

Automotive parts - Hex lobular wrenching fasteners

1. Scope

This standard specifies the bolts (including socket head bolts and stud bolts), nuts, machine screws, and tapping screws (hereinafter collectively referred to as "TORX wrenching fasteners") with hex lobes (hereinafter referred to as "TORX®") used for cars.

Remark: TORX® is a trademark of Textron Inc. and referred to as "TORX" when it is used for the second time and thereafter in this standard.

2. Normative reference

The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. Only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter are not applied.

JIS B 0101: 1994	Screw threads and fasteners - Vocabulary
JIS B 0205: 1997	Metric coarse screw threads
JIS B 0207: 1997	Metric fine screw threads
JIS B 0209: 1997	Limits of sizes and tolerances for metric coarse screw threads
JIS B 0211: 1997	Limits of sizes and tolerances for metric fine screw threads
JIS B 0601: 1994	Surface roughness - Definitions and designation
JIS B 1003: 1985	Shapes and dimensions of ends of threaded fasteners
JIS B 1007: 1987	Shapes and dimensions of threads of tapping screws
JIS B 1021: 1985	Tolerance system for threaded fasteners
JIS B 1041: 1993	Fasteners - Surface discontinuities - Part 1: Bolts, screws and studs for general requirements
JIS B 1042: 1998	Fasteners - Surface discontinuities - Part 2: Nuts
JIS B 1043: 1993	Fasteners - Surface discontinuities - Part 3: Bolts, screws and studs for special requirements
JIS B 1051: 1991	Mechanical properties of steel bolts and screws
JIS B 1052: 1991	Mechanical properties of steel nuts
JIS B 1054: 1985	Mechanical properties of corrosion-resistant stainless steel fasteners
JIS B 1055: 1987	Tapping screws - Mechanical properties
JIS B 1071: 1985	Method of verification for size and geometry of threaded fasteners
JIS B 1091: 2003	Fasteners - Acceptance inspection
JIS B 1173: 1987	Stud bolts
JIS D 0201: 1995	Automobile parts - General rules of electroplating
JIS G 3539: 1988	Carbon steels wires for cold heading and cold forging
JIS G 4051: 1979	Carbon steels for machine structural use
JIS G 4315: 1994	Stainless steel wires for cold heading and cold forging
JIS Z 2201: 1980	Test pieces for tensile test for metallic materials
JASO F 102: 2005	Automotive parts - Hexagon nuts and hexagon thin nuts

3. Definitions

Definitions of main terms used in this standard are as indicated below in addition to those specified in **JIS B 0101**.

3.1 TORX

TORX means a section to transmit a tightening torque which is formed in hex lobular shape as shown in **Figure 1**.

3.2 T-type TORX

TORX formed internally (See **Annex 1.**)

3.3 E-type TORX

TORX formed externally (See **Annex 1.**)

3.4 Drive size

Nominal size indicating the size of T-type and E-type TORX.

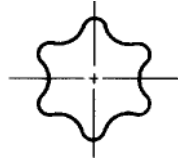


Figure 1 Shape of TORX

4. Type

The types of TORX wrenching fasteners are as shown in **Table 1**. It depends on two factors: one is the shape of TORX and the other is the shape of wrenching fasteners. (See **Table 1.**)

Table 1 Type

Wrenching fasteners	Types classified according to the shape of TORX	Types classified according to the shapes of wrenching fasteners
Bolt	T-type TORX	Flat fillister head bolt
	T-type TORX	Countersunk bolt
	E-type TORX	Flange bolt
	T-type TORX	Socked head bolt
	E-type TORX	Stud bolt
Nut	E-type TORX	Flange nut (S-type)
	E-type TORX	Flange nut (F-type)
Machine screw	T-type TORX	Pan head machine screw
	T-type TORX	Countersunk head machine screw
	T-type TORX	Raised countersunk head machine screw
	T-type TORX	Truss head machine screw
	T-type TORX	Binding head machine screw
	T-type TORX	Pan head with collar machine screw
Tapping screw	T-type TORX	Pan head tapping screw
	T-type TORX	Countersunk tapping screw
	T-type TORX	Raised countersunk head tapping screw
	T-type TORX	Truss head tapping screw
	T-type TORX	Pan head with collar tapping screw

5. Mechanical properties**5.1 Mechanical properties of steel bolts and machine screws**

The mechanical properties of steel bolts and machine screws are as shown in **Tables 2, 3 and 4.**

Table 2 Strength division

Type of wrenching fasteners	Strength division									
	Column I						Column II			
	4.8	5.8	6.8	8.8	9.8	10.9	4T	5T	6T	7T
Flat fillister head bolt Countersunk bolt Flange bolt	○	○	○	○	○	○	○	○	○	○
Socked head bolt				○		○				
Stud bolt	○			○		○	○			○
Machine screw	○			○			○			

Remark 1: The strength division 8.8 of machine screw shall be applicable to those machine screws of M3 or over.

Remark 2: Wrenching fasteners classified into strength divisions Column II will be abolished in the future.

Table 3 Mechanical properties of bolts and mechanical screws

Mechanical properties	Flat fillister head bolt, countersunk bolt and flange bolt		Socked head bolt		Stud bolt		Machine screw	
	Column I	Column II	Column I	Column II	Column I	Column II	Column I	Column II
Tensile strength	○		○		○	○	○	
Hardness	○	○	○	○	○	○	○	○
Surface hardness ⁽¹⁾	○		○		○		○	
Yield point or yield strength (reference)		○		○		○		○
Proof load stress	○		○		○		○	
Wedge tensile strength	○	○	○	○			○	○
Head impact strength	○		○				○	
Decarburisation of threaded portion ⁽¹⁾	○		○		○		○	

Note:⁽¹⁾

Applicable to the strength division 8.8 and over.

Table 4 Mechanical properties vs. strength division

Mechanical properties			Strength division											
			Column I						Column II					
			4.8	5.8	6.8	8.8		⁽²⁾ 9.8	10.9	4T	5T	6T	7T	
d≤16	d>16													
Tensile strength ⁽³⁾ MPa		Nominal	400	500	600	800	800	900	1000	-	-	-	-	
		Minimum	420	520	600	800	830	900	1040	392	490	588	686	
Hardness	Vickers hardness HV		Minimum	130	160	190	250	255	290	320	122	150	180	213
			Maximum	250			320	335	360	380	241	253	286	294
	Rockwell hardness	HRB	Minimum	71	82	89	-				60	76	88	-
			Maximum	99.5			-				98	100	103	-
		HRC	Minimum	-			22	23	28	32	-			15
			Maximum	-			32	34	37	39	-			29
		Surface hardness HV		Maximum	-			⁽⁴⁾				-		
Yield point or yield strength ⁽⁵⁾ MPa		Minimum (reference)	-							294	343	441	539	
Proof load stress ⁽⁶⁾ MPa			310	380	440	580	600	650	830	-				
Wedge tensile strength			Same as minimum value of tensile strength ⁽⁷⁾											
Head impact strength			No cracking shall occur in the joint between head portion and shank ⁽⁸⁾ .							-				
⁽⁹⁾ Decarburisation of threaded portion	Height of non-decarburised portion E mm	Minimum	-			$\frac{1}{2} H_1$			$\frac{2}{3} H_1$	-				
	Depth of ferrite decarburised layer G mm	Maximum	-			0.015			-					

Note:⁽²⁾

Applicable to bolts of 16 mm or smaller in nominal diameter.

Note:⁽³⁾

The minimum value of tensile strength shall be applicable to bolts of 2.5 d or longer in nominal length.

The fracture of bolts and machine screws due to tension shall occur at the threaded portion or shank, but not in the joint between them.

Note:⁽⁴⁾

A difference between a surface hardness and an internal hardness shall not exceed 30 in Vickers hardness (test load: 2.94N). In addition, the surface hardness of the bolts classified as strength division 10.9 shall not exceed 390HV.

Notes:⁽⁵⁾The yield point or yield strength above is shown for your reference only. If its exact value is required, measure it using No. 4 Test Piece of **JIS Z 2201** or its equivalent one sampled from the bolt.

If the yield point is not clear in the measurement, adopt yield strength at a permanent elongation of 0.2%.

Note:⁽⁶⁾

No permanent elongation shall occur by proof load stress.

Note:⁽⁷⁾

Shall withstand a load equivalent to the minimum value of a tensile strength. Any fracture shall occur at the threaded portion or shank, and shall not occur in the joint between the head portion and shank. For complete screw threads, however, the fracture can be accepted if a cracking resulting in the fracture occurs in the free threaded portion and extends to the under fillet or head portion.

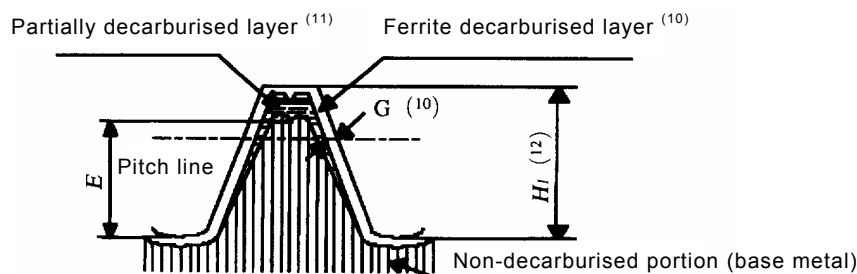
Note:⁽⁸⁾

For complete screw bolts and machine screws, a cracking can be accepted unless the head portion is twisted off even if a crack occurs at the first crest on the head portion side.

Note:⁽⁹⁾

See **Figure 2**.

Remark: The symbol “d” in the table represents nominal diameter (mm) of bolts.



Unit: mm

Thread pitch			0.5	0.7	0.8	1	1.25	1.5	1.75	2	2.5	3
$H_1^{(12)}$			0.307	0.429	0.491	0.613	0.767	0.920	1.074	1.227	1.534	1.840
E Minimum	Strength division	8.8	0.154	0.215	0.245	0.307	0.384	0.460	0.537	0.614	0.767	0.920
		9.8	0.205	0.286	0.327	0.409	0.511	0.613	0.716	0.818	1.023	1.227

Note:⁽¹⁰⁾

The surface layer of a thread in which carbon is dissipated and only ferrite remains. G indicates a ferrite decarburised layer depth from the surface on the pitch line.

Note:⁽¹¹⁾

The martensite is slightly visible and, due to the loss of carbon, the hardness is clearly lower than that of the base metal.

Note:⁽¹²⁾

Height of thread at maximum material condition

Figure 2 Decarburisation of threaded portion

5.2 Mechanical properties of stainless steel bolts and machine screws

The mechanical properties of stainless steel bolts and machine screws shall be in accordance with an agreement between the parties concerned. Unless otherwise specified, it may be preferable to apply the specification of mechanical properties specified in **JIS B 1054**.

5.3 Mechanical properties of steel nuts

The mechanical properties of steel nuts for the strength division shall be as shown in **Table 5**.

Table 5 Mechanical properties of steel nuts

Mechanical properties		Strength division				
		5N	6N	8N		10N
				<i>d</i> ≤16	<i>d</i> >16	
Proof load stress MPa		520	600	800	830	1040
Hardness (max.)	HV	302	302	302	353	353
	HRC	30	30	30	36	36

Remark: The symbol “d” in the table represents nominal diameter (mm) of bolts.

5.4 Mechanical properties of tapping screws

5.4.1 Mechanical properties of steel tapping screws

The mechanical properties of steel tapping screws shall be in accordance with **JIS B 1055, Appendix 1.3** "Mechanical properties."

5.4.2 Mechanical properties of stainless tapping screws

The mechanical properties of stainless tapping screws shall be in accordance with **JIS B 1055, Appendix 2.3** "Mechanical properties."

6. Shapes and dimensions

6.1 Shapes and basic dimensions of TORX

The shapes and basic dimensions of TORX shall be in accordance with **Annex 1**. However, the gage sink depth of T-type TORX and engagement length of E-type TORX shall be in accordance with their respective **Attached Tables**.

6.2 Shapes and basic dimensions of portions other than TORX

The shapes and dimensions of portions other than TORX of TORX wrenching fasteners shall be in accordance with **Table 6**.

Table 6 Shapes and basic dimensions of portions other than TORX

Wrenching fasteners	Type of TORX wrenching fastener	Applicable nominal diameter mm	Applicable Attached Table
Bolt	T-type TORX flat fillister head bolt	5 to 24	Attached Table 1
	T-type TORX countersunk head bolt	8 to 16	Attached Table 2
	E-type TORX flange bolt	5 to 24	Attached Table 3
	T-type TORX socket head bolt	5 to 24	Attached Table 4
	E-type TORX stud bolt	6 to 12	Attached Table 5
Nut	E-type TORX flange nut (S-type)	3 to 24	Attached Table 6
	E-type TORX flange nut (F-type)		
Machine screw	T-type TORX pan head machine screw	2 to 8	Attached Table 7
	T-type TORX countersunk head machine screw		Attached Table 8
	T-type TORX raised countersunk head machine screw		Attached Table 9
	T-type TORX truss head machine screw		Attached Table 10
	T-type TORX binding machine screw		Attached Table 11
	T-type TORX pan head with collar machine screw	3 to 8	Attached Table 12
Tapping screw	T-type TORX pan head tapping screw	2 to 8	Attached Table 13
	T-type TORX countersunk head tapping screw		Attached Table 14
	T-type TORX raised countersunk head tapping screw		Attached Table 15
	T-type TORX truss head tapping screw	3 to 8	Attached Table 16
	T-type TORX pan head with collar tapping screw		Attached Table 17

Remark: The nominal length (*l*) and thread length (*b*) of bolts, machine screws, and tapping screws shall be in accordance with **Attached Tables 18 to 21**.

7. Types and dimension tolerances of threads

The types and dimension tolerances of threads of TORX wrenching fasteners shall be in accordance with **Table 7**.

The maximum tolerance of a surface-treated male thread shall be 4 h. However, the maximum allowable dimensions of a male thread treated by zinc / chromate composite coating shall be such that it can be easily screwed into and passed through a nut specified in **JASO F 102** through the entire length of the male thread.

Table 7 Types and dimension tolerances of threads

Type of thread		Dimension tolerance
Bolts and nuts	JIS B 0205	6 g or 6 H specified in JIS B 0209
	JIS B 0207	6 g or 6 H specified in JIS B 0211
Embedded section of stud bolt	The thread of embedded section shall be in accordance with JIS B1173, Attached Table 2 . However, any dimension tolerances of plated bolts or other tolerances specified in the Attached Table shall be in accordance with an agreement between the parties concerned.	
Machine screw	JIS B 0205	6 g specified in JIS B 0209
Tapping screw	Four types of threads are available: Types 1, 2, 3 and 4 specified in JIS B 1007, Appendix .	-

8. Combination of nominal diameters and drive sizes

The combination of nominal diameters and drive sizes of TORX wrenching fasteners shall be in accordance with **Table 8**.

Table 8 Combination of nominal diameters and drive sizes

Nominal diameter mm			2	2.5	3	3.5	4	4.5	5	6	8	10	12	14	16	18	20	22	24
Drive size	T-type	Bolt	-						T25	T30	T40	T50	T55		T60	T70	T80	T90	T100
		Socked head bolt	-						T27	T30	T45	T50	T55		T60	T70	T80	T90	T100
		Machine screw Tapping screw	T6	T8	T10	T15	T20		T25	T30	T40	-							
	E-type	Bolt	-						E6	E8	E10	E12	E14	E18	E20	E32		E28	E32
		Nut	-		E6	-	E8	-	E10	E12	E16	E18	E20	E24	E28	E24		E36	E40
		Stud bolt	-						E5			E7	E8	E11	-				

Remark: For socket head bolt, as required, T25 and T40 may be used instead of M5 and M8, respectively.

9. Surface conditions

The surface conditions of TORX wrenching fasteners shall be in accordance with **a)** and **b)** in addition to those specified in **12**.

a) The tolerances of surface discontinuities of bolts, machine screws, and nuts shall be in accordance with **Table 9**.

Unless otherwise specified, the criteria of tolerances of surface discontinuities of tapping screws shall be in accordance with **JIS B 1041**.

b) No defect detrimental in use such as burr or rust shall occur on fasteners.

Table 9 Tolerances of surface discontinuities

Type of wrenching fasteners	Type of surface discontinuity	Tolerance ⁽¹³⁾
Bolt Machine screw	Quenching crack	No quenching crack of any depth and length at any location shall be permitted.
	Forging crack	a) A forging crack which occurs in the top surface of a bolt head shall be permitted if its length is 1 d or shorter and its depth or width is 0.04 d or shorter. (See Figure 3 .) b) A forging crack which occurs in the edge of an upset head bolt shall be permitted if its depth or width is 0.04 d or shorter. c) A forging crack, the length of which is 1/2 or shorter of the distance between a socket section and end section of a T-type fastener shall be permitted. (See Figure 3 .)
	Forging bursts and shear bursts	a) A burst which occurs at the flat side section of a bolt head shall be permitted if it does not reach the circular flat surface at the top of it (chamfered circular section) or bearing surface. (See Figure 3 .) b) A burst which occurs at the edge of an upset bolt head shall be permitted if its width is 0.06 d or shorter and its depth does not reach the underside of a recessed portion.
	Raw material seams and laps	Seams and laps of material which occur at a threaded portion, shank or head portion shall be permitted if its depth is 0.03 d or shorter. Seams and laps which reach the head portion shall be permitted if their width or depth does not exceed a tolerance specified for the burst.
	Voids	a) A void in the surface of a bolt shall be permitted if its depth is 0.02 d or smaller (0.25 mm maximum). b) Voids in the bearing surface of a bolt shall be permitted if the overall area of the dent does not exceed 10% of a bearing surface area.
	Folds	Folds which occur at the recessed corner portions located on or under a bearing surface shall not be permitted. Folds which occur at the protruded corner portions shall be permitted.
	Tool marks	Tool marks produced at a shank, fillet or bearing surface by machining shall be permitted if their surface roughness does not exceed 3.2 μ mRa according to JIS B 0601 .
	Damage	Damages such as recesses, scratches, dents and grooves shall be permitted if they do not impair functions or serviceability. Those recesses, scratches, dents or grooves which occur at the first three threads of a bolt or screw shall be permitted if the bolt or screw can be screwed into a go-thread ring gage at a torque of 0.001 d^2 N·m. Example: When a nominal diameter is 10 mm, 0.001 $\times$ 10 ³ = 1 N·m.
Nut	Quenching crack	No quenching crack of any depth and length at any location shall be permitted.
	Forging crack and cracking due to inclusion	A cracking in the top and bottom surfaces shall be permitted if the requirements below are satisfied. a) The number of cracks crossing the entire width of a bearing surface is 2 or fewer and their depths are 0.05 d or smaller. b) When a crack does not extend to the threaded portion beyond the first one thread of a complete thread. c) When the depth of a crack in the first one thread of a complete thread is 0.5 H_t or smaller.
	Shearing burst	a) A shearing burst which occurs at a side of a nut shall be permitted if it does not reach the bearing surface of the nut. b) A burst which occurs around the periphery of a flange shall be permitted if it does not extend beyond the minimum diameter d_w of a bearing surface and its width does not exceed 0.08 d_c .
	Burst	a) If a burst occurs in connection with the seams resulted from a material, the seams may extend to the chamfered circular section, but the burst shall not be permitted. b) A burst which occurs around the periphery of a flange shall be permitted if it does not extend beyond the minimum diameter d_w of a bearing surface and its width does not exceed 0.08 d_c .
	Streak	For all nominal sizes of screws, streaks shall be permitted if their depth from the surface is 0.05 d or smaller.
	Folds	Folds shall be permitted but those on a crossed line of the annular section of the flange and the bearing surface shall not extend to the bearing surface.
	Voids	a) A void shall be permitted if its depth is 0.02 d (0.25 mm maximum) or smaller. b) Voids shall be permitted if the overall area of the void in the bearing surface is 5% or less of the bearing surface area.
	Tool marks	Tool marks on the bearing surface shall be permitted if their surface roughness does not exceed 3.2 μ mRa according to JIS B 0601 . The other tool marks on the surface shall be permitted. Note: ⁽¹³⁾ Tolerances for the screws of less than 5 mm in nominal diameter shall be in accordance with an agreement between the parties concerned.
	Damage	Damages such as recesses, scratches, dents and grooves shall be permitted if they do not impair functions or serviceability.

Note:⁽¹³⁾

Tolerances for the screws of less than 5 mm in nominal diameter shall be in accordance with an agreement between the parties concerned.

Remarks 1: The shaded and parenthesized sections in this standard are requirements not specified in JIS.

Remarks 2: The types and tolerances of surface discontinuities shall be in accordance with the requirements specified in JIS B 1041, 1042 and 1043.

Remarks 3: The symbols d, H1 and dc in the table above indicate the nominal diameter of TORX wrenching fasteners (mm), height of threads (mm), and diameter of the flange portion (mm), respectively.

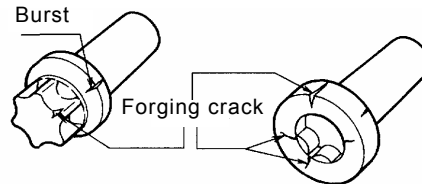


Figure 3 Surface discontinuities

10. Materials and heat treatments

10.1 Materials and heat treatments of steel bolts and machine screws

In general, the materials and heat treatments of steel bolts and machine screws shall be in accordance with **Table 10**. The minimum tempering temperature specified in this table shall be applicable to 8.8 to 10.9 in strength division Column I and 7T in strength division Column II. When the bolts and machine screws meet all requirements for mechanical properties specified in **Table 4**, the materials and heat treatments other than those specified in **Table 10** may be used under an agreement between the parties concerned.

Table 10 Materials and heat treatments of steel bolts and machine screws

Strength division	Material and heat treatment	Chemical composition %				Tempering temperature ⁽¹⁸⁾ °C (Minimum)
		C		P	S	
		Minimum	Maximum	Maximum	Maximum	
4.8 and 4T 5.8 and 5T 6.8 and 6T	Carbon steel	-	0.55	0.05	0.06	-
8.8 ⁽¹⁴⁾ and 7T	Carbon steel containing additives (B, Mn or Cr), quenching and tempering	⁽¹⁹⁾ 0.15	0.40	0.035	0.035	425
	Carbon steel, quenching and tempering	0.25	0.55	0.035	0.035	
9.8	Carbon steel containing additives (B, Mn or Cr), quenching and tempering	⁽¹⁹⁾ 0.15	0.35	0.035	0.035	
	Carbon steel, quenching and tempering	0.25	0.55	0.035	0.035	
10.9 ⁽¹⁵⁾	Carbon steel containing additives (B, Mn or Cr), quenching and tempering	⁽¹⁹⁾ 0.15	0.35	0.035	0.035	340
10.9 ⁽¹⁶⁾	Carbon steel, quenching and tempering	0.25	0.55	0.035	0.035	425
	Carbon steel containing additives (B, Mn or Cr), quenching and tempering	⁽¹⁹⁾ 0.20				
	Alloy steel ⁽¹⁷⁾ , quenching and tempering	0.20				

Note:⁽¹⁴⁾

For steel bolts and screws of which nominal diameters exceed 20 mm and which require sufficient hardenability, a material classified as strength division 10.9 may be used.

Note:⁽¹⁵⁾

When bolts in this column are used for strength division 10.9, they shall be identified by underlining the symbol of the strength division.

Note:⁽¹⁶⁾

The materials in this strength division must have sufficient hardenability so that the centre part of the thread cross-section has a martensite structure of approximately 90% under the condition that it has been quenched but is not tempered.

Note:⁽¹⁷⁾

An alloy steel in this strength division shall include at least one alloy element of chrome (Cr), nickel (Ni), molybdenum (Mo) and vanadium (V).

Note:⁽¹⁸⁾

When the bolts in strength division 8.8 to 10.9 or 7T are tested according to **4.3** Re-tempering test in the body of **JIS B 1051**, a difference of the average hardness exceeding 20 in Vickers hardness shall not occur.

Note:⁽¹⁹⁾

For boron steels of which carbon content is 0.25 % (molten steel analysis value) or less, the content of Mn shall be 0.6 % or more for the strength division 8.8 and 0.7 % or more for 9.8 and 10.9.

10.2 Materials of stainless steel bolts and machine screws

The materials of stainless steel bolts and machine screws shall be in accordance with an agreement between the parties concerned.

Unless otherwise specified, the specification of properties specified in **JIS B 1054** may be applied.

10.3 Chemical compositions of materials of steel nuts

The chemical composition of material of steel nuts for each strength division shall be as shown in **Table 11**.

Note that nuts of 8N and 10N in strength divisions shall be quenched and tempered as required.

When a product meets all the requirements for the mechanical properties specified in **Table 5**, the chemical composition and heat treatment conditions of the material may be altered by an agreement between the parties concerned.

Table 11 Chemical compositions of materials of steel nuts

Strength division	Chemical composition %			
	C Maximum	Mn Minimum	P Maximum	S Maximum
5N and 6N	0.50	-	0.110	0.150
8N ⁽²⁰⁾	0.58	0.25	0.060	0.150
10N ⁽²⁰⁾	0.58	0.30	0.048	0.058

Note:⁽²⁰⁾

In order to increase the mechanical properties of nuts, the other elements may be added as required.

10.4 Materials of tapping screws

The materials of tapping screws shall be those specified in **Table 12** or their equivalent. A carburisation, quenching, and tempering shall be applied to steel tapping screws after cold working except for stainless steel tapping screws.

Table 12 Materials of tapping screws

Classification	Material
Steel tapping screw	SWCH12A to 22A and SWCH12K to 22K specified in JIS G 3539 or SI2C to S22C specified in JIS G 4051
Stainless steel tapping screws	Type A or B of SUS 304, 305 or 305Jl specified in JIS G 4315 or SUSXM7

11. Surface treatment

The surface treatments applied to TORX wrenching fasteners shall be in accordance with **Table 13**. If no surface treatment is applied or surface treatment other than those specified in the table is applied, a purchaser shall specify it.

Bolts classified as 9.8 and 10.9 and nuts classified as 10N in strength division onto which electrogalvanising is applied shall be treated so that hydrogen embrittlement is eliminated. Also, nuts classified as strength division 8N shall be treated so that hydrogen embrittlement is eliminated. The treatment conditions shall be determined based on an agreement between the parties concerned.

Also, the surface treatment of stainless TORX wrenching fasteners shall be determined based on an agreement between the parties concerned.

Table 13 Surface treatment

Type of surface treatment		Symbol of surface treatment ⁽²¹⁾	Applicable standard
Electrogalvanising	Yellow chromate	Ep-Fe/Zn 5 C [MFZn5c] or Ep-Fe/Zn 8 C [MFZn8]	As per JIS D 0201
	Green chromate	Ep-Fe/Zn 5 G or Ep-Fe/Zn 8 G	
Zinc / chromate composite coating	2-coats 2-bakes ⁽²²⁾	-	-

Note: ⁽²¹⁾

For the symbols of surface treatments, those conventional symbols shown in [] may be used.

Note: ⁽²²⁾

Zinc / chromate composite coating shall not be applied to nuts. The adhered amount and corrosion resistance of zinc / chromate composite coating shall be determined based on an agreement between the parties concerned.

12 Grade of finish**12.1 Grade of finish of bolts**

The grade of finish of bolts shall be in accordance with **JIS B 0601**, and the surface roughness of a bearing surface shall be 3.2 μmRa and the surface roughness of shank shall be 6.3 mRa .

In addition, a threaded portion shall be finished smooth.

12.2 Grade of finish of nuts

The grade of finish of nuts shall be in accordance with **Table 14**.

In addition, a threaded portion shall be finished smooth.

Table 14 Grade of finish of nuts

Grade of finish		Surface roughness of bearing surface	Surface roughness of side and top surfaces
A	Cold forging	3.2 μmRa	6.3 μmRa
B	Hot forging	6.3 μmRa	12.5 μmRa

Remark: The surface roughness shall be in accordance with the requirements specified in **JIS B 0601**.

12.3 Grade of finish of machine screws

The grade of finish of machine screws shall be such that the surface roughness of those sections excluding a screw tip is finished smoother than 6.3 μmRa specified in **JIS B 0601**.

12.4 Grade of finish of tapping screws

The surface of tapping screws shall be finished smooth.

13. Test methods of mechanical properties

The test methods of mechanical properties of steel TORX wrenching fasteners shall be in accordance with **Table 15**.

Table 15 Test methods of mechanical properties

Type of wrenching fasteners	Test item		Test method	
			Method for strength division column I	Method for strength division column II
Bolt and Machine screw	Tensile strength of product		As per 4.2.2 Tensile strength test of product in the body of JIS B 1051	As per 3.2.2 Tensile strength test of product in Appendix 1 of JIS B 1051
	Wedge tensile strength		As per 4.2.3 Wedge tensile strength test in the body of JIS B 1051	As per 3.2.3 Wedge tensile strength test in Appendix 1 of JIS B 1051
	Hardness	Hardness	As per 4.2.5 (1) Hardness test in the body of JIS B 1051	As per 3.2.4 Hardness test in Appendix 1 of JIS B 1051
		Surface hardness	As per 4.2.5 (2) Surface hardness test in the body of JIS B 1051	-
	Proof load stress		As per 4.2.4 Proof load test in the body of JIS B 1051	-
	Head impact strength		As per 4.2.6 Head impact test in the body of JIS B 1051	-
	Decarburised layer of threaded portion		As per 4.2.8 Decarburised layer test in the body of JIS B 1051	-
	Re-tempering		As per 4.3 Re-tempering test in the body of JIS B 1051	
Nut	Hardness		As per 4.2.2 Hardness test in the body of JIS B 1052	
	Proof load stress		As per 4.2.1 Proof load test in the body of JIS B 1052	
Tapping screw	Hardness	Hardness	As per 4.2.1 Hardness test in Appendix 1 of JIS B 1055	
		Surface hardness		
	Hardened layer depth		As per 4.2.2 Hardened layer depth test in Appendix 1 of JIS B 1055	
	Microstructure		As per 4.2.3 Microstructure test in Appendix 1 of JIS B 1055	
	Screw-in capability		As per 4.2.4 Screw-in test in Appendix 1 of JIS B 1055	
	Torsional strength		As per 4.2.5 Torsional strength test in Appendix 1 of JIS B 1055	
	Head toughness		As per 4.2.6 Head toughness test in Appendix 1 of JIS B 1055	

14. Inspection

The inspection of TORX wrenching fasteners shall be performed as follows.

14.1 Inspection of mechanical properties**14.1.1 Inspection of mechanical properties of steel bolts and machine screws**

The inspection of mechanical properties of steel bolts and machine screws shall be performed in accordance with **a)** and **b)** below and using the test methods specified in **13** above. The inspection results shall meet the requirements specified in **5.1** and **10.1**.

a) Inspection programme

The inspection of mechanical properties of bolts and machine screws for each strength division shall be performed in accordance with the inspection programme shown in **Table 17**. The bolts and screws to which the inspection programme is applied shall be classified into those marked with ○ and ● as shown in **Table 16**.

Table 16 Classification of bolts and machine screws to be inspected

Bolts to be inspected	○	●
Applicable conditions	Bolts and machine screws of which nominal lengths are less than 2.5 <i>d</i>	Bolts and machine screws of which nominal lengths are 2.5 <i>d</i> or longer

Remark: The symbol *d* in the table above indicates the nominal diameter of bolts and machine screws (mm).

b) Inspection items for which acceptance or rejection is determined

The inspection items for which the acceptance or rejection of a bolt or machine screw is determined for each strength division shall be those marked with ○ and ● in **Table 17** "Inspection programme" for each inspection of strength division. In addition, if a tension test cannot be performed because of the reasons such that the nominal length of the bolts or machine screw is short or the capacity of the tester is small, the inspection shall be performed for the items among those specified by ○ and ● in **Table 17** for which the test can be performed to determine the acceptance or rejection of it.

Table 17 Inspection programme

Inspection item		Strength division									
		Column I						Column II			
		4.8	5.8	6.8	8.8	9.8	10.9	4T	5T	6T	7T
Tensile strength of product ⁽²³⁾		●	●	●	●	●	●	⁽²⁸⁾ ● ○	-	-	⁽²⁸⁾ ● ○
Wedge tensile strength		● ○	● ○	● ○	● ○	● ○	● ○	● ○	● ○	● ○	● ○
Hardness ⁽²⁴⁾	Minimum	○	○	○	○	○	○	● ○	● ○	● ○	● ○
	Maximum	● ○	● ○	● ○	● ○	● ○	● ○				
Surface hardness ⁽²⁵⁾		-	-	-	● ○	● ○	● ○	-	-	-	-
Proof load stress		●	●	●	●	●	●	-	-	-	-
Head impact strength ⁽²⁶⁾		○	○	○	○	○	○	-	-	-	-
Decarburisation of threaded portion ⁽²⁷⁾		-	-	-	● ○	● ○	● ○	-	-	-	-
Variation in hardness after re-tempering		-	-	-	● ○	● ○	● ○	-	-	-	● ○

Note:⁽²³⁾

This inspection may be omitted for those products which passed the wedge tensile strength test.

Note:⁽²⁴⁾

The hardness shall be given in Vickers hardness or Rockwell hardness. If any doubt arises with a measured hardness, determine the acceptance or rejection based on the measured value given in Vickers hardness. To make easier the inspection of those products marked with ●, the tensile strength test can be substituted by the minimum hardness inspection. However, the final decision of acceptance or rejection shall be performed by the tensile strength inspection.

Note:⁽²⁵⁾

The surface hardness inspection may be omitted for those products which meet the requirements for the decarburised layer inspection by hardness measurement.

For the products of strength division 10.9, however, this inspection shall be performed.

Note:⁽²⁶⁾

This shall be applied to those bolts and screws of which nominal diameter is 16 mm or less and which cannot be wedge tensile tested because its nominal length is too short.

Note:⁽²⁷⁾

The decarburised layer inspection shall be performed using a micrometer or by hardness measurement. However, the decarburised layer inspection by hardness measurement shall be applied only to those bolts and machine screws of 8.8 or higher in strength division and 1.25 mm or longer in pitch.

Note:⁽²⁸⁾

Shall be applied to stud bolts.

14.1.2 Inspection of mechanical properties of stainless steel bolts and machine screws

The inspection of mechanical properties of stainless steel bolts and machine screws shall be performed based on an agreement between the parties concerned. Unless otherwise specified, however, it may be better to apply the requirements specified in 7 "Inspection" of **JIS B 1054**.

14.1.3 Inspection of mechanical properties of nuts

The inspection of mechanical properties of nuts shall be performed in accordance with **13** above, and the inspection results shall meet the requirements specified in **5.3 and 10.3** above.

If any doubt arises with a measured hardness, determine the acceptance or rejection based on the measured value given in Vickers hardness.

14.1.4 Inspection of mechanical properties of tapping screws

The inspection for mechanical properties of tapping screws shall be performed in accordance with **13** above, and the inspection results shall meet the requirements specified in **5.4 and 10.4** above.

14.2 Inspection of shapes and dimensions

The inspection of shapes and dimensions shall be performed in accordance with **JIS B1071, 3.3** "Method of measurement of each dimension" and **3.4** "Method of measurement of geometric deviation," or any other alternative, and the inspection results shall meet the requirements specified in **6**.

The inspection of shapes and dimensions of TORX shall be performed in accordance with **Annex 2**.

14.3 Inspection of thread

The inspection of thread of bolts, machine screws, and nuts shall be performed in accordance with **JIS B 1071, 3.2** "Method of measurement of thread accuracy" or any other alternative, and the inspection results shall meet the requirements specified in **7** above.

For plated bolts and machine screws, a go-thread ring gage or an alternative limit gage for 4 h shall be used.

In addition, the inspection of thread of tapping screws shall be performed by direct measurement, and the measurement results shall meet the requirements specified in **3** "Shapes and dimensions of thread" of

Appendix of JIS B 1007,

14.4 Inspection of surface condition

The surface condition shall be inspected in accordance with **a) to c)** as below and the inspection results shall meet the requirements specified in **9** above.

- a)** Surface roughness shall be measured in accordance with **JIS B 1071, 3.1** "Method of measurement of surface roughness," or an alternative.
- b)** Surface discontinuities shall be detected in accordance with **JIS B 1041, 4** "Inspection and evaluation method," **JIS B 1042, 4** "Inspection and evaluation methods" and **JIS B 1043, 4** "Inspection and evaluation methods."

If required, the depth of defects shall be measured in cross-section. Also the measurement of defects on plated bolts shall be performed after the removal of plating.

- c)** The defects such as burrs and rust shall be inspected visually.

14.5 Inspection of surface treatment

The inspection of surface treatment shall be performed in accordance with **JIS D 0201**, and the inspection results shall meet the requirements specified in **11** above. This inspection shall not be applied to threaded portions.

14.6 Acceptance inspection

Unless otherwise specified, a lot sampling inspection system at acceptance inspection shall be in accordance with **JIS B1091**.

15. Nominal designation of product

The nominal designation of a product shall be given by **JASO** number, type, nominal diameter (*d*) x nominal length (*l*) x length of threaded portion (*b*), material or strength division, surface treatment, and remarks.

Example 1: Bolts, machine screws and nuts

JASO F 116:2005	T-type TORX flat fillister head bolt	M10×1.25×35×22	8.8	Ep-Fe/Zn5C [MFZn5-C]	Upset type
JASO F 116:2005	E-type TORX flange nut (F-type)	M8	6N	Ep-Fe/Zn5C [M4FZn5-C]	
JASO number	Type	Nominal diameter × nominal length × length of threaded portion	Strength division	Surface treatment ⁽²¹⁾	Remarks

Example 2: Tapping screws

JASO F 116:2005	T-type TORX truss head tapping screw	5×20	Type 1	SUS×M7	No plating	
JASO number	Type	Nominal diameter × nominal length	Type of screw thread	Material or strength division	Surface treatment ⁽²¹⁾	Remarks

Example 3: Stud bolt

JASO F 116:2005	E-type TORX stud bolt	8×40	8.8	Coarse	Type 2	Coarse	No plating	
JASO number	Type	Nominal diameter × nominal length	Material or Strength Division	Pitch series on stud bolt side	classification of bm	Pitch series on nut side	Surface treatment ⁽²¹⁾	Remarks

Note:⁽²¹⁾

See the **Note** for **Table 13**.

16. Indication of strength division

In general, the strength division may be indicated, if technically possible, on the head top surface for bolts and machine screws of 5 mm or larger in nominal diameter and on the upper surface of flange for nuts of 5 mm or larger in nominal diameter in accordance with **Table 18**.

The other indication methods shall be determined based on an agreement between the parties concerned.

Table 18 Indication of strength division

Bolt	Strength division	4.8	5.8	6.8	8.8	9.8	10.9	4T	5T	6T	7T
	Indication code	4.8	5.8	6.8	8.8	9.8	10.9	4	5	6	7
Nut	Strength division	-	5N	6N	8N	-	10N	-	-	-	-
	Indication code	-	5N	6N	8N	-	10N	-	-	-	-
Machine screw	Strength division	4.8	-	-	8.8	-	-	4	-	-	-
	Indication code	4.8	-	-	8.8	-	-	-	-	-	-

Remark 1: The decimal point of the indication code for bolts and machine screws may be omitted.

Bolts and machine screws classified as strength division 10.9 shall be identified by underlining according to Table 10.

Remark 2: The indication code may be recessed or protruded. However, it must be marked legibly. The indication marked on the side surface of a head shall be recessed.

The character style and size of indication codes shall be the manufacturer's option.

Reference: Combination of bolts, machine screws and nuts

In general, bolts, machine screws and nuts should be combined in use as shown in **Table 19**.

Table 19 Combination of bolts, machine screws and nuts

Combination	Strength division of bolt	Column I	4.8	5.8	6.8	8.8	9.8	10.9
		Column II	5T	5T	6T	7T	-	-
	Strength division of machine screw	Column I	4.8	-	-	8.8	-	-
		Column II	4T	-	-	-	-	-
	Strength division of nut		5N	5N	6N	8N	10N	

Remark: For the nuts in combination with bolts and machine screws, those higher in strength than the strength divisions specified in this table may be used