unless specified by the user or by agreement between the parties concerned.

13.1 Mechanical property inspections

13.1.1 Inspection for mechanical property of screw body

The mechanical properties of screw bodies shall be inspected in accordance with **12.1** based on the program shown in **Table 7**, and shall meet the requirements of **5.1**.

Table 7 Inspection program

Inspection Item		Strength Category		
		4.8	6.8	8.8
Product tensile strength ^{a)}		○	○	○
Hardness ^{b)}	Min.	○	○	○
	Max.	○	○	○
Proof load stress		●	●	●
Wedge tensile strength		●	●	●
Head impact strength ^{c)}		○	○	○
Thread decarburization ^{d)}		-	-	●

The supplemental explanation for **Table 7** is as follows:

- a)** Mechanical property suitability or unsuitability shall be determined for items marked with a shaded circle ●.
- b)** Items marked with a hollow circle ○ shall be inspected as needed. Unless particularly designated, these items shall not be inspected for the purpose of determining suitability or unsuitability.
- c)** If a tensile test cannot be performed due to insufficient length or other size-related reason, a hardness inspection shall be performed instead to determine suitability or unsuitability.

Note:^{a)} This inspection may be omitted when a wedge tensile strength inspection is performed.

^{b)} Either Vickers hardness or Rockwell hardness can be applied. If there are doubts regarding a hardness measurement, however, the Vickers hardness value shall be used to determine suitability. To simplify inspection, minimum hardness can be inspected instead of tensile strength for items marked with a shaded circle ●.

However, the final determination of acceptability shall be made by performing a wedge tensile strength inspection.

^{c)} This shall apply to bolts and machine screws whose nominal length is too short for the wedge tensile test.

^{d)} Hardness-based decarburized layer inspections shall apply only to bolts in strength category 8.8 with a pitch of at least 1.25 mm.

13.1.2 Washer inspection

The mechanical properties of washers shall be inspected in accordance with **12.2**, and shall meet the requirements of **5.2**.

13.2 Shape, dimensions, and geometric tolerance inspection

- a)** The shape and dimensions of screws other than cross-recessed types shall be inspected in accordance with the methods of measuring component dimensions and geometric deviations specified in **JIS B 1071** or an alternative method. Furthermore, the requirements of **6 a)** and **c)** shall be met.

- b) The shape and dimensions of cross recesses shall meet the requirements of **6 b)**, and the gauge's sunken depth (q) shall be measured in accordance with **JIS B1012, 3.2.2** (Gauge's sunken depth q of H-type cross recess). The wing length (m) of the cross recess, however, shall be exempt from inspection. Also, the engagement of the cross recess and gauge shall be inspected in accordance with **JIS B1012, 3.2.3** (Engagement of H-type cross recess and gauge), and the screw must not drop by its own weight. This shall not apply, however, when the nominal length (l) is at least 4.5 times the nominal size (d).

13.3 Screw inspection

Screws shall be inspected in accordance with the male screw precision measurement methods specified in **JIS B1071** or an alternative method. Furthermore, the requirements of **7** shall be met.

13.4 Appearance inspection

The appearance shall be inspected in accordance with **a) through d)** below, and the requirements of **8** shall be met.

- a) Washer rotation and release shall be visually inspected.
- b) The surface of the screw body shall be checked for defects visually with the naked eye or with a magnifying glass. If a defect is detected, its width and depth shall be determined with a microscope.
Incidentally, the depth shall be measured at the cross section when necessary. Furthermore, plated bolts and machine screws shall be inspected after the plating is removed.
- c) Surface roughness shall be checked in accordance with the measurement method specified in **JIS B1071** or an alternative method. Furthermore, the requirements of **11** shall be met.
- d) A visual inspection shall be performed for flashes, burrs, rust, and other defects.

13.5 Surface treatment inspection

The surface treatment shall be inspected in accordance with **JIS D0201**, and the requirements of **10** shall be met. The threaded section, however, shall be exempt from inspection.

14. Product designation

Example: JASO F 109	Round head screw Class 13	M5×20	4.8	Ep - Fe/Zn 5 C
JASO F 109	Hexagon bolt Class 5	M6×35×18	8.8	Upset type
(Standard No.)	(Type)	(Strength category)	(Surface treatment or instructions)	
	(Nominal size (d) × Nominal length (l) × Thread length (b))			

15. Strength category designation

The strength category, based on **Table 8**, shall be displayed on the crown (top of the head) of nominal size M6 or larger bolts. And normally the manufacturer's identification symbol shall also be displayed for bolts of at least strength category 8.8 and nominal size M6.

Table 8 Designation symbol

Strength category	4.8	6.8	8.8
Designation symbol	4.8	6.8	8.8
The supplemental explanation for Table 8 is as follows: a) The decimal point can be omitted from the designation symbol. Furthermore, usage of low-carbon martensitic steel with a strength category of 8.8 shall be denoted by an underline as <u>8.8</u>. b) The designation symbol may be embossed or engraved, as long as it is clearly marked. Furthermore, the character font and size shall be left to the discretion of the manufacturer. c) Designations other than the above shall be determined by agreement between the parties concerned.			