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JSS II 09-2015

Sets of Torshear Type High-Strength Bolt, Hexagon Nut and Plain Washer for Structural Joints

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Forward

This document is the English edition of JSS II 09-2015 *Sets of Torshear Type High-Strength Bolt, Hexagon Nut and Plain Washer for Structural Joints,* published in the Japanese language in March 2015. The original Japanese edition contains extensive commentary. That commentary is not included in this English edition.

Standard JSS II 09-2015, hereinafter referred to as the *Standard*, is an industry standard which supplements the Japan Industrial Standard (JIS) B 1186 *Sets of high-strength hexagon bolt, hexagon nut and plain washers for friction grip joints*, established in 1981 and revised in 1996. The Japanese legislative system requires products that adhere to this *Standard* obtain a certification of conformance by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) before the products can be used in building structures (specifically, buildings to which the *Building Standard Law* applies). Each manufacturer is required to obtain an independent certification by MLIT for its product.

The *Standard* was revised in 2015 to address changes within the last twenty years. The recent revision of JIS B 1186, the increasing use of computers and other information technology, along with advancements in manufacturing technology and quality control have made some elements of the previous *Standard* obsolete. The primary modifications are listed below.

i) Alternative test methods are specified for determining the mechanical properties of short bolts from which sampling of coupons is impractical or impossible.
ii) An expanded definition of set lots (derivative lots) is specified to address sets of a particular bolt lot when combined with nuts and washers from multiple lots.

The revised *Standard* was developed and issued by the Committee on Standards Revision established within JSSC. The English translation of the *Standard* was developed by a Translation Committee that was separate from the Committee on Standards Revision. While every effort was made by the Translation Committee to prepare an accurate translation, if any discrepancy is found in the English translation, the original JSS II 09-2015, written in the Japanese language, shall take precedence over the English version.

Committee on Torshear HTB (JSS II 09-2015) Standard Revision

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Revised : March 1, 2015

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The original Japanese edition of JSS II 09-2015 supersedes this English version.

Sets of Torshear Type High Strength Bolt, Hexagon Nut and Plain Washer for Structural Joints

1. Scope

This *Standard* specifies the requirements for sets of a torshear type high-strength bolt, a hexagon nut and plain washer(s) (hereinafter referred to as "sets") that are used in steel structures in the temperature range of 0°C to 60°C.

Note: 1. This *Standard* specifies spline driven bolt sets that are capable of developing a specified minimum bolt tension when installed by an appropriate installation tool, which applies torque to the nut, while at the same time applying a counter torque to the splined end. The splined end extends beyond a shear groove on the threaded end of the bolt. The splined end shears from the body of the bolt when the torque applied exceeds the capacity of the shear groove.

2. The following standards are referenced in this *Standard*.

JIS B 0101 Screw threads and fasteners—Vocabulary

JIS B 0205-3 ISO general purpose metric screw threads—Part3 : Selected sizes for screws, bolts and nuts

JIS B 0209-2 ISO general purpose metric screw threads—Tolerances—Part 2 : Limits of sizes for general purpose external and internal screw threads—Medium quality

JIS B 0251 Limit gauges for metric screw threads

JIS B 1041 Fasteners—Surface discontinuities—Part 1 : Bolts, screws and studs for general requirements

JIS B 1042 Fasteners—Surface discontinuities—Part 2 : Nuts

JIS B 1186 Sets of high strength hexagon bolt, hexagon nut and plain washers for friction grip joints

JIS B 4652 Hand torque tools—Requirements and test methods

JIS Z 2241 Metallic materials—Tensile testing—Method of test at room temperature

JIS Z 2245 Rockwell hardness test—Test method

JIS Z 2320 (All three parts) Non-destructive testing—Magnetic particle testing

JIS Z 2343-1 Non-destructive testing—Penetrant testing—Part 1 : General principles—Method for liquid penetrant testing and classification of the penetrant indication

JIS Z 8401 Guide to the rounding of numbers

JIS Z 9003 Single Sampling Inspection Plans having Desired Operating Characteristics by Variables (Standard Deviation Known)

Notes to the English Edition: Torshear bolts are identical in concept and function to "twist-off" type tension control structural bolts, such as those specified in ASTM F3125, grades F1852 and F2280. In general, nut tightening of torshear bolts is achieved by use of a special

electric or pneumatic tightening tool.

The shear groove of torshear bolts is carefully designed and manufactured. The shear groove facilitates the "twisting off" of the splined end when the target torque is applied to the nut. When the torque coefficient (as defined in 2.1) is well controlled, along with other production variables and installation techniques, the twist off mechanism is intended to demonstrate visually that the specified bolt (fastener) tension was reached.

It is believed that 95% of bolted slip-critical structural joints constructed in Japan use torshear bolts. This popularity is mainly the result of the installation system using an economical, single sided/single user installation, along with the simple visual inspection that the splined end has been removed.

While the system is quite reliable under controlled conditions, when there are conditions where the torque coefficient varies considerably from the assumed value, such as from unprotected set storage, environmental factors, or lengthy time delays between placement and tensioning, it is recommended that additional measures such as turn-of-nut inspection, additional pre-installation testing, or torque verification be considered for dispute or arbitration.

2. Glossary

The following terms are used in this *Standard* in addition to the terms defined in JIS B 0101.

2.1 Torque Coefficient

When steel plates are fastened using a bolt and nut, the torque applied to the nut is a product of a coefficient, the introduced tension and the nominal bolt diameter. This coefficient is referred to as the torque coefficient.

2.2 Bolt Tension

The tensile force in a bolt after the splined end has sheared from the bolt is referred to as bolt tension. Also sometimes known as clamping force or fastener tension.

3. Set

3.1. Composition

A set is composed of a torshear type high-strength bolt (hereafter referred to as the "bolt"), a suitable heavy-hex nut (hereinafter referred to as the "nut") and a suitable plain washer (hereinafter referred to as the "washer"), each of which is specified in Section 3.2.

3.2 Class and Grades

The components of the set shall be of the grade and class specified in Table 1.

Table 1 Component Grades of Bolt Sets

Component of set	Bolt	Nut	Washer
Grade	S10T	F10	F35

Note 1. Among the classes according to the mechanical properties specified by JIS B 1186, the set given in Table 1 qualifies as Class 2.

2. The grades of each component shall comply with their respective mechanical requirements specified in Tables 2 through 5.

3. While this *Standard* does not specify a torque coefficient requirement for sets, a coefficient between 0.10 and 0.17 is recommended.

3.3 Lot

3.3.1 General

A lot may refer to a lot of an individual component or to a set lot. The definition for each use of the term lot is defined below.

3.3.2 Bolt Lot

A bolt lot shall be uniquely identified by the following:

(a) heat number;

(b) grade, according to mechanical properties;

(c) nominal bolt diameter;

(d) bolt length, l, specified in Table 8;

(e) manufacturing process;

(f) heat treatment; and

(g) surface treatment, if applied.

Bolts that are within a small variation in length l but are identical in all other items listed above shall be considered to be of an identical lot.

3.3.3 Nut Lot

A nut lot shall be uniquely identified by the following:

(a) heat number;

(b) grade, according to mechanical properties;

(c) manufacturing process,

(d) heat treatment; and

(e) surface treatment, if applied.

3.3.4 Washer Lot

A washer lot shall be uniquely identified by the following:

(a) heat number;

(b) grade, according to mechanical properties;

(c) manufacturing process;

(d) heat treatment; and

(e) surface treatment, if applied.

3.3.5 Set Lot

A set lot composed of bolts, nuts and washers of the same lot are assigned a lot number as an "original set." Because bolt lots, nut lots and washer lots differ in quantity, additional set lots, referred to as "derivative sets," may be created by bolts from the same lot as the original set, but with nuts and/or washers from different lots. The original set and derivative sets shall be distinguished by different lot numbers. There may be more than one derivative set associated with an original set. However, provided that all four of the following conditions are met, the derivative set may be certified with the same mill test report as the original set.

(a) The bolts in the derivative set are of the same lot as those in the original set. The nuts and washers in the derivative set are produced by the same manufacturer as those in the original set.

(b) Results of all specified tests and inspections are documented, and the documentation is preserved by the manufacturer for both the original set and the derivative set.

(c) The coefficient of variation (CV or RSD) computed for ten (10) bolt tensile tests (refer to Section 11.2), where five (5) samples each are taken from both the original set and the derivative set, is not more than 5%.

(d) The set tensile strengths from six (6) sets, tested in accordance with Section 11.1.1(1.3), where three (3) sets each are taken from both the original set and the derivative set, are approximately identical. In those tests, none of the six (6) specimens fail by separation of the head, bolt or nut stripping, and all specimens exhibit ductile fracture in the threaded portion of the bolt. Where tensile testing is not practical due to short bolt length, this condition may be waived.

4. Mechanical Properties

4.1 Bolts

4.1.1 Test Coupons

Mechanical properties of bolts shall be determined using coupons prepared in accordance with Section 11.1.1(1.1), and shall comply with the requirements in Table 2. Where short bolt length makes sampling of such coupons impractical, the mechanical properties shall be determined based on the alternative coupon method specified in Section 11.1.1(1.1.1.2).

When rating for impact is required, specific testing requirements, such as Charpy impact testing, shall be established between the supplier and the purchaser.

Table 2 Mechanical Requirements for Coupons

Grade	Yield Strength N/mm^2	Tensile Strength N/mm^2	Elongation %	Reduction of Area %
S10T	900 min.	1 000 to 1 200	14 min.	40 min.

4.1.2 Full-Size Bolts

The mechanical properties of full-size bolts shall be determined based on the tensile test procedure specified in Section 11.1.1(1.2). The tensile load at failure shall exceed the minimum tensile load specified in Table 3. Failure by separation of the head from the body of the bolt shall be considered nonconforming.

Hardness shall be determined based on the test procedure specified in Section 11.1.1(2), and shall comply with the requirement in Table 3. When agreement is established between the supplier and the purchaser, the hardness test requirement may be waived for bolts that meet the tensile test requirements.

Table 3 Mechanical Requirements for Bolts

Grade	Minimum Tensile Load (kN) Nominal Diameter						Hardness (H_RC)
	M 16	M 20	M 22	M 24	M 27	M 30	
S10T	157	245	303	353	459	561	27 to 38

4.2 Nuts

The mechanical properties of nuts shall be determined based on the test procedures specified in Section 11.1.2, and shall comply with the requirements in Table 4.

Table 4 Mechanical Requirements for Nuts

Grade	Hardness (H_RC)		Proof load
	Min.	Max.	
F10	20	35	Minimum tensile load specified in Table 3.*

4.3 Washers

The hardness of the washer shall be determined based on the test procedure specified in Section 11.1.3, and shall comply with the requirement in Table 5. Washers shall be through hardened. Surface hardening treatment, such as carburization is not permitted..

Table 5 Hardness Requirement for Washers

Grade	Hardness (H_RC)
F 35	35 to 45

5. Bolt Tension

5.1 Ambient Temperature

At ambient temperature, the bolt tension of a set lot shall be determined based on the test procedure specified in Section 11.2, and shall comply with the requirements in Table 6.

Table 6 Bolt Tension of Sets Tested at Ambient Temperature

[Unit: kN]

Bolt Size (d)	Average Bolt Tension in Set Lot ([1])	Standard Deviation of Bolt Tension within a Set Lot ([1])
M 16	110 to 133	8.5 max.
M 20	172 to 207	13 max.
M 22	212 to 256	16 max.
M 24	247 to 298	19 max.
M 27	322 to 388	24 max.
M 30	394 to 474	30 max.

([1]) A set lot is defined in Section 3.3.5.

Note Where the short length l of the bolt makes the lot bolt tension test impractical, an alternative quality assurance method shall be established between the supplier and the purchaser.

5.2 Temperature Dependence

The bolt tension of a set lot shall be determined for each temperature based on the test procedure specified in Section 11.3, and shall meet the requirements in Table 7.

Table 7 Temperature Dependence of Bolt Tension

[Unit: kN]

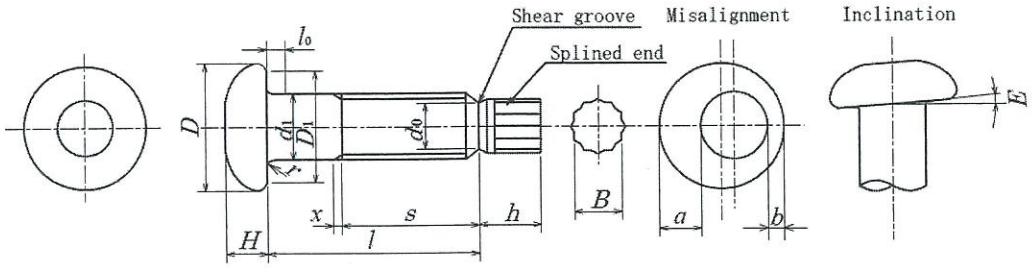
Bolt Size (d)	Average Bolt Tension from Set Lot ([1])
M 16	106 to 139
M 20	165 to 217
M 22	205 to 268
M 24	238 to 312
M 27	310 to 406
M 30	379 to 496

Note Where the short length l of the bolt makes the lot bolt tension test impractical, an alternative quality assurance method shall be established between the supplier and the purchaser.

6. Shape and Dimensions

The shape and dimensions of bolts, nuts and washers shall be within the tolerance specified in Tables 8 through 10.

Table 8 Torshear Type High-Strength Bolts



[Unit: mm]

Bolt Size (d)	d_1 ([2])		D_1	D	H		d_0		h	B		r	a–b	E	s	
	Nom.	Tol.	Min.	Min.	Nom.	Tol.	Nom.	Tol.	Ref.	Nom.	Tol.		Max.	Max.	Nom.	Tol.
M16	16	+0.7 to −0.2	26	27	10	±0.8	Not specified		15	11.3	±0.3	1.2 to 2.0	0.8	1°	30	+5 to 0
M20	20	+0.8 to −0.4	33	34	13	±0.9			18	14.1			0.9		35	+6 to 0
M22	22		37	38.5	14				19	15.4			1.1		40	
M24	24		41	43	15				20	16.8		1.6 to 2.4	1.2		45	
M27	27		47	49	17				22	19.0			1.3		50	
M30	30		53	55	19	±1.0			24	21.1		2.0 to 2.8	1.5		55	

([2]) Dimension d_1 shall be measured at a distance l_0 from the bearing surface, where l_0 shall be taken as $d_1/4$.

Note: 1. Length x of incomplete threads shall be approximately twice the thread pitch except for all-threaded bolts where x shall equal approximately three times the thread pitch.

2. Subject to agreement between the supplier and the purchaser, dimension d_1 of the unthreaded segment may be reduced to the effective diameter of the threaded segment. In this case, the radius r under the head shall be dimensioned as follows:

[Unit: mm]

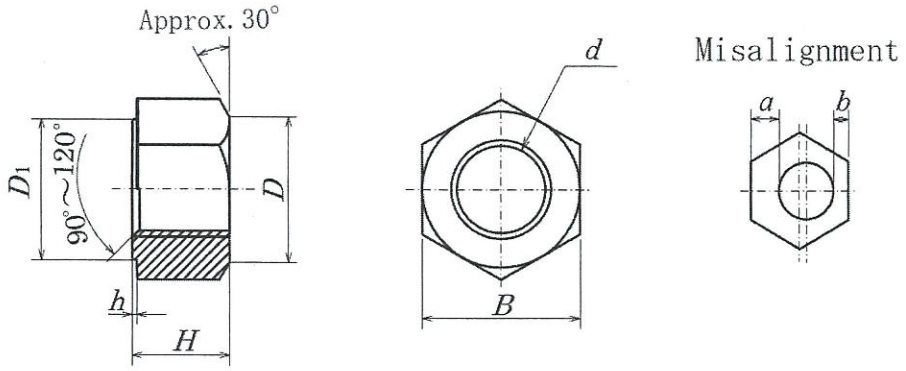
Bolt Size	M16	M20	M22	M24	M27	M30
r	1.2 to 2.4	2.0 to 3.3		2.5 to 3.8		

3. The circles in the following table marks the recommended bolt lengths l.
4. Dimensions l and s may be varied from the listed values when agreement is made between the supplier and the purchaser.

[Unit: mm]

Bolt Size (d)	l Bolt Length																																	
	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	190	200	210	220
M16			○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○																
M20				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○												
M22					○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○								
M24						○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○				
M27							○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
M30										○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Tol. in l	±1.0					±1.4														±1.8														

Table 9 High-Strength Heavy-Hex Nuts for Structural Joints

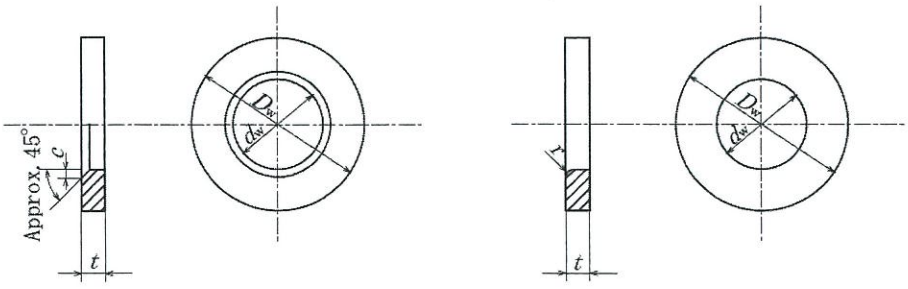


[Unit: mm]

Bolt Size (d)	Outside Thread Diam.	H		B		D	D_1	$a-b$	h
		Nom.	Tol.	Nom.	Tol.	Ref.	Min.	Max.	
M16	16	16	±0.35	27	0 to −0.8	25	25	0.8	0.4 to 0.8
M20	20	20	±0.4	32	0 to −1	30	29	0.9	
M22	22	22		36		34	33	1.1	
M24	24	24		41		39	38	1.2	
M27	27	27		46		44	43	1.3	
M30	30	30		50		48	47	1.5	

Note The chamfer on the bearing side of the nut shall have a diameter of 1.0 to 1.05d.

Table 10 Hardened Plain Washers for Structural Joints



[Unit: mm]

Nominal Diameter	d_w		D_w		t		c or r
	Nom.	Tol.	Nom.	Tol.	Nom.	Tol.	Ref.
16	17	+0.7 to 0	32	0 to −1	4.5	±0.5	1.5
20	21	+0.8 to 0	40				2.0
22	23		44		6	±0.7	
24	25		48				2.4
27	28		56	0 to −1.2			
30	31	+1.0 to 0	60		8		2.8

Note As shown in the figures, either a 45° chamfer c or radius r may be used.

7. Threads and Shear Groove

The threads of bolts and nuts shall be the coarse thread series as specified in JIS B 0205-3 with a thread pitch as listed in Table 11. The tolerance grade shall be 6H/6g as specified in JIS B 0209-2.

The threads and shear groove of the bolts shall be made by thread rolling. The shear groove shall be designed to break at the prescribed bolt tension.

Table 11 Thread Pitch

[Unit: mm]

Thread Designation	M16	M20	M22	M24	M27	M30
Pitch	2	2.5	2.5	3	3	3.5

8. Appearance

8.1 Bolt

Bolts shall be free from forging cracks or any unfavorable defects defined in JIS B 1042 including flaws, burrs, rust or thread damage.

8.2 Nut

Nuts shall be free from forging cracks or any unfavorable defects defined in JIS B 1042 including flaws, burrs or rust.

8.3 Washer

Washers shall be free from forging cracks, unfavorable defects, burrs, rust or substantial warping.

9. Materials

Provided that the requirements of Sections 4 through 8 are met, any material may be used for bolts, nuts and washers.

10. Surface Treatment

Surface treatment may be applied to bolts, nuts and washers provided that the treatment does not adversely affect the mechanical properties.

11. Tests and Measurements

11.1 Mechanical Properties

11.1.1 Bolts

The mechanical properties of bolts shall be determined by tensile and hardness testing defined in this section.

(1) Tensile Test

Tensile tests shall be performed on coupons machined from the bolt and on full-size assemblies consisting of the bolt, nut and washer used for the set.

(1.1) Tensile Coupon Test

(1.1.1) Coupon

(1.1.1.1) Coupons to be used in tensile tests shall be No. 4 coupons, as specified in JIS Z 2201, and shall be machined from the bolt as illustrated in Fig. 1(A) or (B).

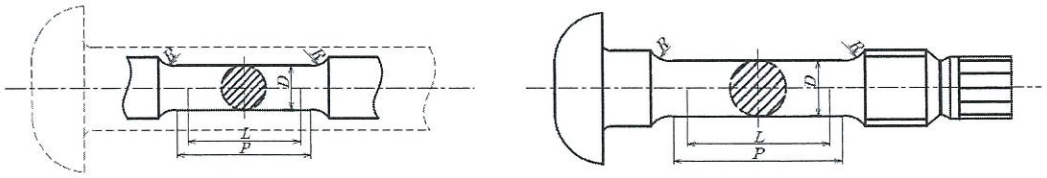


Fig. 1 Coupon Dimensions

Gage length:	L = 50 mm
Diameter:	D = 14 ± 0.5 [mm]
Length of reduced section:	P = approx. 60 mm
Radius of fillet:	R = 15 mm min.

Where the above mentioned dimensions are not possible, reduced-size coupons may be used that meet the following requirements.

$L = 3.54D$

D : shall not be less than the value given in Table 8.

$P = L + D$

R= 4 mm min.

Table 12 Minimum Diameter of Coupons

Bolt Size	D (mm)
M16	6
M20	6
M22	6
M24	8
M27	10
M30	12

(1.1.1.2)Where the short length l of the bolt makes the above described coupon sampling method impractical, coupons may be machined from a rod of the same material as the bolt lot ([3]) and heat treated with that bolt lot. The coupons shall be No. 4, as specified in JIS Z 2201, and machined to no smaller than the dimension D given in Table 12.

Where a No. 4 coupon cannot be sampled, the mechanical requirement of the bolt may be based on hardness measured in a cross section within the unthreaded body. The requirement is listed in Table 3, while the test method is defined in Section 11.1.1(1.1.2).

([3]): The rod shall be sampled from material (steel) of the same melt number and same rod (wire) diameter as the bolt.

(1.1.2) Test Method

Tensile tests shall be conducted in accordance with JIS Z 2241. Where surface hardness tests are performed in lieu of tensile tests due to the small size of the bolt, the hardness tests shall be conducted in accordance with Rockwell hardness tests specified in JIS Z 2245. Hardness shall be measured at five points along the diameter as indicated in Fig. 2, at the center, mid-radius, and 2 mm from the surface , and represented by the average of the those five measurements. Hardness evaluated from three samples selected arbitrarily shall conform to the requirements specified in Table 3.

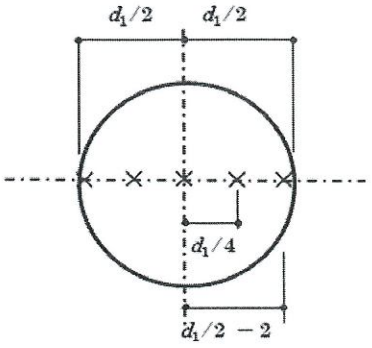


Fig. 2 Hardness Measurement Points

(1.2) Full-Bolt Tensile Test

Tensile tests of full-size bolts shall be conducted using a set of grips, as shown in Fig. 3(A) or (B), with appropriate shape, size and stiffness. A wedge (see Fig. 4) of hardness 45 H_RC or greater shall be placed between the grip and bolt head, with the outer edge of the bolt head contacting the inclined face of the wedge. The opposite end of the bolt shall bear against the grip using a fixture or nut but leaving six bolt threads unengaged between the grips. The bolt assembly shall develop the minimum tensile load specified in Table 3 prior to failure. Failure by separation of the head from the body shall be considered nonconforming. If thread stripping occurs prior to failure in the body, the lot shall be retested after replacing the grip, fixture, or nut to increase the depth of thread engagement.

The use of a wedge is not necessary if the grip itself meets the specified contact angle and hardness as shown in Fig. 5.

Part \ Unthreaded Body Length, $(l-s)$	To $2d$, incl.	Over $2d$
θ	6 ± 0.5°	10 ± 0.5°

[Unit: mm]

Dimension \ Bolt Size	M16 to M22	M24 to M30
r	2.0	2.4
c	1.6	2.0

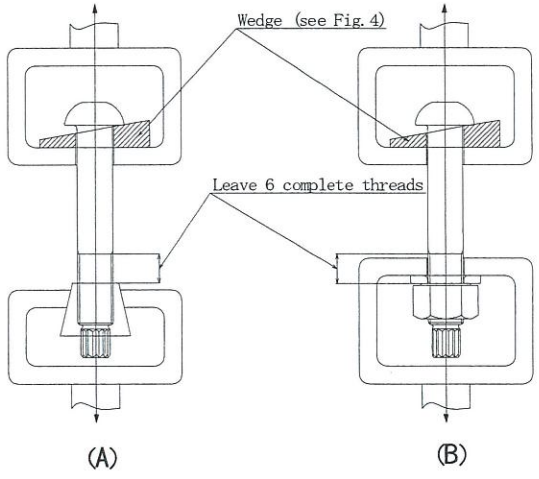


Fig. 3 Full-Bolt Tensile Test

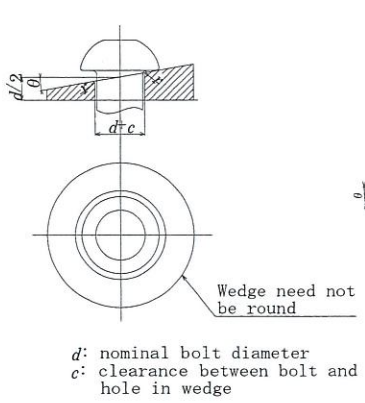


Fig. 4 Wedge Dimension

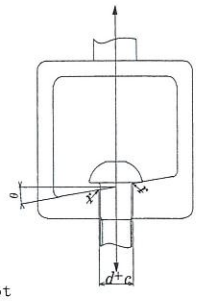


Fig. 5 Grip with inclined face

(1.3) Set Tensile Test

Full-bolt tensile tests of a set shall be performed using grips with a nut as illustrated in Fig. 3(B). The full bolts shall be tested to failure to confirm that the failure mode is ductile fracture and that head separation from the body or thread stripping does not occur. Proof load tests of the nut lot may be waived for set lots that pass this test.

(2) Hardness Testing of Bolts

Hardness tests of bolts shall be conducted in accordance with JIS Z 2245. For each sampled bolt, hardness

shall be measured at three points on the head. The average measurement rounded to an integer per JIS Z 8401 shall be taken as the hardness of the bolt.

11.1.2 Nuts

The mechanical properties of nuts shall be determined by the hardness test and proof load test defined in this section.

(1) Hardness Test

Hardness tests of nuts shall be conducted in accordance with JIS Z 2245. For each sampled nut, hardness shall be measured at three points on the bearing surface. The average measurement rounded to an integer per JIS Z 8401 shall be taken as the hardness of the nut.

(2) Proof Load Test

Proof load tests of nuts shall be conducted using the method for full-bolt tensile test described in Section 11.1.1(1.2) but using the nut specimen to engage the bolt thread and applying the proof load specified in Table 4 to examine whether the nut can develop the load without stripping or unanticipated fracture. A wedge shall not be placed under the bolt head. A hardened threaded mandrel may be used in lieu of a bolt.

11.1.3 Washers

Hardness tests of washers shall be conducted in accordance with JIS Z 2245. For each sampled washer, hardness shall be measured at three points on the bearing surface. The average measurement rounded to an integer per JIS Z 8401 shall be taken as the hardness of the washer.

11.2 Bolt Tension Test at Ambient Temperature

The bolt tension of set lots at ambient temperature shall be determined according to the procedure described below.

(1) The test shall be conducted at an ambient temperature between 10°C and 30°C.

(2) The test shall be conducted using either a specialized bolt testing machine or a separate load cell and tightening device. Bolt tension shall be measured after tightening the bolt until fracture occurs at the shear groove.

(3) The scale interval of the load measurement device shall be no more than 1% of the bolt tension and its instrument error shall be no more than 2% of the range of measurement.

(4) Room temperature during testing shall be recorded.

11.3 Temperature Dependence of Bolt Tension

The temperature dependence test of bolt tension of set lots shall be determined according to the procedure described below.

(1) In addition to the ambient temperature test specified in Section 11.2, tests shall be conducted at low (0°C) and high temperature (60°C).

(2) The test shall be conducted using either a specialized bolt testing machine or a separate load cell and tightening device. Bolt tension shall be measured after tightening the bolt until fracture occurs at the shear groove.

(3) The scale interval of the load measurement device shall be no more than 1% of the bolt tension and its instrument error shall be no more than 2% of the range of measurement.

(4) The scale interval of the surface thermometer shall be no more than 2°C and its instrument error shall be no more than 2°C for the temperature range of -5 to 65°C.

(5) The surface temperature of the bolt set shall be within 4°C from the target temperature.

(6) Room temperature during testing shall be recorded.

(7) The temperature dependence test shall be conducted using common production materials, and shall be conducted several times per year at evenly paced intervals covering extreme range of weather conditions from dry to humid, and from hot to cold.

11.4 Surface Defect Test for Bolts

Cracks, flaws, or any defects on the bolt surface shall be examined either by liquid penetrant testing specified in JIS Z 2343-1 or by magnetic particle testing specified in JIS Z 2320.

12. Inspection and Acceptance Criteria

12.1 Shape and Dimensions

The shape and dimensions of bolt, nuts and washers shall be inspected, by direct measurement or by using limit gages, to verify conformance with the requirements specified in Section 6.

12.2 Threads

The threads of bolts and nuts shall be inspected, using limit gages (6H and 6g) for metric coarse threads as specified in JIS B 0251 or using other suitable inspection devices, to verify conformance with the requirements specified in Section 7.

12.3 Appearance

The appearance of bolts, nuts and washers comprising a set shall be inspected to verify conformance with the requirements specified in Sections 8.1 to 8.3.

12.4 Surface Defect Test

Surface defects shall comply with the requirements specified in JIS B 1041 and JIS B 1042.

12.5 Mechanical Properties

12.5.1 Machined Coupons

The yield strength, tensile strength and reduction of area determined from coupons machined from a bolt as specified in Section 11.1.1(1.1) shall conform to the requirements specified in Section 4.1.1.

The acceptable quality level (AQL) of the inspected bolt lot ([4]) shall be $p_0 \leqq 0.125\%$ ([5]) ($\alpha \fallingdotseq 0.05$) and $p_1 \leqq 12.5\%$ ([6]) ($\beta \fallingdotseq 0.10$).

The method of specimen sampling shall be in accordance with JIS Z 9003.

(4) The inspected bolt lot shall comply with the definition in Section 3.3.2.

(5) The value of p_0 = 0.125 % is the typical value representing the range of p_0 between 0.113 and 0.140%.

(6) The value of p_1 = 12.5% is the typical value representing the range of p_1 between 11.3 and 14.0%.

Note Notations p_0, p_1, α and β are as defined in JIS Z 9015-0.

12.5.2 Full-Size Bolts

The tensile strength and hardness determined from the test methods specified in Sections 11.1.1(1.2) and 1.1.1(2) shall conform to the requirements specified in Section 4.1.2.

The acceptable quality level (AQL) of the inspected bolt lot (4) shall be $p_0 \leqq 0.125\%$ (5) ($\alpha \fallingdotseq 0.05$) and $p_1 \leqq 8\%$ (7) ($\beta \fallingdotseq 0.10$).

The method of specimen sampling shall be in accordance with JIS Z 9003.

(7) The value of p_1 = 8% is the typical value representing the range of p_1 between 7.11 and 9.00%.

12.5.3 Nuts

The hardness and proof-load test results determined from the test methods specified in Sections 11.1.1(1.2) and 1.1.1(2) shall conform to the requirements specified in Section 4.2.

The acceptable quality level (AQL) of the inspected nut lot (8) shall be as follows:

(1) For hardness tests, the acceptable quality level (AQL) of the inspected nut lot (8) shall be $p_0 \leqq 0.125\%$(5) ($\alpha \fallingdotseq 0.05$) and $p_1 \leqq 8\%$ (7) ($\beta \fallingdotseq 0.10$).

The method of specimen sampling shall be in accordance with JIS Z 9003.

(2) For proof load tests, a minimum of two nuts shall be sampled per inspected nut lot (8), and all samples shall conform to the requirements specified in Section 4.2.

(8) The inspected nut lot shall comply with the definition in Section 3.3.3.

12.5.4 Washer Hardness

The hardness determined from the test methods specified in Section 11.1.3 shall conform to the requirements specified in Section 4.3.

The acceptable quality level (AQL) of the inspected washer lot (9) shall be $p_0 \leqq 0.125\%$ (5) ($\alpha \fallingdotseq 0.05$) and $p_1 \leqq 8\%$ (7) ($\beta \fallingdotseq 0.10$).

The method of specimen sampling shall be in accordance with JIS Z 9003.

(9) The inspected washer lot shall comply with the definition in Section 3.3.4.

12.6 Bolt Tension at Ambient Temperature

The bolt tension of a set tested at ambient temperature shall be based on the test method specified in Section 11.2, and shall conform to the requirements specified in Section 5.1.

The acceptable quality level (AQL) of the inspected set lot (10) shall be as follows:

(1) The standard deviation of bolt tension of the inspected set lot (10) shall have a significance level no more than 5% and a relative standard error no greater than 8%.

Note: If the manufacturing process demonstrates a consistent and stable state, the requirements in Section 12.6(1) may be checked based on the latest quality control data (i.e., an Xbar and R chart) or inspection data.

If deemed necessary, the supplier and the purchaser may agree to relax the acceptance criteria, within reason, by raising the limiting relative standard error and/or reducing the number of samples.

(2) The average bolt tension of the inspected set lot ([10]), established from five sets, shall conform to the requirements specified in Table 13.

([10]) The inspected set lot shall comply with the definition of set lot in Section 3.3.5.

Table 13 Acceptable Quality Level of Average Bolt Tension at Ambient Temperature

[Unit: kN]

Bolt Size (d)	Lower Limit		Upper Limit	
	m_0" ($\alpha \fallingdotseq 0.05$)	m_1" ($\beta \fallingdotseq 0.10$)	m_0' ($\alpha \fallingdotseq 0.05$)	m_1' ($\beta \fallingdotseq 0.10$)
M16	115	106	128	137
M20	179	165	200	214
M22	222	205	247	264
M24	258	238	288	308
M27	336	310	374	400
M30	411	379	457	489

Note 1. The notations m_0', m_1', m_0" and m_1" are as defined in JIS Z 9003.

2. The standard deviation shall be evaluated in accordance with the method specified in Section 12.6(1).

12.7 Temperature Dependence of Bolt Tension

The temperature dependence of bolt tension shall be examined in accordance with Section 11.3, and shall conform to the requirements specified in Section 5.2.

The average bolt tensioin of the inspected set lot ([10]), established from five sets, shall conform to the requirements specified in Table 14. If deemed necessary, the supplier and the purchaser may agree to relax the acceptance criteria, within reason, by repeating the tests using different sets and/or adjusting the number of samples.

Table 14 Acceptable Quality Level of Temperature Dependence of Average Bolt Tension

[Unit: kN]

Bolt Size (d)	Lower Limit		Upper Limit	
	m_0" ($\alpha \fallingdotseq 0.05$)	m_1" ($\beta \fallingdotseq 0.10$)	m_0' ($\alpha \fallingdotseq 0.05$)	m_1' ($\beta \fallingdotseq 0.10$)
M16	111	102	134	143
M20	173	159	209	223
M22	214	197	259	275
M24	249	229	301	321
M27	324	297	392	418
M30	396	364	479	511

Note 1. The notations m_0', m_1', m_0'' and m_1'' are as defined in JIS Z 9003.

2. The standard deviation shall be evaluated in accordance with the method specified in Section 12.6(1).

13. Designation

The set shall be designated by the number or title of the standard, bolt grade, bolt size by (×) bolt length (l), and additional notices ([11]).

([11]) Any additional notice shall be written in parentheses.

Example:

JSS II-2009

or

Sets of Torshear Type High Strength Bolt,
Hexagon Nut and Plain Washer for

Structural Joints	S10T	M20 × 70	( )
(Number or title of standard)	Bolt grade	Bolt size × Bolt length	Additional notices

14. Marking

14.1 Marking of Products

Components of a set shall be marked as follows:

(1) The following items shall be marked on top of the bolt head and may be either raised or depressed.

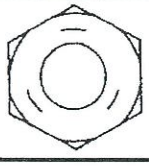
(1.1) Notation (S10T) designating the bolt grade.

(1.2) Registered trademark or identifier to identify the manufacturer.

(2) The notation shown in Table 15 which designates the nut grade shall be marked on the chamfer side of nut and may be either raised or depressed.

When an agreement is established, the manufacturer shall be permitted to mark the nuts with their registered trademark or identifier.

Table 15 Marking symbol of nut

Grade	Marking symbol
F10	

(3) No marking to designate the washer grade is required on washers.

When an agreement is established, the manufacturer shall be permitted to mark the washer with their registered trademark or identifier.

14.2 Marking of Package

The package shall be clearly marked with the following information:

(1) Title of standard;

(2) Bolt grade (S10T);

(3) Bolt size × bolt length (*l*);

(4) Quantity;

(5) Additional notices;

(6) Manufacturer's name or registered trademark;

(7) Lot number of the set; and

(8) Month and year when bolt tension test per Section 11.2 was conducted.

15. Certification

Manufacturers are required to provide the purchaser with a product certification that reports the set lot number, bolt size by (×) bolt diameter, bolt length, inspection results, and identification information.