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**Dimensions, shape, mass and
permissible variations of hot rolled
steel sections**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 3192** : 2014), which has been technically revised.

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Dimensions, shape, mass and permissible variations of hot rolled steel sections

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 657-1** : 1989, Edition 1, **ISO 657-2** : 1989, Edition 1, **ISO 657-5** : 1976, Edition 1, **ISO 657-11** : 1980, Edition 1, **ISO 657-15** : 1980, Edition 1, **ISO 657-18** : 1980, Edition 1, **ISO 657-19** : 1980, Edition 1 and **ISO 657-21** : 1983, Edition 1 with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the appearance, shapes and permissible variations thereof, and the dimensions, mass and their tolerances of hot rolled steel sections (hereafter referred to as steel sections).

The application of this Standard shall be as specified in each product standard.

NOTE The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 657-1 : 1989 *Hot-rolled steel sections — Part 1 : Equal-leg angles — Dimensions*

ISO 657-2 : 1989 *Hot-rolled steel sections — Part 2 : Unequal-leg angles — Dimensions*

ISO 657-5 : 1976 *Hot-rolled steel sections — Part 5 : Equal-leg angles and unequal-leg angles — Tolerances for metric and inch series*

ISO 657-11 : 1980 *Hot-rolled steel sections — Part 11 : Sloping flange channel sections (Metric series) — Dimensions and sectional properties*

ISO 657-15 : 1980 *Hot-rolled steel sections — Part 15 : Sloping flange beam sections (Metric series) — Dimensions and sectional properties*

ISO 657-18 : 1980 *Hot-rolled steel sections — Part 18 : L sections for shipbuilding (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-19 : 1980 *Hot-rolled steel sections — Part 19 : Bulb flats (metric series) — Dimensions, sectional properties and tolerances*

ISO 657-21 : 1983 *Hot-rolled steel sections — Part 21 : T-sections with equal depth and flange width — Dimensions* (overall evaluation : MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT

(identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21-1.

2 Normative references

Part or all of the provisions of the following standards, 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 0203 *Glossary of terms used in iron and steel (Products and quality)*

JIS Z 8401 *Rounding of numbers*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions, and those given in JIS G 0203 apply.

3.1

H-sections

sections with cross-section whose shape resembles the letter H

Note 1 to entry Generally, they are manufactured by universal rolling mill, two parallel sides have the same thickness and the inside surface of the side has no slope.

Note 2 to entry It may be classified into narrow width (beam), medium width (beam) and wide width (column) according to the relationship between the height and the side.

Note 3 to entry H-sections with flanges wider than 0.8 times the nominal height may be called “columns”.

Note 4 to entry H-sections include equal outer dimension H-sections. Equal outer dimension H-sections refers to H-sections whose depth is constant irrespective of the thickness of the flange.

3.2

CT-sections

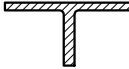
sections prepared by cutting H-sections at the web

Note 1 to entry CT-sections include equal outer dimension CT-sections.

4 Classification and sectional shape

The classification and sectional shapes of steel sections shall be as given in Table 1.

Table 1 Classification and sectional shapes of steel sections

Classification		Sectional shape diagram
Angle	Equal-leg	
	Unequal-leg	
	Unequal-leg and unequal-thickness	
I-section		
Channel		
Bulb flat		
T-section		
H-section		
CT-section		

5 Expression of dimensions and marking

The expression of dimensions and marking of steel sections shall be as follows.

- Dimensions of each part of section shall be expressed in millimetre. As a rule, dimensions of each part of section shall be marked with items among the leg length (A , B), depth (H) and thickness (t , t_1 , t_2) of sectional dimensions shown in Table 3 to Table 5 and Table 8 to Table 18 according to each sectional shape. The thickness (t_1 , t_2) of channels in Table 12 may be marked with t_1 only.
- The length shall be expressed in metre. However, the length may be expressed in millimetre upon the agreement between the purchaser and the manufacturer.

6 Standard dimensions

The standard dimensions shall be as follows. The standard dimensions are representative dimensions, and the sectional dimensions and the length not given in the tables may be used upon the agreement between the purchaser and the manufacturer.

- The standard sectional dimensions of steel sections shall be as given in Table 8 to Table 18.
- The standard lengths of steel sections shall be as given in Table 2.

Table 2 Standard lengths

Unit: m

6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0
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7 Shapes and dimensional tolerances

The shapes and dimensional tolerances of steel sections shall be as follows. Tolerances not specified in a) to c) shall be upon the agreement between the purchaser and the manufacturer.

- a) The shapes and dimensional tolerances of angles, I-sections, channels, bulb flats and T-sections shall be as given in Table 3. The plus tolerance on length may be determined upon the agreement between the purchaser and the manufacturer.
- b) The shapes and dimensional tolerances of H-sections shall be as given in Table 4. The plus tolerance on length may be determined upon the agreement between the purchaser and the manufacturer. The tolerances on sectional squareness shall be applied on the request from the purchaser.
- c) The shapes and dimensional tolerances of CT-sections shall be as given in Table 5. The plus tolerance on length may be determined upon the agreement between the purchaser and the manufacturer. The tolerances on sectional squareness shall be applied on the request from the purchaser.

8 Mass

The mass of steel sections shall be as follows.

- a) The mass of steel sections shall generally be expressed by theoretical mass in kilogramme.
- b) The mass of steel sections shall be calculated according to Table 6 using the nominal dimensions ¹⁾.
- c) The sectional area and unit mass corresponding to the standard sectional dimensions of steel section calculated according to Table 6 shall be as given in Table 8 to Table 18. Besides the sectional area and the unit mass, Table 8 to Table 18 show the distance of centre of gravity, geometrical moment of inertia, radius of gyration of area and modulus of section for reference.

Note ¹⁾ Nominal dimensions are used in commercial transactions and are usually referred to as dimensions. The term “nominal dimensions” is used here to avoid confusion with actually measured dimensions.

9 Tolerances on mass

When requested by the purchaser, the mass tolerances for steel sections shall be as given in Table 7. In this case, the tolerances on mass shall be calculated by dividing the difference between the theoretical mass and actual mass by the theoretical mass

and shall be expressed in percentage.

10 Appearance

The appearance of steel sections shall be as follows.

- a) The steel sections shall be free from defects that are detrimental to practical use.
- b) In the case where there are some harmful defects on the surface of steel sections, the manufacturer may remove or repair the defects by grinding or welding. In this case, the operation shall be as follows.

1) Conditioning with grinder

- 1.1) The sectional dimensions of steel sections after conditioning shall fall within the range of the tolerances. When approved by the purchaser, however, this restriction may be applied flexibly according to its application.
- 1.2) The conditioned parts of steel sections shall be finished neatly, and the boundary between the repaired portions and the as-rolled surface shall be smoothly finished.

2) Repair by welding

- 2.1) The harmful defects of steel sections shall be repaired by welded overlay after complete removal by means of appropriate method such as chipping or grinding.
- 2.2) The depth of the defect-removed portion prior to the repair by welding shall be 30 % or under of the nominal thickness. For the toe of the leg of steel sections, however, the depth shall fall within the nominal thickness of the leg from the end part (12 mm in maximum).
- 2.3) The repaired area by welding shall be 2 % or under of the whole surface area of steel sections.
- 2.4) The weld repairing shall be carried out by suitable means according to the type of steel products.
- 2.5) The welded part of steel sections shall be free from undercut or overlaps around the fringe of welds. The reinforcement of weld shall be 1.5 mm or over in height from the rolled surface, and this shall be removed by chipping, grinding, etc. and smoothly finished as high as the rolled surface.
- 2.6) When the heat-treated steel section is repaired by welding, the body including repaired portions shall be heat-treated once again after the repair.

Table 3 Shapes and dimensional tolerances of angles, I-sections, channels, bulb flats and T-sections

Unit: mm

Division and dimension			Tolerance	Remarks
Leg length (A, B)	Under 50		±1.5	
	50 or over to and excl. 100		±2.0	
	100 or over to and excl. 200		±3.0	
	200 or over		±4.0	
Depth (H)	Under 100		±1.5	
	100 or over to and excl. 200		±2.0	
	200 or over to and excl. 400		±3.0	
	400 or over		±4.0	
Thick- ness (t, t ₁ , t ₂)	For leg length A (B for T-section) or under 130 in depth	Under 6.3	±0.6	
		6.3 or over to and excl. 10	±0.7	
		10 or over to and excl. 16	±0.8	
		16 or over	±1.0	
	For leg length A (B for T-section) or 130 or over in depth	Under 6.3	±0.7	
		6.3 or over to and excl. 10	±0.8	
		10 or over to and excl. 16	±1.0	
		16 or over to and excl. 25	±1.2	
		25 or over	±1.5	
Length	7 m or under		+40 0	
	Over 7 m		Add 5 mm to the plus tolerance given in the above column for every 1 m increase or its fraction in length. The minus tolerance shall be 0 mm.	
Out-of- square (T)	I-section		2.0 % or under of leg length B	 For I-sections, see diagrams of H-sections in Table 4.
	Angle and channel ^{a)}		2.5 % or under of leg length B	
Bend	I-section and T-section		0.20 % or under of length	To be applied to bend such as sweep and camber
	Angle, channel and bulb flat		0.30 % or under of length	
Eccen- tricity (S)	300 or under in width B	T-section	±3.0	$S = \frac{b_1 - b_2}{2}$
Note ^{a)} The purchaser may designate that the out-of-square shall be 2.0 % or under of the leg length B for equal-leg angles of 200 mm or over in leg length.				

Table 4 Shapes and dimensional tolerances of H-sections

Unit: mm

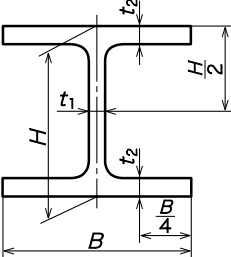
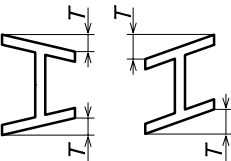
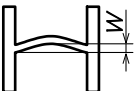
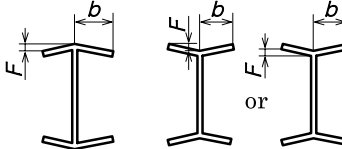
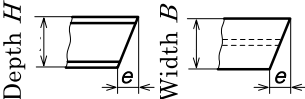
Division and dimension			Tolerance	Remarks	
Width (<i>B</i>)		400 or under	±2.0		
		Over 400	±3.0		
Depth (<i>H</i>)		Under 800	400 or under in width <i>B</i>		±2.0
			Over 400 in width <i>B</i>		±3.0
		800 or over			±3.0
Thickness	Flange (<i>t</i> ₂)	Under 16	±1.0		
		16 or over to and excl. 25	±1.5		
		25 or over to and excl. 40	±1.7		
		40 or over	±2.0		
	Web (<i>t</i> ₁)	Under 16	±0.7		
		16 or over to and excl. 25	±1.0		
		25 or over to and excl. 40	±1.5		
		40 or over	±2.0		
Length		7 m or under	+40 0		
		Over 7 m	Add 5 mm to the plus tolerance given in the above column for every 1 m increase or its fraction in length. The minus tolerance shall be 0 mm.		
Out-of-square (<i>T</i>)		300 or under in depth <i>H</i>	1.0 % or under of width <i>B</i> , provided that 1.5 mm is the minimum		
		Over 300 in depth <i>H</i>	1.2 % or under of width <i>B</i> , provided that 1.5 mm is the minimum		
Bend		300 or under in depth <i>H</i>	0.15 % or under of length	To be applied to bend such as sweep and camber	
		Over 300 in depth <i>H</i>	0.10 % or under of length		
Eccentricity (<i>S</i>)		400 or under in width <i>B</i>	±2.0	$S = \frac{b_1 - b_2}{2}$ 	
		Over 400 in width <i>B</i>	±3.5		
Concavity of web ^{b)} (<i>W</i>)		350 or under in depth <i>H</i>	2.0 or under		
		Over 350 to and excl. 550 in depth <i>H</i>	2.5 or under		
		550 or over in depth <i>H</i>	3.0 or under		
Flange fold (<i>F</i>)		400 or under in width <i>B</i>	1.5 % or under of <i>b</i> , provided that 1.5 mm is the maximum		
Sectional squareness ^{a)} (<i>e</i>)			1.6 % or under of width <i>B</i> or of depth <i>H</i> , provided that 3.0 mm is the minimum		
Note ^{a)} The tolerances on sectional squareness shall be applied on the request from the purchaser.					
Note ^{b)} Concavity of web shall be applied to the portion of web excluding corner R.					

Table 5 Shapes and dimensional tolerances of CT-sections

Unit: mm

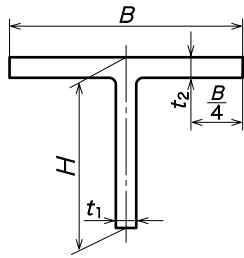
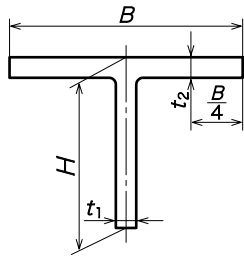
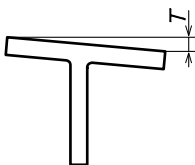
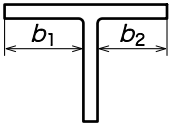
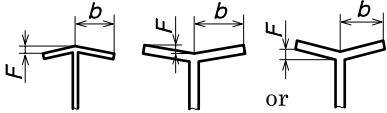
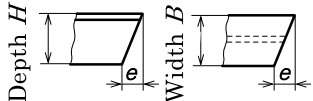
Division and dimension		Tolerance	Remarks
Width (B)	400 or under	± 2.0	
	Over 400	± 3.0	
Depth (H)		± 3.0	
Thickness	Flange (t_2)	Under 16	
		16 or over to and excl. 25	
		25 or over to and excl. 40	
		40 or over	
	Web (t_1)	Under 16	
		16 or over to and excl. 25	
		25 or over to and excl. 40	
		40 or over	
Length	7 m or under	+40 0	
	Over 7 m	Add 5 mm to the plus tolerance given in the above column for every 1 m increase or its fraction in length. The minus tolerance shall be 0 mm.	
Out-of-square (T)	150 or under in depth H	1.0 % or under of width B , provided that 1.5 mm is the minimum	
	Over 150 in depth H	1.2 % or under of width B , provided that 1.5 mm is the minimum	
Bend	150 or under in depth H	0.15 % or under of length	To be applied to bend such as sweep and camber
	Over 150 in depth H	0.10 % or under of length	
Eccentricity (S)	400 or under in width B	± 2.0	 $S = (b_1 - b_2)/2$
	Over 400 in width B	± 3.5	
Flange fold (F)	400 or under in width B	1.5 % or under of b , provided that 1.5 mm is the maximum	 or
Sectional squareness ^{a)} (e)		1.6 % or under of width B or of depth H , provided that 3.0 mm is the minimum	
Note ^{a)} The tolerances on sectional squareness shall be applied on the request from the purchaser.			

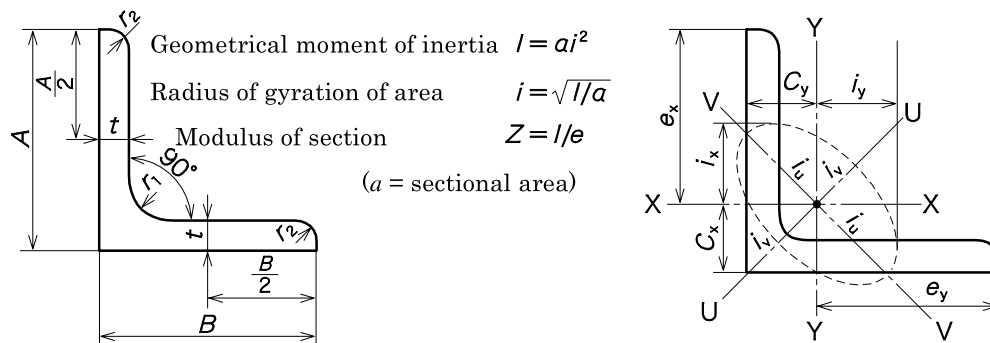
Table 6 Method for calculation of mass

Calculation order	Calculation method ^{a)}	Number of digits in calculated result ^{b)}
Basic mass kg/(cm ² ·m)	0.785 (mass per square centimetre sectional area, per metre length)	—
Sectional area cm ²	Use the following formulae and multiply the result by $\frac{1}{100}$: For equal-leg angles $t(2A - t) + 0.215(r_1^2 - 2r_2^2)$ For unequal-leg angles $t(A + B - t) + 0.215(r_1^2 - 2r_2^2)$ For unequal-leg and unequal-thickness angles $At_1 + t_2(B - t_1) + 0.215(r_1^2 - r_2^2)$ For I-sections $Ht_1 + 2t_2(B - t_1) + 0.615(r_1^2 - r_2^2)$ For channels $Ht_1 + 2t_2(B - t_1) + 0.349(r_1^2 - r_2^2)$ For bulb flats $At + dr_1 - 0.289d(2r_1 + d) - 0.215(r_1^2 + r_2^2)$ For T-sections $Bt_2 + 0.307r_1^2 + 482.6$ For H-sections $t_1(H - 2t_2) + 2Bt_2 + 0.858r^2$ For CT-sections $t_1(H - t_2) + Bt_2 + 0.429r^2$	Round off to 4 significant figures.
Unit mass kg/m	Basic mass [kg/(cm ² ·m)] × sectional area (cm ²)	Round off to 3 significant figures. For those exceeding 1 000 kg, round off to an integer in kg.
Mass of single piece kg	Unit mass (kg/m) × length (m)	Round off to 3 significant figures. For those exceeding 1 000 kg, round off to an integer in kg.
Total mass kg	Mass of single piece (kg) × total number of pieces of the same dimensions	Round off to an integer in kg.
Note ^{a)} The symbols used for calculation of sectional area represent sectional dimensions of the steel section, and the relation of the symbols to the respective parts of the section shall be as given in Table 8 to Table 18. Note ^{b)} Rounding shall be in accordance with Rule A of JIS Z 8401.		

Table 7 Tolerances on mass

Thickness ^{a)}	Tolerance
Under 10 mm	±5 %
10 mm or over	±4 %
To be applied to one lot of steel sections of the same dimensions (mass 1 t or over). When the number of pieces corresponding to 1 t in mass does not amount to 10, it shall be applied to each lot of 10 or more pieces. Note ^{a)} The thickness to be applied shall be t_1 or t_2, whichever is thicker.	

Table 8 Standard sectional dimensions, sectional area, unit mass and sectional properties of equal-leg angles



Standard sectional dimensions ^{a)} mm				Sec- tional area cm ²	Unit mass kg/m	Informative													
$A \times B$	t	r_1	r_2			Distance of centre of gravity cm		Geometrical moment of inertia cm ⁴				Radius of gyration of area cm				Modulus of section cm ³			
						C_x	C_y	I_x	I_y	Max. I_u	Min. I_v	i_x	i_y	Max. i_u	Min. i_v	Z_x	Z_y		
25 × 25	3	4	2	1.427	1.12	0.719	0.719	0.797	0.797	1.26	0.332	0.747	0.747	0.940	0.483	0.448	0.448		
30 × 30	3	4	2	1.727	1.36	0.844	0.844	1.42	1.42	2.26	0.590	0.908	0.908	1.14	0.585	0.661	0.661		
40 × 40	3	4.5	2	2.336	1.83	1.09	1.09	3.53	3.53	5.60	1.46	1.23	1.23	1.55	0.790	1.21	1.21		
40 × 40	5	4.5	3	3.755	2.95	1.17	1.17	5.42	5.42	8.59	2.25	1.20	1.20	1.51	0.774	1.91	1.91		
45 × 45	4	6.5	3	3.492	2.74	1.24	1.24	6.50	6.50	10.3	2.70	1.36	1.36	1.72	0.880	2.00	2.00		
45 × 45	5	6.5	3	4.302	3.38	1.28	1.28	7.91	7.91	12.5	3.29	1.36	1.36	1.71	0.874	2.46	2.46		
50 × 50	4	6.5	3	3.892	3.06	1.37	1.37	9.06	9.06	14.4	3.76	1.53	1.53	1.92	0.983	2.49	2.49		
50 × 50	5	6.5	3	4.802	3.77	1.41	1.41	11.1	11.1	17.5	4.58	1.52	1.52	1.91	0.976	3.08	3.08		
50 × 50	6	6.5	4.5	5.644	4.43	1.44	1.44	12.6	12.6	20.0	5.23	1.50	1.50	1.88	0.963	3.55	3.55		
60 × 60	4	6.5	3	4.692	3.68	1.61	1.61	16.0	16.0	25.4	6.62	1.85	1.85	2.33	1.19	3.66	3.66		
60 × 60	5	6.5	3	5.802	4.55	1.66	1.66	19.6	19.6	31.2	8.09	1.84	1.84	2.32	1.18	4.52	4.52		
65 × 65	5	8.5	3	6.367	5.00	1.77	1.77	25.3	25.3	40.1	10.5	1.99	1.99	2.51	1.28	5.35	5.35		
65 × 65	6	8.5	4	7.527	5.91	1.81	1.81	29.4	29.4	46.6	12.2	1.98	1.98	2.49	1.27	6.26	6.26		
65 × 65	8	8.5	6	9.761	7.66	1.88	1.88	36.8	36.8	58.3	15.3	1.94	1.94	2.44	1.25	7.96	7.96		
70 × 70	6	8.5	4	8.127	6.38	1.93	1.93	37.1	37.1	58.9	15.3	2.14	2.14	2.69	1.37	7.33	7.33		
75 × 75	6	8.5	4	8.727	6.85	2.06	2.06	46.1	46.1	73.2	19.0	2.30	2.30	2.90	1.48	8.47	8.47		
75 × 75	9	8.5	6	12.69	9.96	2.17	2.17	64.4	64.4	102	26.7	2.25	2.25	2.84	1.45	12.1	12.1		
75 × 75	12	8.5	6	16.56	13.0	2.29	2.29	81.9	81.9	129	34.5	2.22	2.22	2.79	1.44	15.7	15.7		
80 × 80	6	8.5	4	9.327	7.32	2.18	2.18	56.4	56.4	89.6	23.2	2.46	2.46	3.10	1.58	9.70	9.70		
90 × 90	6	10	5	10.55	8.28	2.42	2.42	80.7	80.7	128	33.4	2.77	2.77	3.48	1.78	12.3	12.3		
90 × 90	7	10	5	12.22	9.59	2.46	2.46	93.0	93.0	148	38.3	2.76	2.76	3.48	1.77	14.2	14.2		
90 × 90	10	10	7	17.00	13.3	2.57	2.57	125	125	199	51.7	2.71	2.71	3.42	1.74	19.5	19.5		
90 × 90	13	10	7	21.71	17.0	2.69	2.69	156	156	248	65.3	2.68	2.68	3.38	1.73	24.8	24.8		
100 × 100	7	10	5	13.62	10.7	2.71	2.71	129	129	205	53.2	3.08	3.08	3.88	1.98	17.7	17.7		