



**Society of Steel Construction of Japan  
Standard**

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

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

1. Scope

This standard specifies the sets of torshear type high strength bolt, hexagon nut and plain washers (hereinafter referred to as the "sets") that are applied at the temperature range between 0°C and 60°C.

- Remarks:
1. The set specified in this standard is limited to the torshear type one to which the bolt tension is introduced by giving the torque force to the breakage of a pintale neck with its reaction taken by the pintale.
  2. In this standard, units and numerical values given in ( ) are based on the International System of Units(SI), and are given for reference.

2. Composition

A set shall be composed of one torshear type high strength bolt for structural joints (hereinafter referred to as the "bolt"), one high strength hexagon nut for structural joints (hereinafter referred to as the "nut") and one high strength plain washer for structural joint (hereinafter referred to as the "washer"), respectively specified in 3. below.

3. Classes and Grades

The sets shall be of one class and one grade and the combination of the grade of the components according to the mechanical properties is as given in Table 1.

Table 1

Component of the set	Bolt	Nut	Washer
Grade by mechanical property	S 10T	F 10T	F 35

- Remarks:
1. The set given in Table 1 is equivalent to the Class 2 "according to mechanical properties" as specified by JIS B 1186, "Sets of High Strength Hexagon Bolt, Hexagon Nut and Plain Washers for Friction Grip Joints".
  2. The grades of the set components shall be provided with the mechanical properties described in Tables 2 through 5.
  3. The torque factor for the set is not specified in this standard. However, it is recommended to be between 0.10 and 0.17.

4. Mechanical Properties

4.1 Mechanical Properties of Bolt

4.1.1 Mechanical Properties of Test Specimen Machined from Bolt

The mechanical properties of the test specimen machined from bolt shall comply with the requirements of Table 2, when the test is done in accordance with 11.1.1(1)(1.1).

The impact value, when particularly required, shall be subject to an agreement between the parties concerned.

Table 2

Grade by mechanical properties of bolt	Proof stress kgf/mm <sup>2</sup> {N/mm <sup>2</sup> }*	Tensile strength kgf/mm <sup>2</sup> {N/mm <sup>2</sup> }	Elongation %	Reduction of area %
S 10T	min. 90 {min. 882.6}	100 to 120 {980.7 to 1176.8}	min. 14	min. 40

Note \* : 1 N/mm<sup>2</sup> = 1 MPa

4.1.2 Mechanical Properties of Full-Size Bolt

The mechanical properties of the full-size bolt, when tested in accordance with 11.1.1(1)(1.2), shall be such as not to break at less than the tensile load (minimum) specified in Table 3 and also not to bring forth head separation when the tensile load is increased. In addition, when the bolt is tested in accordance with 11.1.1(2), the results shall conform to the hardness requirements of Table 3.

Table 3

Grade by mechanical properties of bolt	Tensile load (min.) (kgf){kN}				Hardness
	Designation of bolt				
	M 16	M 20	M 22	M 24	
S 10T	15700 {154.0}	24500 {240.3}	30300 {297.1}	35300 {346.2}	H <sub>R</sub> C 27 to 38

#### 4.2 Mechanical Properties of Nut

The mechanical properties of nut, when tested in accordance with 11.1.2, shall conform to the requirements of Table 4.

Table 4

Grade by mechanical properties of nut	Hardness		Guaranteed load
	Minimum	Maximum	
F 10T	H <sub>R</sub> B 95	H <sub>R</sub> C 35	Same as the tensile load (min.) of bolt specified in Table 3.

Note \* : Under the guaranteed load, the nut shall be free from any damage, and after taking the load off, the nut shall be easily untightened by fingers from the test bolt. However, the first 1/2 turn can be made by a wrench to loosen.

#### 4.3 Hardness of Washer

The hardness of the washer, when tested in accordance with 11.1.3, shall conform to the requirements of Table 5.

The washers shall not be subjected to surface hardening such as carburization, quenching and tempering.

Table 5

Grade by mechanical properties of washer	Hardness
F 35	H <sub>R</sub> C 35 to 45

5. Bolt Tension of Sets

5.1 Bolt Tension of Sets at Ambient Temperature

The bolt tension of the sets at ambient temperature when tested in accordance with 11.2 shall conform to the requirements of Table 6.

Table 6

Unit: kgf(kN)

Designation of bolt	Average bolt tension in a set <sup>(1)</sup> in one manufacturing lot <sup>(2)</sup>	Standard deviation of bolt tension of a set <sup>(1)</sup> in one manufacturing lot <sup>(2)</sup>
M 16	11000 - 13300 {107.9 - 130.4}	Max. 850 {Max. 8.336}
M 20	17200 - 20700 {168.7 - 203.0}	Max. 1300 {Max. 12.75}
M 22	21200 - 25600 {207.9 - 251.1}	Max. 1600 {Max. 15.69}
M 24	24700 - 29800 {242.2 - 292.2}	Max. 1900 {Max. 18.63}

Notes: <sup>(1)</sup> The bolt tension mentioned above means the tensile force introduced to the bolt at the time of breakage of the pintale neck by applying the torque on the bolt.

<sup>(2)</sup> The one manufacturing lot mentioned above means the lot of the sets which the bolts, nuts and washers of each identical lot constitute. The identical lot of the bolts, nuts and washers mentioned herein shall be as defined below.

(1) The identical lot of the bolts is defined as a manufacturing lot composed by the bolts which are identical in;

- (a) melt number of material (steel),
- (b) class according to mechanical properties,
- (c) designation of bolts,
- (d) length l,
- (e) machining process,

- (f) heat treatment conditions, and,
- (g) surface treatment conditions, when the bolts are subjected to surface treatment.

However, the bolts having slight variations of length l may be considered to be of an identical lot.

- (2) The identical lot of the nuts is defined as a manufacturing lot composed by the nuts which are identical in;

- (a) melt number of material (steel),
- (b) class according to mechanical properties,
- (c) designation of bolts,
- (d) machining process,
- (e) heat treatment conditions, and,
- (f) surface treatment conditions, when the nuts are subjected to surface treatment.

- (3) The identical lot of the washers is defined as a manufacturing lot composed by the washers which are identical in;

- (a) melt number of material (steel),
- (b) class according to mechanical properties,
- (c) designation of washer,
- (d) machining process,
- (e) heat treatment conditions, and,
- (f) surface treatment condition, when the washers are subjected to surface treatment.

Remark: In the case where the bolt tension test for the set is impossible due to the shortage in length, a measure shall be taken by an agreement between the parties concerned.

5.2 Temperature Dependence of Bolt Tension of the Sets

Temperature dependence of bolt tension of the set shall be such that the average bolt tensions at each temperature shall satisfy the values given in Table 7 when one manufacturing lot is tested in accordance with 11.3.

Table 7

Unit: kgf{kN}

Designation of bolt (d)	Average bolt tension <sup>(3)</sup> of the set in one manufacturing lot <sup>(4)</sup>
M 16	10600 - 13900 {104.0 - 136.3}
M 20	16500 - 21700 {161.8 - 212.8}
M 22	20500 - 26800 {201.0 - 262.8}
M 24	23800 - 31200 {233.4 - 306.0}

Notes: <sup>(3)</sup> Bolt tension is the one specified in Note <sup>(1)</sup> of 5.

<sup>(4)</sup> One manufacturing lot is the one specified in Note <sup>(2)</sup> of 5.

Remark: In the case where the bolt tension test for the set is impossible due to shortage in length, a measure shall be taken by an agreement between the parties concerned.

6. Configuration and Dimensions

The configuration and dimensions of the bolts, nuts and washers shall be as specified in Attached Tables 1 through 3.

7. Screw Threads and Pintale Neck

The screw threads of the bolts and nuts shall be the ones specified by JIS B 0205, "Metric Coarse Screw Threads" and their grades shall be of 6H/6g specified in JIS B 0209, "Limits of Sizes and Tolerances for Metric Coarse Screw Threads".

The screw threads of the bolts and the pintale neck shall be made by thread rolling, and the pintale neck shall break at the prescribed tension.



## 8. Appearance

### 8.1 Appearance of Bolt

The appearance of the bolt shall be in compliance with the requirements of Attached Table 1 in surface roughness, and, in addition, free from quenching cracks and such defects harmful in use as flaws, burrs, rust and damage of screw threads. The harmful defects are defined as those specified by JIS B 0101, "Glossary of Terms Relating to Fasteners" in the reference clause.

### 8.2 Appearance of Nut

The appearance of the nut shall be in compliance with the requirements of Attached Table 2 in surface roughness, and, in addition, free from quenching cracks and such defects harmful in use as flaws, burrs and rust. The harmful defects are defined as those specified by JIS B 0101 in the reference clause.

### 8.3 Appearance of Washer

The appearance of the washer shall be in compliance with the requirements of Attached Table 3 in surface roughness, and, in addition, free from quenching cracks and such defects harmful in use as flaws, burrs, rust and remarkable bend.

## 9. Materials

The materials for the bolts, nuts and washers shall satisfy the requirements of 4. through 8.

## 10. Surface Treatment

The bolts, nuts and washers may be subjected to any surface treatment, provided that it might not adversely affect their quality.

## 11. Test and Measurements

### 11.1 Tests on Mechanical Properties

#### 11.1.1 Tests on Mechanical Properties of Bolt

The tests on mechanical properties of the bolt shall consist of the tension test and hardness test described below.

##### (1) Tension Tests of Bolt

The tension tests of the bolt shall be carried out for the test specimens machined from bolt and for the full-size bolt.

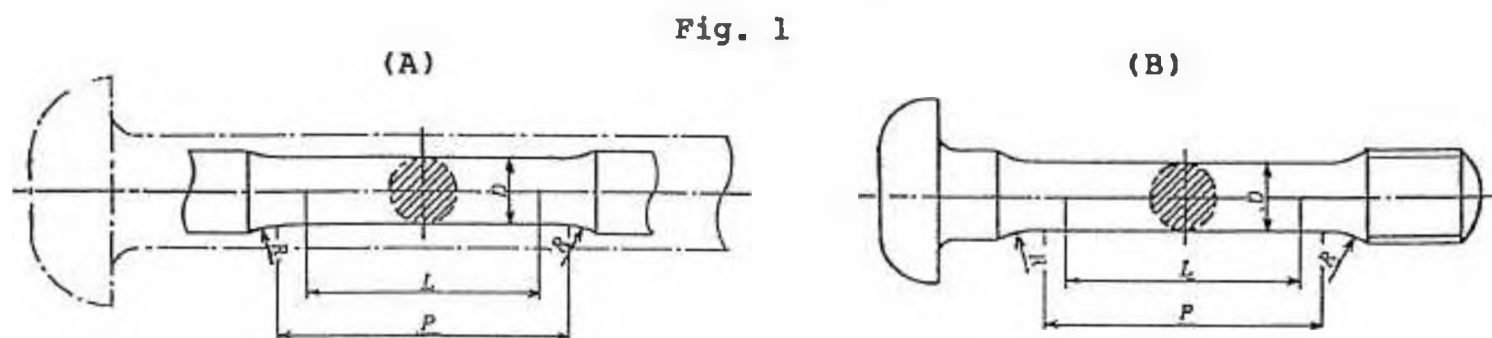
(1.1) Tension tests for test specimens

The tension tests for the test specimens shall be made as described in the following articles.

(1.1.1) Test specimen

The test specimen shall be as follows.

(1.1.1.1) The test specimen to be used shall be the No. 4 test piece specified in JIS Z 2201, "Test Pieces for Tensile Test for Metallic Materials", which is machined from the bolt as shown in Fig. 1 (A) or (B).



Gage length:	L = 50 mm
Diameter:	D = 14 mm
Length of reduced section:	P = approx. 60 mm
Radius of Fillet:	R = min. 15 mm

For the bolt with threads of M 16 to M 24, when unable to be machined to the dimensions given above, the dimensions L and D shall be determined assuming that  $L = 3.54D$ , and P shall be determined assuming that  $P = L + \text{approx. } 10 \text{ mm}$ . In this case, the dimension D shall be not less than the value given in Table 8.

Table 8

Designation of bolt	D (mm)
M 16	6
M 20	6
M 22	8
M 24	10

(1.1.1.2) If it is impossible to machine a test specimen owing to the shortage of the bolt length  $l$ , a test bar taken out of the material of the lot<sup>(5)</sup> identical with the bolt material is to be heat-treated in the same lot as for the bolt and, after the heat treatment, the No. 4 test piece specified in JIS Z 2201 shall be taken out of that test bar. In this case, the dimension  $D$  of the test piece shall be the same as that given in Table 8.

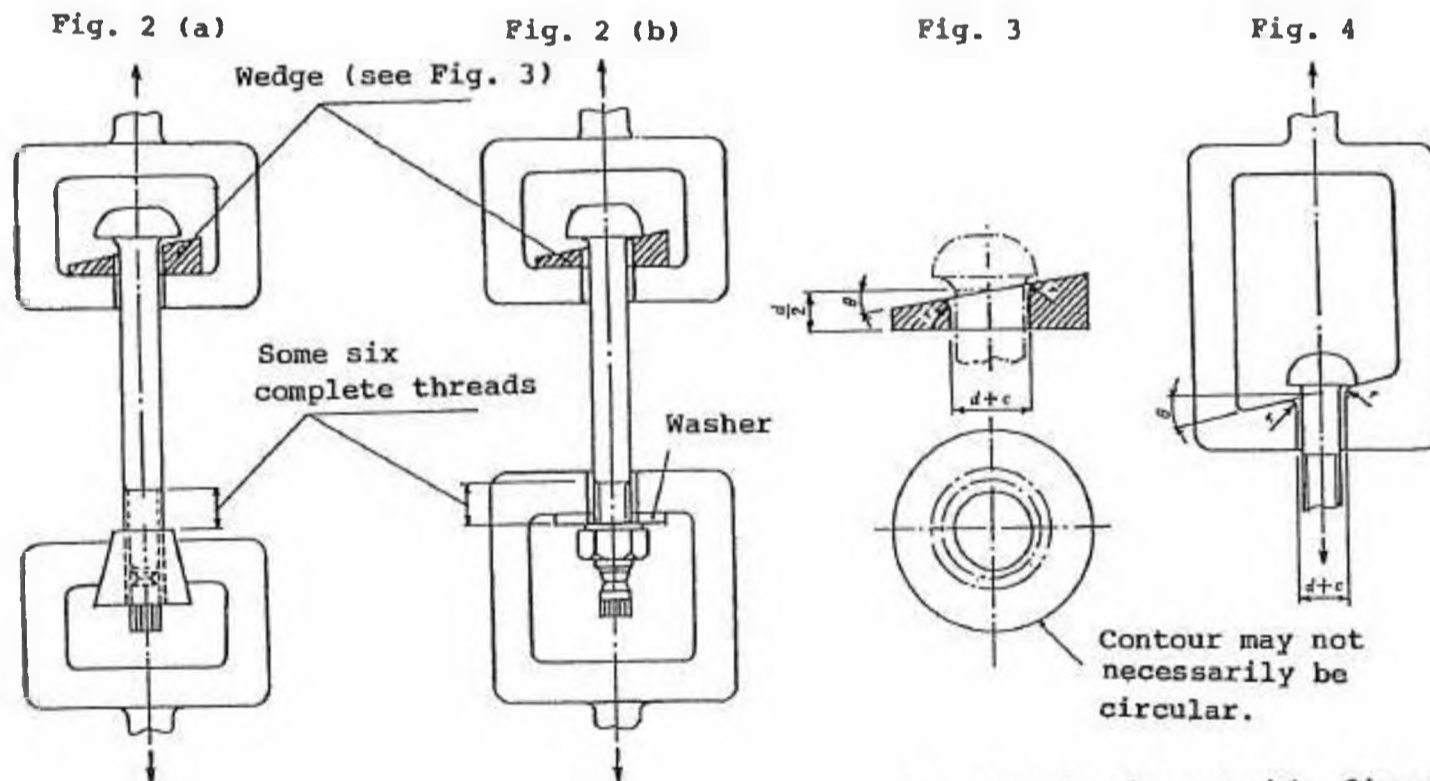
Note <sup>(5)</sup>: The identical lot mentioned above is defined as that identical to the bolt in melt number of material (steel) and diameter.

(1.1.2) Testing Methods

The test shall follow the method specified in JIS Z 2241, "Method of Tensile Test for Metallic Materials".

(1.2) Tension Tests of Full-Size Bolt

The tension tests of full-size bolt shall be carried out as described below (see Fig. 2).



- d: The basic outside diameter of bolt thread
- c: The clearance between the inside diameter of wedge and dimension d.

Put a wedge (see Fig. 3), not less than H<sub>R</sub>C 45 in hardness, beneath the bearing face of a bolt as shown in Fig. 2 (a) or (b) by employment of a jig having suitable construction, shape, dimensions and sufficient rigidity. Make its slope to be in contact with the periphery of the head, and make the jig or a nut to engage with the threaded portion on the opposite side so that some six complete threads remain unengaged in the head side of the bolt. Examine whether the bolt breaks or not under the minimum axial tension load given in Table 3, and examine whether the separation of bolt head brings forth or not when further increasing the tensile load until the bolt breaks down.

In the event of the screw threads coming out due to collapse, retest shall be made after either improving the thread accuracy of the jig or the nut or by increasing the engaging length.

Division	Length of unthreaded part	Under 2d	2d and over
	θ		6 ± 0.5°

Division	Designation of screw threads	M 16 to M 22
	r	
c		1.6

Remark: Where the slope of the jig used for the tension test comes in contact with the bolt bearing face, as shown in Fig. 4, because of its slope same as inclination of the wedge shown in Fig. 3 and the hardness and rigidity are in compliance with the requirements of 11.1.1 (1)(1.2), the wedge is not required.

(2) Hardness Test of Bolt

The hardness test of the bolt shall follow the method specified in JIS Z 2245, "Method of Rockwell Superficial Hardness Test". In this case, measuring places shall be positioned at three points per one sample on the side face of the head or the head top.. Mean of the values obtained shall be rounded off to an integer in accordance with the rule provided in JIS Z 8401, "Rules for Rounding off of Numerical Values", and it shall be taken as the hardness of the sample.

11.1.2 Tests on Mechanical Properties of Nuts

The tests on the mechanical properties of nuts shall consist of the hardness test and guaranteed load test described below.

(1) Hardness Test of Nut

The hardness test of nut shall follow the method specified in JIS Z 2245. In this case, measuring places shall be positioned at three points per one sample on the bearing face of the nut. Mean of the values obtained shall be rounded off to an integer in accordance with the rules provided in JIS Z 8401, and it shall be taken as the hardness of the sample.

(2) Guaranteed Load Test of Nut

The guaranteed load test of nut shall be performed in a manner similar to the bolt tension test described in 11.1.1 (1) (1.2) by engaging a sample nut in place of the internal thread jig and then by applying the guaranteed load given in Table 4 and the existence of abnormalities on the sample shall be examined. In this case, the wedge is not to be used. Instead of the bolt, an external thread jig for testing may be used.

11.1.3 Hardness Test of Washer

The hardness test of washer shall follow the method described in JIS Z 2245. In this case, the measuring places shall be positioned at three points per one sample on the bearing face of the washer. Mean of the values obtained shall be rounded off to an integer in accordance with the rules described in JIS Z 8401, and it shall be taken as the hardness of the sample.

11.2 Bolt Tension Test of Sets at Ambient Temperature

The bolt tension test of the sets at ambient temperature shall be performed as described below.

- (1) The bolt tension test of the sets shall be performed in the ambient temperature (10°C - 30°C).
- (2) The test shall be performed either by a bolt testing machine or a bolt tension meter and a tightening machine. The tightening shall be continuously made until the pintale neck breaks, and the bolt tension shall be measured after the breakage of the pintale neck.
- (3) The scale interval of the bolt tension meter shall be 1 % or smaller of the tension to be measured and its error shall be 2 % or smaller of the scale in the range of the bolt tension to be measured.
- (4) Room temperature shall be measured when testing.

### 11.3 Temperature Dependence Test for Bolt Tension of the Sets

The temperature dependence test for the bolt tension of the sets shall be performed as described below.

- (1) The test shall be made under two surface temperature conditions in addition to the test at ambient temperature described in 11.2; one at a low temperature (0°C) and the other at a high temperature (60°C).
- (2) The test shall be performed either by a bolt testing machine or by a tension meter and a tightening machine. Tightening shall continuously be made until the pintale neck breaks, and the bolt tension shall be measured after the breakage of the pintale neck.
- (3) The scale interval of the bolt tension meter shall be 1 % or smaller of the tension to be measured and the error shall be within 2 % of the smallest scale in the range of the bolt tension to be measured.
- (4) The scale interval of the surface thermometer shall be 2°C or smaller and its error shall be 2°C or smaller for the temperature range of -5°C through 65°C.
- (5) The allowance of the surface temperature of the set to be assumed for the test under low and high temperatures shall be  $\pm 4^\circ\text{C}$ .
- (6) Room temperature shall be measured when testing.

### 11.4 Surface Defect Test for Bolts

The cracks, flaws and the like on bolt surfaces shall be examined either by the liquid penetrant testing method specified in 4. of JIS Z 2343 or by the magnetic particle testing method specified in 5. of JIS G 0565.

## 12. Inspection

### 12.1 Shape and Dimensional Inspection

The inspection for the shape and dimensions of a set shall be performed by testing the bolt, nut and washer constituting the set by direct measurement, by employment of limit gage or by other suitable means, and the test results of each part shall meet the requirements specified in 6.

### 12.2 Screw Threads Inspection

The screw threads inspection for the bolt and nut shall be carried out by using the limit gages (for 6H and for 6g) for metric coarse threads specified in JIS B 0251 or by employment of other suitable screw threads inspecting instrument, and the results shall comply with the requirements of 7.

### 12.3 Appearance Inspection

The appearance inspection of a set shall be performed for the bolt, nut and washer constituting the set, and the results of each part shall comply with the requirements specified in 8.1 to 8.3. The inspection for surface defect shall be made in accordance with 11.3 and the surface roughness inspection shall be made visually or with the aid of surface roughness measuring instrument specified in JIS B 0651 by comparing with the roughness comparison specimens specified in JIS B 0659.

### 12.4 Surface Defect Test

The results shall comply with the Reference clause of JIS B 0101.

### 12.5 Inspection on Mechanical Properties

#### 12.5.1 Inspection on Mechanical Properties of Test Pieces Machined from Bolt

The inspection results on the mechanical properties of test pieces machined from bolts shall comply with the requirements of 4.1.1, when the test pieces are inspected on proof stress, tensile strength, elongation and reduction of area in accordance with the methods 11.1.1(1)(1.1).

In this inspection, the certified level of quality of the inspection lot<sup>(6)</sup> shall be laid down so that  $I'_0 \leq 0.125\%$  <sup>(7)</sup> ( $\alpha \equiv 0.05$ ) and  $I'_1 \leq 12.5\%$  <sup>(8)</sup> ( $\beta \equiv 0.10$ ).

The sampling inspection plan should preferably be in accordance with the sampling inspection plan by variables provided in JIS Z 9003.

- Notes: <sup>(6)</sup> One inspection lot mentioned above is the same as one manufacturing lot defined in (1), Note <sup>(1)</sup>, 5.
- <sup>(7)</sup> The value of  $P_0$ , 0.125 % is a representative value, which represents the values  $P_0$  within the range from 0.113 to 0.140 %.
- <sup>(8)</sup> The value of  $P_1$ , 12.5 % is a representative value, which represents the values  $P_1$  within the range from 11.3 to 14.0 %.

Remark: The notations  $P_0$ ,  $P_1$ ,  $\alpha$  and  $\beta$  are as defined in JIS Z 9001.

12.5.2 Inspection on Mechanical Properties of Full-Size Bolt

The inspection results on mechanical properties of full-size bolt shall comply with the requirements of 4.1.2, when the bolts are inspected on tensile load and hardness in accordance with 11.1.1 (1)(1.2) and 11.1.1 (2).

In this inspection, the certified level of quality of the inspection lot <sup>(6)</sup> shall be laid down so that  $P_0 \leq 0.125\%$  <sup>(7)</sup> ( $\alpha \approx 0.05$ ) and  $P_1 \leq 8\%$  <sup>(9)</sup> ( $\beta \approx 0.10$ ).

The sampling inspection plan should preferably be in accordance with the sampling inspection plan by variables provided in JIS Z 9003.

Note: <sup>(9)</sup> The value of  $P_1$ , 8% is a representative value, which represents the values  $P_1$  within the range from 7.11 to 9.00%.

12.5.3 Inspection on Mechanical Properties of Nut

The inspection results on mechanical properties of nut shall comply with the requirements of 4.2, when the nuts are inspected on the hardness and guaranteed load in accordance with 11.1.2.

In this inspection, the certified level of quality of the inspection lot <sup>(10)</sup> shall be laid down as follows:

- (1) The certified level of quality of the inspection lot <sup>(10)</sup> in the hardness inspection of the nut shall be laid down so that  $P_0 \leq 0.125\%$  <sup>(7)</sup> ( $\alpha \approx 0.05$ ) and  $P_1 \leq 8\%$  <sup>(9)</sup> ( $\beta \approx 0.10$ ).

The sampling inspection plan should preferably be in accordance with the sampling inspection plan by variables provided in JIS Z 9003.

- (2) For the guaranteed load inspection of the nuts, the check inspection shall be carried out for one sample size of two or more pieces for one inspection lot <sup>(10)</sup> and all of the samples shall meet the requirements of 4.2.

Note: <sup>(10)</sup> One inspection lot mentioned above is the same as one manufacturing lot defined in (2), Note <sup>(1)</sup> of 5.



#### 12.5.4 Inspection on Hardness of Washer

The inspection result on hardness of the washer shall comply with the requirement of 4.3, when the washer is inspected in accordance with the method of 11.1.3.

In this inspection, the certified level of quality of the inspection lot<sup>(11)</sup> shall be laid down so that  $P_0 \leq 0.125\% <sup>(7)</sup> ( $\alpha \approx 0.05$ ) and  $P_1 \leq 8\% <sup>(9)</sup> ( $\beta \approx 0.10$ ).$$

The sampling inspection plan should preferably be in accordance with the sampling inspection plan by variables provided in JIS Z 9003.

Note: <sup>(11)</sup> One inspection lot mentioned above is the same as one manufacturing lot defined in (3), Note <sup>(1)</sup> of 5.

#### 12.6 Bolt Tension Inspection of Sets at Ambient Temperature

The bolt tension inspection of the set ambient temperature shall be made in accordance with the method described in 11.2 and the results shall comply with the requirement given in 5.1.

In this inspection, the certified level of quality of the inspection lot<sup>(12)</sup> shall be laid down as follows:

- (1) The certified level of standard deviation on the bolt tension of the inspection lot<sup>(12)</sup> shall be set under the level of significance of 5% or less and under the standard relative error of 8% or less.

Remark: For the application of rule of 12.6(1), if the process is in a stable state, the latest  $\bar{x}$ -R control chart or inspection data including the data of the lot to be inspected may be used.

If particularly required, the sample size may be lessened by slightly enlarging the standard relative error than the specified value, subject to the agreement between the parties concerned.

- (2) The certified levels of quality for the mean value of the bolt tension for the inspection lot<sup>(12)</sup> shall be laid down so that they may be not less than the value given in Table 9 for the sample size of 5 sets.

Note: <sup>(12)</sup> One inspection lot mentioned here is the same one manufacturing lot defined in Note <sup>(1)</sup> of 5.

Table 9

(n=5, Unit: kgf(kN))

Designation of bolt (d)	Values for lower limit		Values for upper limit	
	$m_0'' (\alpha \approx 0.05)$	$m_1'' (\beta \approx 0.10)$	$m_0' (\alpha \approx 0.05)$	$m_1' (\beta \approx 0.10)$
M 16	11500 {112.8}	10600 {104.0}	12800 {125.5}	13700 {134.4}
M 20	17900 {175.5}	16500 {161.8}	20000 {196.1}	21400 {209.9}
M 22	22200 {217.7}	20500 {201.0}	24700 {242.2}	26400 {258.9}
M 24	25800 {253.0}	23800 {233.4}	28800 {282.4}	30800 {302.0}

- Remarks: 1. The notations  $m_0'$ ,  $m_1'$ ,  $m_0''$  and  $m_1''$  are as defined in JIS Z 9003.
2. For the standard deviation, the values obtained in accordance with 12.6 (1) shall be used.

#### 12.7 Temperature Dependence Inspection of Bolt Tension

The temperature dependence inspection of bolt tension of the set shall be made in accordance with the method described in 11.3 and the results shall conform to the requirements given in 5.2.

The certified level of quality for the mean value of the bolt tensions of one inspection lot (<sup>12</sup>) shall be higher than the values given in Table 10 for the size of 5 samples.

If particularly required, the set and the number of tests may be changed, subject to the agreement between the parties concerned.

Table 10

(n=5, Unit: kgf(kN))

Designation of Bolt (d)	Values for lower limit		Values for upper limit	
	$m_0'' (\alpha \approx 0.05)$	$m_1'' (\beta \approx 0.10)$	$m_0' (\alpha \approx 0.05)$	$m_1' (\beta \approx 0.10)$
16	11100 {108.9}	10200 {100.0}	13400 {131.4}	14300 {140.2}
M 20	17300 {169.7}	15900 {155.9}	20900 {205.0}	22300 {218.7}
M 22	21400 {209.9}	19700 {193.2}	25900 {254.0}	27500 {269.7}
M 24	24900 {244.2}	22900 {224.6}	30100 {295.2}	32100 {314.8}

- Remarks: 1. The notations  $m_0'$ ,  $m_1'$ ,  $m_0''$  and  $m_1''$  are as defined in JIS Z 9003.
2. For the standard deviation, the values obtained in accordance with 12.6 (1) shall be used.

### 13. Designation

The set shall be designated in the order of the number or title of the standard, grade according to mechanical properties of the bolt, designation of screw threads x bolt length (1) and particularly specified matters (<sup>13</sup>).

Note: (<sup>13</sup>) The particularly specified matter is to be shown in parentheses.

#### Example:

JSS II-09 or  
set of torshear type  
high strength bolt,  
hexagon nut and plain washer for structural joints      S 10T      M 20 x 70      (      )

(Number or title of standard)	Grade according to mechanical properties of bolt	Designation of screw threads x bolt length	Particularly specified matter
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14. Marking


14.1 Marking of Products

The marking of the parts constituting a set shall be done as described below:

- (1) The following items shall be marked either in relief or by press stamping on the upper face of the bolt head.
  - (1.1) Notation (S 10T) designating the grade according to mechanical properties of bolt.  
  
For the time being, however, the designation of F 10T may be used if agreed by the parties concerned.
  - (1.2) Registered trademark or identification mark of manufacturer.
- (2) The notation designating the grade according to mechanical properties of the nut shall be marked either in relief or by press stamping by using marking symbol of Table 11 on the upper face of the nut.

The registered trademark or identification mark of manufacturer may be marked, when agreed by the parties concerned.

Table 11

Grade by mechanical properties of nut	Marking symbol
F 10	

- (3) The washer is exempted from marking the notation designating the grade according to mechanical properties:

The registered trademark or identification mark of the manufacturer may be marked, when agreed by the parties concerned.

14.2 Marking of Package

The package shall be clearly marked with the following informations:

- (1) Title of the standard
- (2) Grade (S 10T) according to mechanical properties of the bolt.  
For the time being, the designation of F 10T may be used, when agreed by the parties concerned.

- (3) Designation of screw threads x bolt length (1)
- (4) Quantity
- (5) Particularly specified matter
- (6) Manufacturer's name or registered trademark
- (7) Manufacturing lot number of the set
- (8) Month and year of inspection for bolt tension of the set

15. Cautions at the Time of Contract

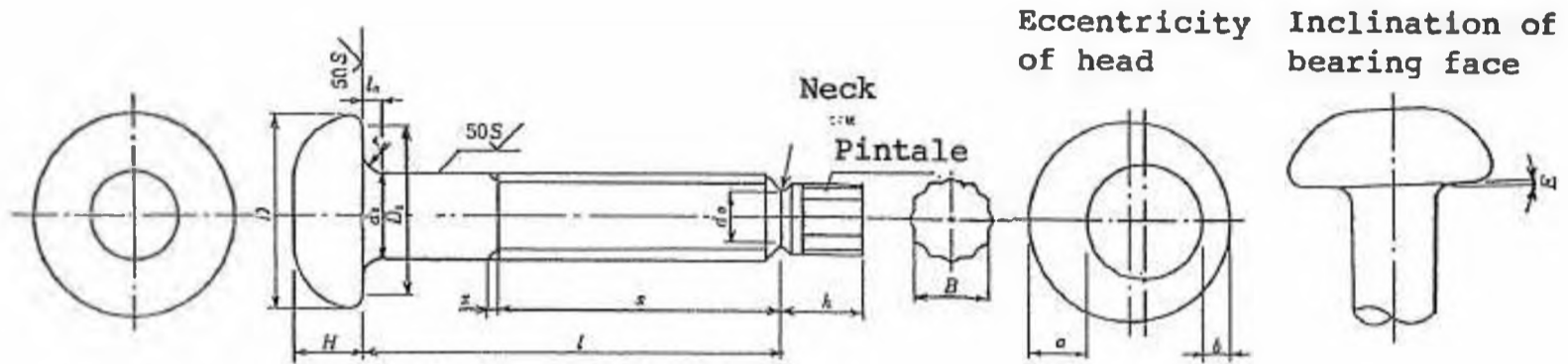
It is recommended that the contract includes the following conditions:

- (1) The manufacturers of sets, bolts, nuts and washers are to submit the control charts or other quality control data or inspection result sheets.
- (2) The manufacturer of the sets is to be given the packaging standard.

Applicable Standards

- JIS B 0101; Glossary of Terms Relating Fasteners.
- JIS B 0205; Metric Coarse Screw Threads
- JIS B 0209; Limits of Sizes and Tolerances for Metric Coarse Screw Threads.
- JIS B 0251; Limit Gages for Metric Coarse Screw Threads.
- JIS B 0651; Instruments for the Measurement of Surface Roughness by the Stylus Method.
- JIS B 0659; Roughness Comparison Specimens.
- JIS B 1186; Sets of High Strength Hexagon Bolt, Hexagon Nut and Plain Washers for Friction Grip Joints.
- JIS B 4650; Torque Wrenches.
- JIS G 0565; Methods for Magnetic Particle Testing of Ferromagnetic Materials and Classification of Magnetic Particle Indication.
- JIS Z 2201; Tension Test Pieces for Metallic Materials.
- JIS Z 2241; Method of Tension Test for Metallic Materials
- JIS Z 2245; Method of Rockwell Hardness Test.
- JIS Z 2343; Methods for Liquid Penetrant Testing and Classification of Indication.
- JIS Z 8401; Rules for Rounding Off of Numerical Values.
- JIS Z 9001; General Principles for Sampling Inspection Procedures (Sampling Inspection No. 1).
- JIS Z 9003; Single Sampling Inspection Plans Having Desired Operating Characteristics Part 3. Sampling by Variables (Standard Deviation Known).

Attached Table 1 Torshear Type High Strength Bolts for Structural Joints



(Unit: mm)

Designation of bolt (d)	d <sub>1</sub> <sup>(14)</sup>		D <sub>1</sub>	D	H		d <sub>0</sub>		h	B		r	a-b		E	S	
	Basic dimension	Tolerance			Min.	Max.	Basic dimension	Tolerance		Basic dimension	Tolerance		Approx.	Basic dimension		Tolerance	Approx.
M 16	16	+0.7 -0.2	26	27	10	+0.8	Not specified		15	11.3	+0.3	1.2-2.0	0.8	1°		30	+5 0
M 20	20	+0.8 -0.4	33	34	13	+0.9			18	14.1			0.9			35	+6 0
M 22	22		37	38.5	14				19	15.4			1.1			40	
M 24	24	41	43	15	20	16.8			1.2	45							

Designation of bolt (d)	Basic dimension (mm)																																					
	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			
M 16			○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		
M 20				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
M 22					○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	
M 24						○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Tolerance on l	± 1.0			± 1.4												± 1.8																						

Note: <sup>(14)</sup> The position for measurement of the dimension d<sub>1</sub> shall be determined so that l<sub>0</sub> ≅ d/4.

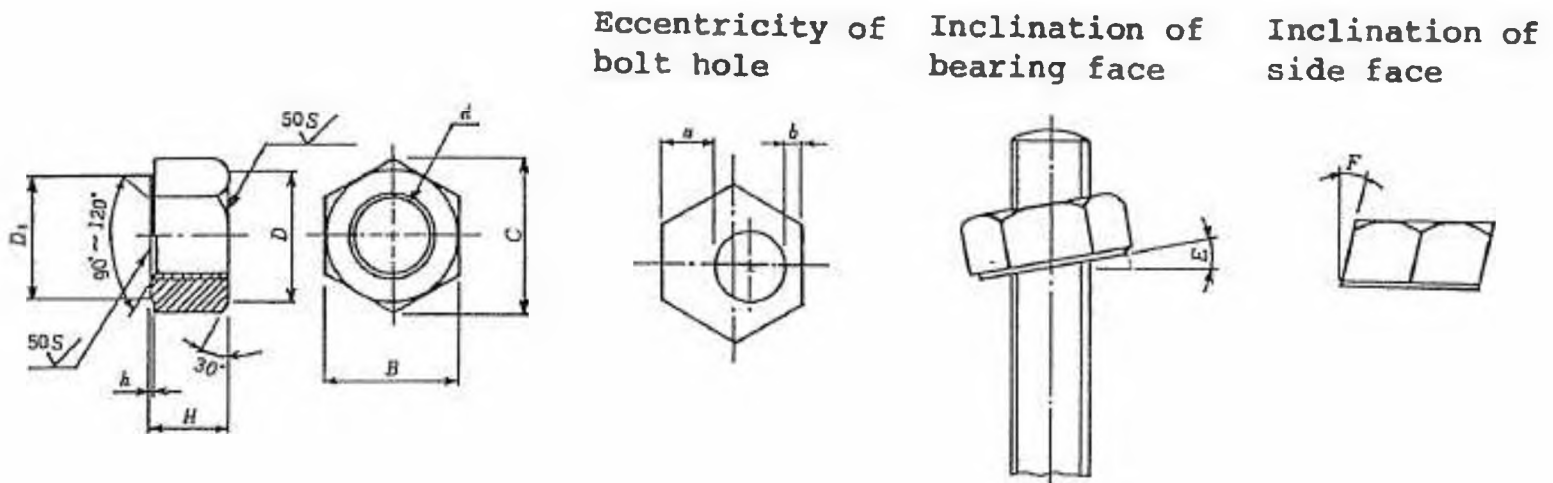
- Remarks:
- The length x of incomplete threads shall number about two threads and that of full threads about three.
  - The dimension d<sub>1</sub> may be made so as to be approximately same as the pitch diameter of screw thread, subject to the agreement between the parties concerned. In this case, the radius r under the head may be made as follows:

(Unit: mm)

Designation of bolt	M 16	M 20	M 22	M 24
r	1.2 - 2.4	2.0 - 3.3	2.5 - 3.8	

3. The dimensions l marked with  $\bigcirc$  indicate the recommended lengths of l.
4. The dimensions l and s other than those given in the above table may be used as specified, if particularly required.

Attached Table 2 High Strength Hexagon Nuts for Structural Joints



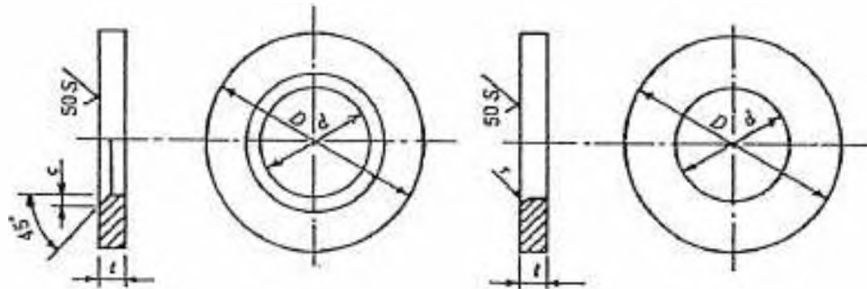
(Unit: mm)

Designation of bolt (d)	Outside diameter of male thread	H		B		C	D	D <sub>1</sub>	a-b	Z	P	h
		Basic dimension	Tolerance	Basic dimension	Tolerance	Approx.	Approx.	Min.	Max.	Max.	Max.	
M 16	16	16	±0.35	27	<sup>0</sup> -0.8	31.2	25	25	0.8	1°	2°	0.4-0.8
M 20	20	20	±0.4	32	<sup>0</sup> -1	37	30	29	0.9			
M 22	22	22		36		41.6	34	33	1.1			
M 24	24	24		41		47.3	39	38	1.2			

Remark: Chamfering of the threaded portion of nut bearing face side shall be of 1.0 to 1.05d in diameter.



Attached Table 3 High Strength Plain Washers for Structural Joints



(Unit: mm)

Designation of washer	d		D		t		c or r
	Basic dimension	Tolerance	Basic dimension	Tolerance	Basic dimension	Tolerance	Approx.
16	17	+0.7 0	32	0 -1	4.5	±0.5	1.5
20	21	+0.8 0	40				2
22	23		44		6	±0.7	
24	25		48				2.4

Remark: The above figures show a plain washer with 45° chamfer and that with radius r, and either type of washer may be used.