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JIS G 4404 : 2006

(JISF)

**Alloy tool steels**

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**Reference number : JIS G 4404 : 2006 (E)**

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## Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 4404 : 2000** is replaced with this Standard.

This revision has been made based on **ISO 4957 : 1999 *Tool steels*** for the purpose of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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In the event of any doubts arising as to the contents,  
the original JIS is to be the final authority.

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## Alloy tool steels

**Introduction** This Japanese Industrial Standard has been prepared based on the second edition of **ISO 4957** *Tool steels* published in 1999 with some modifications of the technical contents.

The portions given sidelines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex 2 (informative).

**1 Scope** This Standard specifies alloy tool steels (hereafter referred to as "steels") manufactured by hot-rolling or forging.

Remarks : The International Standard corresponding to this Standard is as follows :

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 4957 : 1999 *Tool steels* (MOD)

**2 Normative references** The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0320 *Standard test methods for heat analysis of steel products*

JIS G 0404 *Steel and steel products—General technical delivery requirements*

JIS G 0415 *Steel and steel products—Inspection documents*

JIS G 0553 *Macrostructure detecting method for steel*

JIS G 0555 *Microscopic testing method for the non-metallic inclusions in steel*

JIS G 0556 *Method of macro-streak-flaw test for steel*

JIS G 0558 *Methods of measuring decarburized depth for steel*

JIS G 0565 *Method for magnetic particle testing of ferromagnetic materials and classification of magnetic particle indication*

JIS G 3191 *Dimensions, mass and permissible variations of hot rolled steel bars and bar in coil*

JIS G 3193 *Dimensions, mass and permissible variations of hot rolled steel plates, sheets and strips*

JIS G 3194 *Dimensions, mass and permissible variations of hot rolled flat steel*

JIS Z 2243 *Brinell hardness test—Test method*

JIS Z 2244 *Vickers hardness test—Test method*

JIS Z 2245 *Rockwell hardness test—Test method*

JIS Z 2344 *General rule of ultrasonic testing of metals by pulse echo technique*

**3 Grade and designation** Steels shall be classified into 32 grades and the designations shall be as given in table 1.

**Table 1 Designation of grade**

Designation of grade	Application
SKS 11 SKS 2 SKS 21 SKS 5 SKS 51 SKS 7 SKS 81 SKS 8	Mainly used for cutting tool
SKS 4 SKS 41 SKS 43 SKS 44	Mainly used for impact resistance tool
SKS 3 SKS 31 SKS 93 SKS 94 SKS 95 SKD 1 SKD 2 SKD 10 SKD 11 SKD 12	Mainly used for cold working mold
SKD 4 SKD 5 SKD 6 SKD 61 SKD 62 SKD 7 SKD 8 SKT 3 SKT 4 SKT 6	Mainly used for hot forming mold

Informative reference : Designations of grades in **JIS** and corresponding designations in **ISO** are shown in Annex 1.

**4 Method of manufacture** The method of manufacture shall be as follows :

- a) Steel shall be made of killed steel.
- b) Unless otherwise specified, steels shall be rolled or forged with a forming ratio of 4S or over. However, if this forming ratio is under 4S owing to the dimension of the steel, it may be overcome by upset forging.
- c) Unless otherwise specified, steels shall be subjected to annealing.

Information : The designation of forming ratio conforms to **JIS G 0701**.

**5 Chemical composition** The chemical composition of steels shall be determined by the test of 11.1 and the values obtained by the cast analysis shall be as given in tables 2 to 5.

**Table 2 Chemical composition (for cutting tools)**

Unit : %

Designation of grade	Chemical composition <sup>(1)</sup> <sup>(2)</sup>									Example of application (informative)
	C	Si	Mn	P	S	Ni	Cr	W	V	
SKS 11	1.20 to 1.30	0.35 max.	0.50 max.	0.030 max.	0.030 max.	—	0.20 to 0.50	3.00 to 4.00	0.10 to 0.30	Cutting tool, dies for cold drawing, drill
SKS 2	1.00 to 1.10	0.35 max.	0.80 max.	0.030 max.	0.030 max.	—	0.50 to 1.00	1.00 to 1.50	<sup>(3)</sup>	Tap, drill, cutter, die for press, die for thread cutting
SKS 21	1.00 to 1.10	0.35 max.	0.50 max.	0.030 max.	0.030 max.	—	0.20 to 0.50	0.50 to 1.00	0.10 to 0.25	
SKS 5	0.75 to 0.85	0.35 max.	0.50 max.	0.030 max.	0.030 max.	0.70 to 1.30	0.20 to 0.50	—	—	Circular saw, band saw
SKS 51	0.75 to 0.85	0.35 max.	0.50 max.	0.030 max.	0.030 max.	1.30 to 2.00	0.20 to 0.50	—	—	
SKS 7	1.10 to 1.20	0.35 max.	0.50 max.	0.030 max.	0.030 max.	—	0.20 to 0.50	2.00 to 2.50	<sup>(3)</sup>	Hack saw
SKS 81	1.10 to 1.30	0.35 max.	0.50 max.	0.030 max.	0.030 max.	—	0.20 to 0.50	—	—	Spare cutting tool, cutting tool, hack saw
SKS 8	1.30 to 1.50	0.35 max.	0.50 max.	0.030 max.	0.030 max.	—	0.20 to 0.50	—	—	Blade file, file set

Notes <sup>(1)</sup> Elements not specified in table 2 shall not intentionally be added except for the purpose to finish the melt steel, unless otherwise the agreement between the purchaser and the manufacturer has been settled.

<sup>(2)</sup> The contents of Ni (excluding SKS 5 and SKS 51) and Cu for each grade shall not exceed 0.25 %, respectively, as the impurities.

<sup>(3)</sup> SKS 2 and SKS 7 may be added V not exceeding 0.20 %, respectively.

**Table 3 Chemical composition (for impact resistance tools)**

Unit : %

Designation of grade	Chemical composition <sup>(1)</sup> <sup>(2)</sup>								Example of application (informative)
	C	Si	Mn	P	S	Cr	W	V	
SKS 4	0.45 to 0.55	0.35 max.	0.50 max.	0.030 max.	0.030 max.	0.50 to 1.00	0.50 to 1.00	—	Chisel, punch, shear knife
SKS 41	0.35 to 0.45	0.35 max.	0.50 max.	0.030 max.	0.030 max.	1.00 to 1.50	2.50 to 3.50	—	
SKS 43	1.00 to 1.10	0.10 to 0.30	0.10 to 0.40	0.030 max.	0.030 max.	<sup>(6)</sup>	—	0.10 to 0.20	Piston for rock borer, heading die
SKS 44	0.80 to 0.90	0.25 max.	0.30 max.	0.030 max.	0.030 max.	<sup>(6)</sup>	—	0.10 to 0.25	Chisel, heading die

Notes <sup>(4)</sup> Elements not specified in table 3 shall not intentionally be added except for the purpose to finish the melt steel, unless otherwise the agreement between the purchaser and the manufacturer has been settled.

<sup>(5)</sup> The contents of Ni and Cu for each grade shall not exceed 0.25 %, respectively, as the impurities.

<sup>(6)</sup> SKS 43 and SKS 44 shall not contain over 0.20 % Cr as the impurity.

**Table 4 Chemical composition (for cold working mold)**

Unit : %

Designation of grade	Chemical composition <sup>(7)</sup>									Example of application (informative)
	C	Si	Mn	P	S	Cr	Mo	W	V	
SKS 3	0.90 to 1.00	0.35 max.	0.90 to 1.20	0.030 max.	0.030 max.	0.50 to 1.00	—	0.50 to 1.00	—	Gauge, shear knife, die for press, die for thread cutting
SKS 31	0.95 to 1.05	0.35 max.	0.90 to 1.20	0.030 max.	0.030 max.	0.80 to 1.20	—	1.00 to 1.50	—	Gauge, die for press, die for thread cutting
SKS 93	1.00 to 1.10	0.50 max.	0.80 to 1.10	0.030 max.	0.030 max.	0.20 to 0.60	—	—	—	Shear knife, gauge, die for press
SKS 94	0.90 to 1.00	0.50 max.	0.80 to 1.10	0.030 max.	0.030 max.	0.20 to 0.60	—	—	—	
SKS 95	0.80 to 0.90	0.50 max.	0.80 to 1.10	0.030 max.	0.030 max.	0.20 to 0.60	—	—	—	
SKD 1	1.90 to 2.20	0.10 to 0.60	0.20 to 0.60	0.030 max.	0.030 max.	11.00 to 13.00	—	—	<sup>(8)</sup>	Wire drawing die, die for press, die for brick press, die for powder press
SKD 2	2.00 to 2.30	0.10 to 0.40	0.30 to 0.60	0.030 max.	0.030 max.	11.00 to 13.00	—	0.60 to 0.80	—	
SKD 10	1.45 to 1.60	0.10 to 0.60	0.20 to 0.60	0.030 max.	0.030 max.	11.00 to 13.00	0.70 to 1.00	—	0.70 to 1.00	Gauge, die for thread rolling, cutting tool for metal, forming roll, die for press
SKD 11	1.40 to 1.60	0.40 max.	0.60 max.	0.030 max.	0.030 max.	11.00 to 13.00	0.80 to 0.120	—	0.20 to 0.50	
SKD 12	0.95 to 1.05	0.10 to 0.40	0.40 to 0.80	0.030 max.	0.030 max.	4.80 to 5.50	0.90 to 1.20	—	0.15 to 0.35	

Notes <sup>(7)</sup> Elements not specified in table 4 shall not intentionally be added except for the purpose to finish the melt steel, unless otherwise the agreement between the purchaser and the manufacturer has been settled.

<sup>(8)</sup> SKD 1 may be added V not exceeding 0.30 %.

**Table 5 Chemical composition (for hot forming mold)**

Unit : %

Designation of grade	Chemical composition <sup>(9)</sup>											Example of application (informative)
	C	Si	Mn	P	S	Ni	Cr	Mo	W	V	Co	
SKD 4	0.25 to 0.35	0.40 max.	0.60 max.	0.030 max.	0.020 max.	—	2.00 to 3.00	—	5.00 to 6.00	0.30 to 0.50	—	Die for press, die for die-casting, die for extruding, shear knife
SKD 5	0.25 to 0.35	0.10 to 0.40	0.15 to 0.45	0.030 max.	0.020 max.	—	2.50 to 3.20	—	8.50 to 9.50	0.30 to 0.50	—	
SKD 6	0.32 to 0.42	0.80 to 1.20	0.50 max.	0.030 max.	0.020 max.	—	4.50 to 5.50	1.00 to 1.50	—	0.30 to 0.50	—	
SKD 61	0.35 to 0.42	0.80 to 1.20	0.25 to 0.50	0.030 max.	0.020 max.	—	4.80 to 5.50	1.00 to 1.50	—	0.80 to 1.15	—	
SKD 62	0.32 to 0.40	0.80 to 1.20	0.20 to 0.50	0.030 max.	0.020 max.	—	4.75 to 5.50	1.00 to 1.60	1.00 to 1.60	0.20 to 0.50	—	Die for press, die for extruding
SKD 7	0.28 to 0.35	0.10 to 0.40	0.15 to 0.45	0.030 max.	0.020 max.	—	2.70 to 3.20	2.50 to 3.00	—	0.40 to 0.70	—	Die for press, die for extruding
SKD 8	0.35 to 0.45	0.15 to 0.50	0.20 to 0.50	0.030 max.	0.020 max.	—	4.00 to 4.70	0.30 to 0.50	3.80 to 4.50	1.70 to 2.10	4.00 to 4.50	Die for press, die for die-casting, die for extruding
SKT 3	0.50 to 0.60	0.35 max.	0.60 max.	0.030 max.	0.020 max.	0.25 to 0.60	0.90 to 1.20	0.30 to 0.50	—	<sup>(10)</sup>	—	Die for forging, die for press, die for extruding
SKT 4	0.50 to 0.60	0.10 to 0.40	0.60 to 0.90	0.030 max.	0.020 max.	1.50 to 1.80	0.80 to 1.20	0.35 to 0.55	—	0.05 to 0.15	—	
SKT 6	0.40 to 0.50	0.10 to 0.40	0.20 to 0.50	0.030 max.	0.020 max.	3.80 to 4.30	1.20 to 1.50	0.15 to 0.35	—	—	—	

Notes <sup>(9)</sup> Elements not specified in table 5 shall not intentionally be added except for the purpose to finish the melt steel, unless otherwise the agreement between the purchaser and the manufacturer has been settled.

<sup>(10)</sup> SKT 3 may be added V not exceeding 0.20 %.

**6 Hardness in annealed condition** The annealed hardness for steels shall be determined by the test of 11.2 and as given in table 6. Pertaining to steels for which the measurement by Brinell hardness is difficult, however, it may be made by Rockwell hardness or Vickers hardness. In this case, the values shall be agreed upon between the purchaser and the manufacturer.



**Table 6 Annealed hardness of steel**

Category	Designation of grade	Annealing temperature °C	Annealed hardness HBW
Steel for cutting tool	SKS 11	780 to 850 slow cooling	241 max.
	SKS 2	750 to 800 slow cooling	217 max.
	SKS 21	750 to 800 slow cooling	217 max.
	SKS 5	750 to 800 slow cooling	207 max.
	SKS 51	750 to 800 slow cooling	207 max.
	SKS 7	750 to 800 slow cooling	217 max.
	SKS 81	750 to 800 slow cooling	212 max.
	SKS 8	750 to 800 slow cooling	217 max.
Steel for impact resistance tool	SKS 4	740 to 780 slow cooling	201 max.
	SKS 41	760 to 820 slow cooling	217 max.
	SKS 43	750 to 800 slow cooling	212 max.
	SKS 44	730 to 780 slow cooling	207 max.
Steel for cold working mold	SKS 3	750 to 800 slow cooling	217 max.
	SKS 31	750 to 800 slow cooling	217 max.
	SKS 93	750 to 780 slow cooling	217 max.
	SKS 94	740 to 760 slow cooling	212 max.
	SKS 95	730 to 760 slow cooling	212 max.
	SKD 1	830 to 880 slow cooling	248 max.
	SKD 2	830 to 880 slow cooling	255 max.
	SKD 10	830 to 880 slow cooling	255 max.
	SKD 11	830 to 880 slow cooling	255 max.
	SKD 12	830 to 880 slow cooling	241 max.
Steel for hot forming mold	SKD 4	800 to 850 slow cooling	235 max.
	SKD 5	800 to 850 slow cooling	241 max.
	SKD 6	820 to 870 slow cooling	229 max.
	SKD 61	820 to 870 slow cooling	229 max.
	SKD 62	820 to 870 slow cooling	229 max.
	SKD 7	820 to 870 slow cooling	229 max.
	SKD 8	820 to 870 slow cooling	262 max.
	SKT 3	760 to 810 slow cooling	235 max.
	SKT 4	740 to 800 slow cooling	248 max.
	SKT 6	720 to 780 slow cooling	285 max.

Remarks : For hot-rolled steel plate and sheet in coils and cut lengths, the hardness value in annealed condition shall be agreed upon between the purchaser and the manufacturer.

**7 Hardness in quenched and tempered condition** The test piece for hardness in quenched and tempered condition which is sampled in accordance with 11.2 shall be subjected to heat treatment at the temperature given in table 7 and the hardness on the test piece in quenched and tempered condition shall be as given in table 7. The allowable range of the heat treatment temperature for the test piece shall be  $\pm 10^{\circ}\text{C}$  of the temperature given in table 7 for both quenching and tempering treatment.

**Table 7 Quenched and tempered hardness of test piece**

Category	Designation	Heat treatment temperature °C		Quenched and hardness of grade HRC
		Quenching	Tempering	
Steel for cutting tool	SKS 11	790 water quenching	180 air cooling	62 min.
	SKS 2	860 oil quenching	180 air cooling	61 min.
	SKS 21	800 water quenching	180 air cooling	61 min.
	SKS 5	830 oil quenching	420 air cooling	45 min.
	SKS 51	830 oil quenching	420 air cooling	45 min.
	SKS 7	860 oil quenching	180 air cooling	62 min.
	SKS 81	790 water quenching	180 air cooling	63 min.
	SKS 8	810 water quenching	180 air cooling	63 min.
Steel for impact resistance tool	SKS 4	800 water quenching	180 air cooling	56 min.
	SKS 41	880 oil quenching	180 air cooling	53 min.
	SKS 43	790 water quenching	180 air cooling	63 min.
	SKS 44	790 water quenching	180 air cooling	60 min.
Steel for cold working mold	SKS 3	830 oil quenching	180 air cooling	60 min.
	SKS 31	830 oil quenching	180 air cooling	61 min.
	SKS 93	820 oil quenching	180 air cooling	63 min.
	SKS 94	820 oil quenching	180 air cooling	61 min.
	SKS 95	820 oil quenching	180 air cooling	59 min.
	SKD 1	970 air cooling	180 air cooling	62 min.
	SKD 2	970 air cooling	180 air cooling	62 min.
	SKD 10	1 020 air cooling	180 air cooling	61 min.
	SKD 11	1 030 air cooling	180 air cooling	58 min.
	SKD 12	970 air cooling	180 air cooling	60 min.
Steel for hot forming mold	SKD 4	1 080 oil quenching	600 air cooling	42 min.
	SKD 5	1 150 oil quenching	600 air cooling	48 min.
	SKD 6	1 050 air cooling	550 air cooling	48 min.
	SKD 61	1 020 air cooling	550 air cooling	50 min.
	SKD 62	1 020 air cooling	550 air cooling	48 min.
	SKD 7	1 040 air cooling	550 air cooling	46 min.
	SKD 8	1 120 oil quenching	600 air cooling	48 min.
	SKT 3	850 oil quenching	500 air cooling	42 min.
	SKT 4	850 oil quenching	500 air cooling	42 min.
	SKT 6	850 oil quenching	180 air cooling	52 min.

**8 Appearance** Steels shall have a well workmanlike finish, and shall be free from defects that are detrimental to practical use.

## 9 Dimension and tolerances

**9.1 Standard dimension** The standard diameter of the hot-rolled round steel bar shall be as given in table 8.

**Table 8 Standard diameter**

Unit : mm

10	20	30	50	100
11	21	32	55	110
12	22	34	60	120
13	23	36	65	130
14	24	38	70	140
15	25	40	75	150
16	26	42	80	
17	27	44	85	
18	28	46	90	
19	29	48	95	

Remarks : Table 8 is applicable to wire rods and bar in coils whose cross-section is round.

**9.2 Dimensional tolerances** The tolerances on diameter for the hot-rolled round steel bar shall be as given in table 9.

**Table 9 Tolerances on diameter**

Unit : mm

Specified diameter	Tolerance on diameter	Allowable deviation on diameter <sup>(1)</sup>
10 or over to and excl. 16	+0.6 -0.3	Up to and incl. 70 % of the full range of tolerance on diameter
16 or over to and excl. 30	+0.7 -0.3	
30 or over up to and incl. 150	+2.5 % -1.0 %	

Note <sup>(1)</sup> The allowable deviation on diameter means the deference between the maximum and minimum diameters on the same cross-section of the round steel bar.

Remarks 1 The tolerances on diameter for the round steel bar whose diameter is under 10 mm and over 150 mm shall be agreed upon between the purchaser and the manufacturer.

2 Table 9 is applicable to wire rods and bar in coils whose cross-section is round.

**9.3 Dimension and tolerances on dimension of steels other than hot-rolled round steel bars** The dimensions and the tolerances on dimension of steels other than the hot-rolled round steel bar shall be agreed upon between the purchaser and the manufacturer.

**10 Decarburized depth** The decarburized depth of steels shall be measured in accordance with **11.3** and the allowable limit of decarburized depth of hot-rolled round steel bars shall be as given in table 10. The allowable limit of decarburized depth of steels other than hot-rolled round steel bars shall be agreed upon between the purchaser and the manufacturer.

**Table 10 Allowable limit of decarburized depth of hot-rolled round steel bar**

Unit : mm

Specified diameter	Allowable limit
Under 15	0.30
15 or over to and excl. 25	0.50
25 or over to and excl. 50	0.80
50 or over to and excl. 75	1.10
75 or over to and excl. 100	1.40
100 or over to and excl. 130	1.80
130 or over up to and incl. 150	2.00

Remarks 1 The allowable limit of decarburized depth of round steel bars whose diameter is over 150 mm shall be agreed upon between the purchaser and the manufacturer.

2 Table 10 is applicable to wire rods and bar in coils whose cross-section is round.

## 11 Test

### 11.1 Chemical analysis

**11.1.1 General requirement for chemical analysis and sampling method of specimen for analysis** The chemical composition shall be determined by the cast analysis. The general requirement for chemical analysis and sampling method of specimen for analysis conforms to clause **8** of **JIS G 0404**.

**11.1.2 Analytical method** The analytical method conforms to **JIS G 0320**.

### 11.2 Hardness test

**11.2.1** The measurement of hardness on the annealed steels shall be made at arbitrary place of the steel.

**11.2.2** Pertaining to the sampling plan, one test specimen for quenched and tempered hardness test shall be taken from each same heat of the steel and each same heat treatment condition.

**11.2.3** The test piece for quenched and tempered hardness test shall be machined from the test specimen prepared according to **11.2.2** to furnish approximately 15 mm square or circle, and approximately 20 mm length. The test piece with thickness or diameter not more than 15 mm, respectively, shall be regarded as equivalent to thickness × approximately 15 mm × approximately 20 mm or diameter × approximately 20 mm. When it is difficult to apply these dimensions of the test piece, it shall be agreed upon between the purchaser and the manufacturer.

In the case when the test specimen is prepared from un-annealed steels, the test piece for quenched and tempered hardness test shall be annealed according to table 6 followed by quenching and tempering specified in table 7.

**11.2.4** The test method conforms to any one of the following standards :

**JIS Z 2243, JIS Z 2244, JIS Z 2245**

**11.3 Measurement of decarburized depth** The measurement of decarburized depth shall be made by the total decarburized depth (DM-T) according to **4.1** of **JIS G 0558**. However, when it is difficult to carry out microscopic measurement of the steel other than that for hot forming mold, it is recommended to apply the practical decarburized depth (DH-P) according to **4.2** of **JIS G 0558**. In this case, the heat treatment of the test piece shall be as given in table 7 and the practical decarburized depth shall be the depth from the surface obtained when the hardness reaches that given in table 7.

## **12 Inspection**

**12.1 Inspection** Inspection shall be as follows :

- a) General requirements given in **JIS G 0404** shall apply.
- b) Chemical composition shall comply with clause **5**.
- c) Annealed hardness of steels shall comply with clause **6**.
- d) Hardness in quenched and tempered condition shall comply with clause **7**.
- e) Appearance shall comply with clause **8**.
- f) Dimension and tolerances shall comply with clause **9**.
- g) The decarburized depth shall comply with clause **10**.

**12.2 Other inspection** In addition to the inspections specified in **12.1**, the following inspections may be conducted by agreement between the purchaser and the manufacturer.

Macrostructure inspection, non-metallic inclusions inspection, macro-streak-flaw inspection, magnetic particle inspection, ultrasonic flaw detection inspection, microstructure inspection

Test methods for inspections other than the microstructure inspection shall be as follows.

Macrostructure inspection	<b>JIS G 0553</b>
Non-metallic inclusions inspection	<b>JIS G 0555</b>
Macro-streak-flaw inspection	<b>JIS G 0556</b>

Magnetic particle inspection                    **JIS G 0565**

Ultrasonic flaw detection inspection       **JIS Z 2344**

The test method of microstructure inspection shall be agreed upon between the purchaser and the manufacturer.

In this case, the sampling position of test specimen and test piece, acceptance criteria, and others shall previously be agreed between the purchaser and the manufacturer.

**13 Marking** Pertaining to the marking on steels, the following items shall be marked by suitable means on every steel. Steel plates and sheets, steel in coils and cut lengths, flat steels and steel bars and wires whose diameter or width across flats is under 30 mm may be bundled and the items may be marked on each bundle by suitable means. When approved by the purchaser, a part of the following items may be omitted.

- a) Designation of grade
- b) Heat number or alternative manufacturing (inspection) number
- c) Dimension <sup>(12)</sup>
- d) Quantity or mass
- e) Manufacture's name or its identifying brand

Note <sup>(12)</sup> Marking shall conform to **JIS G 3191**, **JIS G 3193** and **JIS G 3194**.

**14 Report** The report conforms to the requirements of clause **13** of **JIS G 0404**. Unless otherwise specified by the purchaser, inspection documents shall be Specific test report (designation 2.3) or Inspection certificate (designation 3.1 B) in table 1 of **JIS G 0415**.

Reports according to **12.2** shall be agreed upon between the purchaser and the manufacturer.

## **Annex 1 (informative)**

### **Designation of grade correspondence between JIS and International Standard**

This Annex (informative) is to supplement the matters related to the text and not to constitute the provisions of this Standard.

**1 Designation of grade correspondence between JIS and International Standard** The designations of grades of **JIS** and those of the International Standard (**ISO 4957 : 1999**) whose chemical composition is equivalent to or similar to are shown in Annex 1 table 1.

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**Annex 1 Table 1 Designation of grade correspondence  
between JIS and International Standard**

Designation of grade		Category
JIS	ISO	
SKS 11	—	Mainly used for cutting tool
SKS 2	—	
SKS 21	—	
SKS 5	—	
SKS 51	—	
SKS 7	—	
SKS 81	—	
SKS 8	—	
SKS 4	—	Mainly used for impact resistance tool
SKS 41	—	
SKS 43	105V	
SKS 44	—	
SKS 3	—	Mainly used for cold working mold
SKS 31	—	
SKS 93	—	
SKS 94	—	
SKS 95	—	
SKD 1	X210Cr12	
SKD 2	X210CrW12	
SKD 10	X153CrMoV12	
SKD 11	—	Mainly used for hot forming mold
SKD 12	X100CrMoV5	
SKD 4	—	
SKD 5	X30WCrV9-3	
SKD 6	—	
SKD 61	X40CrMoV5-1	
SKD 62	X35CrWMoV5	
SKD 7	32CrMoV12-28	
SKD 8	38CrCoWV18-17-17	
SKT 3	—	
SKT 4	55NiCrMoV7	
SKT 6	45NiCrMo16	



**Annex 2 (informative)**  
**Comparison table between JIS and corresponding International Standard**

<b>JIS G 4404 : 2006 Alloy tool steels</b>		<b>ISO 4957 : 1999 Tool steels</b>			<b>(V) Justification for the technical deviation and future measures</b>	
<b>(I) Requirements in JIS</b>		<b>(III) Requirements in International Standard</b>		<b>(IV) Classification and details of technical deviation between JIS and the International Standard by clause</b>		
<b>Clause</b>	<b>Content</b>	<b>Clause</b>	<b>Content</b>	<b>Classification by clause</b>	<b>Detail of technical deviation</b>	
1 Scope	Steels manufactured by hot-rolling or forging . Alloy tool steels	1	Scope : Applies to hot-rolled, forged, cold-drawn or cold-rolled products. a) non-alloy cold-work tool steels b) alloy cold-work tool steels c) alloy hot-work tool steels d) high-speed tool steels	MOD/deletion	JIS specifies carbon tool steels in <b>JIS G 4401</b> and high-speed tool steels in <b>JIS G 4403</b> . This comes from difference of standard system. This table provides comparison focusing on alloy tool steels based on <b>JIS</b> .	This comes from the usability of standard and does not give any problems when comparing difference between both Standards. For the time being difference should not be modified.
2 Normative references	JIS Standards are referred to.		ISO Standards are referred to.			
3 Grade and designation	JIS designation code is conformed.		ISO designation code is conformed.	MOD/alteration	The designation codes between <b>JIS</b> and <b>ISO</b> are different.	

(I) Requirements in JIS		(II) International Standard number		(III) Requirements in International Standard		(IV) Classification and details of technical deviation between the International Standard by clause		(V) Justification for the technical deviation and future measures	
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation	Classification by clause	Detail of technical deviation	Justification for the technical deviation and future measures	Justification for the technical deviation and future measures
4 Method of manufacture	<ul style="list-style-type: none"> <li>· Killed steel</li> <li>· Forming ratio of 4S or over</li> <li>· Unless otherwise specified, the steel shall be subjected to annealing.</li> </ul>	5.1	<p>Manufacturing process</p> <p>a) The manufacturing process of steels is left to the discretion of the manufacturer.</p> <p>b) By the purchaser's requests, the steel making process shall be informed.</p> <p>c) Unless otherwise specified in the order, the tool steels are delivered in the annealed condition except below.</p> <p>C45U, 35CrMo7, X38CrMo16, 40CrMnNiMo8-6-4, 55NiCrMoV7</p>	MOD/addition	<ul style="list-style-type: none"> <li>· a) and b) of ISO are general and ordinary. They should be described in ISO 404.</li> <li>· This idea will be proposed when reviewing ISO 404 next time.</li> <li>· Forming ratio should be specified in light of domestic needs although it is not strict and widely satisfied.</li> <li>· JIS specifies the plate and sheet in coils and cut lengths because they are not generally cut or cold-worked as they are. This will be also proposed when reviewing ISO next time.</li> </ul>	The JIS description relating to forming ratio will be proposed when reviewing ISO next time.			
5 Chemical composition	Specifies 32 grades of steels by application such as for cutting tool, for impact resistance tool, for cold working mold and for hot forming mold. Consists of the conventional JIS and ISO grades.	5.2	Specifies 26 grades of steels as alloy cold-work tool steels, alloy hot-work tool steels.	Combination of MOD/deletion and MOD/addition	Among 32 grades of steels of JIS, 12 grades of steels of ISO are adopted which are adaptable to domestic market needs. Twenty grades of steels of the conventional JIS widely used in the market are also specified.	Harmonization to ISO grades of steels will be promoted, while grades of steels indispensable for domestic market needs are left as they are. JIS-specific grades of steels will be proposed to be incorporated into ISO.			

(I) Requirements in JIS		(II) International Standard number		(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures	
Clause	Content	Clause	Content	Classification by clause	Detail of technical deviation	Justification for the technical deviation and future measures			
6	Hardness in annealed condition Specifies the maximum hardness for each grade in the standard annealing heat treatment.	5.2	Mechanical properties : Specifies the maximum hardness in the usual annealed condition at delivery.	Combination of MOD/deletion and MOD/addition	Specification is linked with grades of steels. However, ISO Standard has no description on the annealed condition.	ISO Standard specifies only the guaranteed value of the maximum hardness in the annealed condition at delivery with the annealed condition randomly chosen. This differs from JIS which specifies the cold-work after annealing carried out by the user side, but for the time being JIS-specific content developed based on the domestic dealings is adopted as the JIS values are equivalent to ISO values.			
7	Hardness in quenched and tempered condition Specifies the minimum hardness in the standard quenched and tempered condition.	5.2	Hardness in quenched and tempered condition : Specifies the minimum hardness in the standard quenched and tempered condition.	Combination of MOD/deletion and MOD/addition	Specification is linked with grades of steels.				
8	Appearance Steels shall be free from defects that are detrimental to practical use.	3.7	Almost the same with JIS.	MOD/alteration	Same as the left.				
9	Dimension and tolerances Specifies concrete values on dimension and tolerances.	5.4	Tolerances on shape and dimension : Subject to the agreement between the purchaser and the manufacturer.	MOD/addition	ISO does not provide any specification explicitly. JIS provides the specification satisfied with domestic market needs explicitly.	JIS specification satisfied with domestic needs is employed.			

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content		
10 Decarburized depth	For round steel bars, <b>JIS</b> specifies the concrete limits of decarburized depth.	—	Not specified.	MOD/addition	For round steel bars, <b>JIS</b> specifies the concrete allowable limits of decarburized depth.	The conventional <b>JIS</b> specification is employed in accordance with market needs. At the time of periodical review in 2004, the addition was proposed.
11 Test	The following three tests are specified. 11.1 Chemical analysis 11.2 Hardness test 11.3 Measurement of decarburized depth	4	The following three tests are specified. — Chemical analysis — Hardness test — Surface quality test Method of surface quality test shall be in accordance with the agreement between the purchaser and the manufacturer. — Decarburized depth — Surface defects	MOD/addition	The contents of tests are almost the same. Measurement of decarburized depth is decided to be in accordance with the agreement between the purchaser and the manufacturer.	At the time of periodical review in 2004, the addition of decarburized depth test was proposed.
12 Inspection	12.1 Inspection — Chemical composition — Hardness in quenched and tempered condition — Appearance — Dimension and tolerances — Decarburized depth 12.2 Other inspection Inspection other than 12.2 shall be agreed between the purchaser and the manufacturer.	3	The following inspection items are specified. — Chemical composition — Hardness in quenched and tempered condition — Surface condition — Dimension	MOD/addition	Fundamental items are almost the same between <b>JIS</b> and <b>ISO</b> . However, <b>JIS</b> specifies more items to be in accordance with the agreement.	<b>JIS</b> specifies to perform the test items meeting with the requirement of domestic needs.
13 Marking	Designation of grade, heat number, name of manufacturer, dimension, and mass.		Almost the same with <b>JIS</b> .	MOD/alteration	Same as the left.	

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation
14 Report	Fundamental report form is specified.			Almost the same with JIS.	MOD/addition	Same as the left.
Annex 1 (informative)	Designation codes of JIS and those corresponding to International Standard are listed as a reference.				MOD/addition	

**Designated degree of correspondence between JIS and International Standard : MOD**

- Remarks 1 Symbols in sub-columns of classification by clause in the above table indicate as follows :
- MOD/deletion : Deletes the specification item(s) and content(s) of International Standard.
  - MOD/addition : Adds the specification item(s) and content(s) which are not included in International Standard.
  - MOD/alteration : Alters the specification content(s) which are included in International Standard.
- 2 Symbol in column of designated degree of correspondence between JIS and International Standard in the above table indicates as follows :
- MOD : Modifies International Standard.

Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

Errata will be provided upon request, please contact:

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