

**INVOICE FOR ISSUE OF  
TOYOTA ENGINEERING STANDARD**

**No. :** **TSG3290G**

**TITLE :** **GENERAL CARBON STEELS**

**CLASS :** **C**

**PUBLICATION RECORD**

This standard has been revised in consequence of the unification of revision numbers of Japanese and English editions of the International TS and of review of applicable standards.

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*Sales*

TOYOTA MOTOR MANUFACTURING  
NORTH AMERICA INC.  
PURCHASING PRODUCTION PREPARATIONS

TOYOTA ENGINEERING STANDARD  
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Date: **'99. 2. 26**  
Engineering Information  
Management Dept.  
Engineering Administration Div.  
TOYOTA MOTOR CORPORATION

**NOTE:** In the case of revision, the old standard which has been issued before should be discarded in proper manner (such as shredding or fire) to avoid possible use of obsolete standards information.

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|                                                                                   |                                    |                 | <b>C</b> |

GENERAL CARBON STEELS

1. Scope

This standard covers general carbon steels that constitute automobile parts.

Remark:

In this standard, units and numerical values given in { } are based on the customary units system, and are given for reference.

2. Classification and Symbols

Classification and symbols and proper standards are according to Table 1.

Table 1

| Symbol | Usual standard (reference) | JIS proper standard | Remark                                                  |
|--------|----------------------------|---------------------|---------------------------------------------------------|
| SS330  | SS34                       | SS330               | Steel plates and sheets, strips, flats and bars         |
| SS400  | SS41                       | SS400               | Steel plates and sheets, strips, flats, bars and shapes |
| SS490  | SS50                       | SS490               |                                                         |
| SS540  | SS55                       | SS540               |                                                         |

Remark 1:

The numerical figures in the symbols represent the lower limit values of tensile strength (MPa) [kgf/mm<sup>2</sup>].

Remark 2:

Steel bars include bar-in-coils.

Remark 3:

The maximum dimension of SS540 steel shall be 40 mm for the diameter, side, distance across opposite side thickness.

**Prepared and Written by:**

.....  
Metallic Material Dept.  
.....

Material Engineering Div. I

Engineering Administration Div.

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3. Chemical Composition

Chemical composition of general carbon steels shall be according to Table 2.

Table 2

| Symbol | Chemical composition (%) |           |            |            |
|--------|--------------------------|-----------|------------|------------|
|        | C                        | Mn        | P          | S          |
| SS330  | -----                    | -----     | 0.050 max. | 0.050 max. |
| SS400  |                          |           |            |            |
| SS490  |                          |           |            |            |
| SS540  | 0.30 max.                | 1.60 max. | 0.040 max. | 0.040 max. |

Remark:

Alloy elements other than those listed in Table 2 may be added to SS540, if necessary.

4. Mechanical Properties

Mechanical properties of general carbon steels shall be according to Table 3.

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Table 3 Mechanical Properties

| Symbol | Yield point or proof stress (N/mm <sup>2</sup> ) |                     |          | Tensile strength (N/mm <sup>2</sup> ) | Thickness of steel material <sup>(1)</sup> (mm)                                |
|--------|--------------------------------------------------|---------------------|----------|---------------------------------------|--------------------------------------------------------------------------------|
|        | Thickness of steel material <sup>(1)</sup> (mm)  |                     |          |                                       |                                                                                |
|        | 16 or under                                      | Over 16 to 40 incl. | Over 40  |                                       |                                                                                |
| SS330  | 205 min.                                         | 195 min.            | 175 min. | 330 to 430                            | To 5 incl. for plates, sheets, strips and flats                                |
|        |                                                  |                     |          |                                       | Over 5 to 16 incl. for plates, sheets, strips and flats                        |
|        |                                                  |                     |          |                                       | Over 16 to 50 incl. for plates, sheets, strips and flats                       |
|        |                                                  |                     |          |                                       | Over 40 for plates, sheets and flats                                           |
|        |                                                  |                     |          |                                       | To 25 incl. with diameter, side or distance across opposite sides of steel bar |
| SS400  | 245 min.                                         | 235 min.            | 215 min. | 400 to 510                            | To 5 incl. for plates, sheets, strips, flats and sections                      |
|        |                                                  |                     |          |                                       | Over 5 to 16 incl. for plates, sheets, strips, flats and sections              |
|        |                                                  |                     |          |                                       | Over 16 to 50 incl. for plates, sheets, strips, flats and sections             |
|        |                                                  |                     |          |                                       | Over 40 for plates, sheets, flats and sections                                 |
|        |                                                  |                     |          |                                       | To 25 incl. with diameter, side or distance across opposite sides of steel bar |
| SS490  | 285 min.                                         | 275 min.            | 255 min. | 490 to 610                            | To 5 incl. for plates, sheets, strips, flats and sections                      |
|        |                                                  |                     |          |                                       | Over 5 to 16 incl. for plates, sheets, strips, flats and sections              |
|        |                                                  |                     |          |                                       | Over 16 to 50 incl. for plates, sheets, strips, flats and sections             |
|        |                                                  |                     |          |                                       | Over 40 for plates, sheets, strips, flats and sections                         |
|        |                                                  |                     |          |                                       | To 25 incl. with diameter, side or distance across opposite sides of steel bar |
| SS540  | 400 min.                                         | 390 min.            | ---      | 540 min.                              | To 5 incl. for plates, sheets, strips, flats and sections                      |
|        |                                                  |                     |          |                                       | Over 5 to 16 incl. for plates, sheets, strips, flats and sections              |
|        |                                                  |                     |          |                                       | Over 16 to 50 incl. for plates, sheets, strips, flats and sections             |
|        |                                                  |                     |          |                                       | To 25 incl. with diameter, side or distance across opposite sides of steel bar |
|        |                                                  |                     |          |                                       | Over 25 with diameter, side or distance across opposite sides of steel bar     |

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Table 3 (Continued)

| Symbol | Test piece for tensile test | Elongation (%) | Bendability       |                                                               |            |
|--------|-----------------------------|----------------|-------------------|---------------------------------------------------------------|------------|
|        |                             |                | Angle of bend (°) | Radius of inner surface                                       | Test piece |
| SS330  | No. 5                       | 26 min.        | 180               | 0.5 times of thickness                                        | No. 1      |
|        | No. 1                       | 21 min.        |                   |                                                               |            |
|        | No. 4                       | 28 min.        |                   |                                                               |            |
|        | No. 2                       | 25 min.        | 180               | 0.5 times of diameter, side or distance across opposite sides | No. 2      |
|        | No. 3                       | 30 min.        |                   |                                                               |            |
| SS400  | No. 5                       | 21 min.        | 180               | 1.5 times of thickness                                        | No. 1      |
|        | No. 1                       | 17 min.        |                   |                                                               |            |
|        | No. 4                       | 23 min.        |                   |                                                               |            |
|        | No. 2                       | 20 min.        | 180               | 1.5 times of diameter, side or distance across opposite sides | No. 2      |
|        | No. 3                       | 24 min.        |                   |                                                               |            |
| SS490  | No. 5                       | 19 min.        | 180               | 2.0 times of thickness                                        | No. 1      |
|        | No. 1                       | 15 min.        |                   |                                                               |            |
|        | No. 4                       | 21 min.        |                   |                                                               |            |
|        | No. 2                       | 18 min.        | 180               | 2.0 times of diameter, side or distance across opposite sides | No. 2      |
|        | No. 3                       | 21 min.        |                   |                                                               |            |
| SS540  | No. 5                       | 16 min.        | 180               | 2.0 times of thickness                                        | No. 1      |
|        | No. 1                       | 13 min.        |                   |                                                               |            |
|        | No. 4                       | 17 min.        |                   |                                                               |            |
|        | No. 2                       | 13 min.        | 180               | 2.0 times of diameter, side or distance across opposite sides | No. 2      |
|        | No. 3                       | 17 min.        |                   |                                                               |            |

Note: (1)

Thickness of steel material of shape steel shall be the thickness at the position where the test piece is sampled as shown in Fig. 1. For steel bars, diameter of round bars, side of square bars and distance across opposite sides of polygonal steel including hexagon steel shall be used as the material thickness.

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## Remark 1:

Test pieces for tensile test and bend test shall comply with TSG2204G and TSG2209G, respectively.

## Remark 2:

Table 3 shall not be applied to both edges of steel strip.

## Remark 3:

For the steel materials SS330, SS400, and SS490 of which thickness, diameter, side or distance across opposite sides exceeds 100 mm, the yield point or proof stress shall be 165 N/mm<sup>2</sup> or over, 205 N/mm<sup>2</sup> or over, and 245 N/mm<sup>2</sup> or over, respectively.

## Remark 4:

Elongation of No. 4 test piece of steel plate with the thickness over 90 mm shall be obtained by subtracting by 1 % from the value of elongation in Table 3 for each increase of 25.0 mm or its odd in thickness. Provided that, the limit of subtraction is 3 % at largest.

## Remark 5:

No.3 test piece may be used in the bending test of the steel material with the thickness of 5 mm or under.

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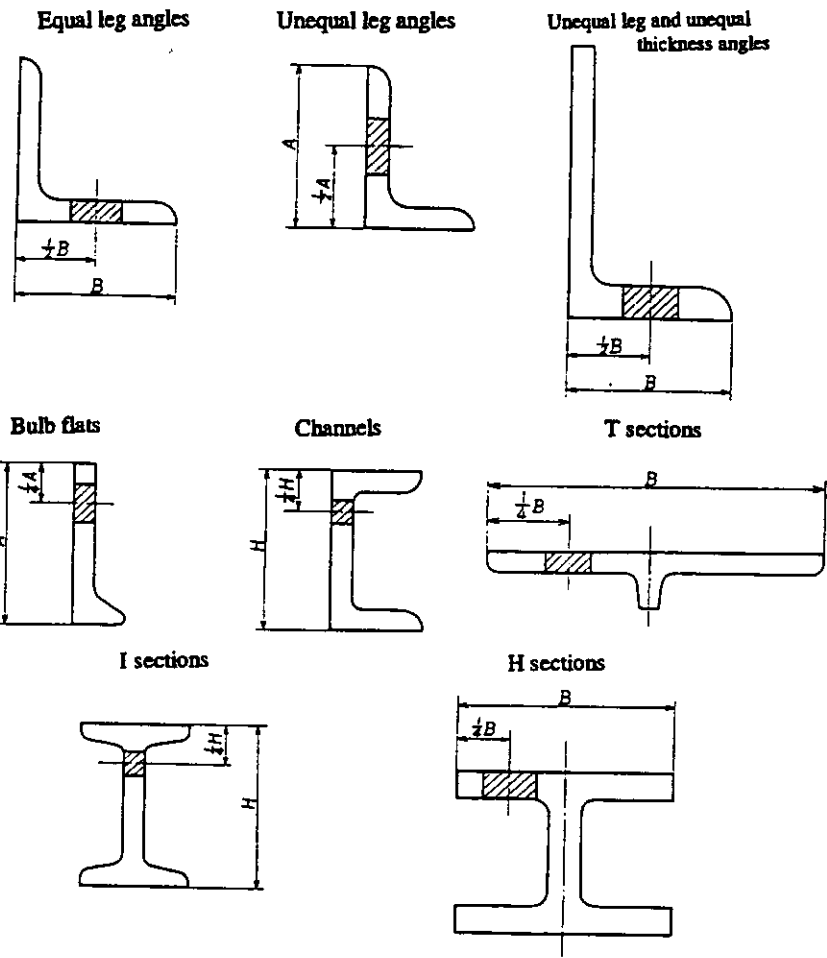


Fig. 1 Sampling Position of Test Piece in Tensile Test and Bend Test for Shape Steels

5. Shapes, Dimensions and Dimensional Tolerances

Shapes, dimensions and dimensional tolerances of general carbon steels shall be according to following standards.

- (1) Hot rolled steel bars and bar-in-coils shall be according to Appendix 1.
- (2) Hot rolled shape steel (steel sections) shall be according to Appendix 2.
- (3) Hot rolled steel sheets, plates and strips shall be according to Appendix 3.
- (4) Hot rolled flat steels shall be according to Appendix 4. Provided that tolerances of lengths of steel sheets, plates and strips, and tolerances on widths of cut-edge steels shall be of the tolerance A, unless otherwise specified.

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## 6. Tests

Test methods for general carbon steels shall be as follows.

## (1) Chemical composition

Chemical composition shall be according to TSG1000G and TSG2902G.

## (2) Tensile tests

Tensile tests shall be according to TSG2203G.

## 7. Inspection

Inspection of general carbon steels are according to the inspection standards specified separately.

## Applicable Standards

|          |                                                       |
|----------|-------------------------------------------------------|
| TSG1000G | General Rule for Chemical Analysis of Steel Materials |
| TSG2203G | Tensile Test Method for Metallic Materials            |
| TSG2204G | Test Pieces for Tensile Test of Metallic Materials    |
| TSG2209G | Bend Test Pieces                                      |
| TSG2902G | Method of Spark Test for Steels                       |

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APPENDIX 1 Shape, Dimension, Weight and Tolerance for Hot Rolled Steel Bar and Bar-in-Coil (JIS G 3191-1966)

1. Scope

- (1) This standard specifies dimension, weight and tolerance thereon as well as appearance, shape and allowable limit thereto of steel bar and bar-in-coil which are manufactured by hot rolling.
- (2) The application of this standard shall be specified in the respective manufacture standards.

2. Definition

The definition of steel bar and bar-in-coil so called in this standard shall be as follows:

- (1) The steel bar shall be defined as the steel which is hot-rolled into a bar form and supplied by being cut into a prescribed length.
- (2) The bar-in-coil shall be defined as the steel which is hot-rolled into a bar form and supplied by being wound into a coil shape.

3. Expression of Dimension

- (1) The dimension of steel bar shall be expressed in mm for the thickness, side or width across flats, and in m for the length.
- (2) The dimension of bar-in-coil shall be expressed in mm for the thickness, side or width across flats.

4. Standard Dimension

- (1) The standard diameter of round steel (inclusive of bar-in-coil) shall comply with Table 1.

Table 1 (Unit: mm)

|      |      |      |       |      |      |     |      |  |  |
|------|------|------|-------|------|------|-----|------|--|--|
| 6    | 7    | 8    | 9     | 10   | 11   | 12  | 13   |  |  |
| (14) | 16   | (18) | 19    | 20   | 22   | 24  | 25   |  |  |
| (27) | 28   | 30   | 32    | (33) | 36   | 38  | (39) |  |  |
| 42   | (45) | 46   | 48    | 50   | (52) | 55  | 56   |  |  |
| 60   | 64   | 65   | (68)  | 70   | 75   | 80  | 85   |  |  |
| 90   | 95   | 100  | 110   | 120  | 130  | 140 | 150  |  |  |
| 160  | 180  | 200  | ----- |      |      |     |      |  |  |

Remark 1:

It is desirable that the standard diameter other than those being enclosed in parentheses shall apply thereto.

Remark 2:

The standard diameter shall apply to the round steel not less than 9 mm therein and to the bar-in-coil not more than 32 mm therein.

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(2) The standard length of steel bar shall comply with Table 2.

Table 2 (Unit: m)

|                                                        |
|--------------------------------------------------------|
| 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 8.0, 9.0, 10.0 |
|--------------------------------------------------------|

## 5. Dimensional Tolerance

(1) The steel bar and bar-in-coil shall have the diametrical variation as well as the tolerance on the diameter, side or width across flats complying with Table 3.

Table 3 (Unit: mm)

| Diameter, side or width across flats | Tolerance | Diametrical variation <sup>(1)</sup>                                                 |
|--------------------------------------|-----------|--------------------------------------------------------------------------------------|
| Under 16                             | ±0.4      | Not more than 70 % of total tolerance range of diameter, side or width across flats. |
| 16 to 28, excl.                      | ±0.5      |                                                                                      |
| 28 and over                          | ±1.8 %    |                                                                                      |

Note: (1)

The diametrical variation shall be denoted by the difference between the maximum and minimum values of the diameter, side or width across flats in the same sectional area.

(2) The tolerance on the length of steel bar shall comply with Table 4.

Table 4

| Length        | Tolerance                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------|
| 7 m and under | $^{+40}_0$ mm                                                                                                |
| Over 7 m      | Add 5 mm to the tolerance on the + side in the upper line for every increment of 1 m length or the fractions |

## 6. Weight

- (1) The weight of steel bar shall comply as a rule with the calculated weight and shall be expressed in kg. Provided that the weight of bar-in-coil shall comply with the actually scaled weight.
- (2) The calculating method for the weight of steel bar shall comply with Table 5, however, the dimension in this case shall be of the expressed dimension.
- (3) The cross-sectional area and unit weight to the standard diameter of the round steel which was found in compliance with (2) shall comply with Attached Table 1.

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Table 5

| Sequence of calculation                 | Calculating method                                                             |                                                                      | Number of result figures                                                                                                                     |
|-----------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Basic weight (kg/cm <sup>2</sup> /m)    | 0.785 (Weight of 1 m length × 1 cm <sup>2</sup> sectional area)                |                                                                      |                                                                                                                                              |
| Cross-sectional area (cm <sup>2</sup> ) | Round steel                                                                    | $D^2 \times 0.7854 \times 1/100$<br>where D: diameter (mm)           | Round off in numerical value to 4 places of significant figures.                                                                             |
|                                         | Square steel                                                                   | $A^2 \times 1/100$<br>where A: side (mm)                             |                                                                                                                                              |
|                                         | Hexagon steel                                                                  | $B^2 \times 0.8660 \times 1/100$<br>where B: width across flats (mm) |                                                                                                                                              |
| Unit weight (kg/m)                      | Basic weight (kg/cm <sup>2</sup> /m) × Cross-sectional area (cm <sup>2</sup> ) |                                                                      | Round off in numerical value to 3 places of significant figures.                                                                             |
| Weight per piece (kg)                   | Unit weight (kg/m) × Length (m)                                                |                                                                      | Round off in numerical value to 3 places of significant figures. Provided that round off those exceeding 1000 kg in the integer value of kg. |
| Gross weight (kg)                       | Weight per piece (kg) × Total number of pieces of the same dimension           |                                                                      | Round off in integer value of kg.                                                                                                            |

Remark 1:

The calculating method for the cross-sectional area of steel bar which is not specified in the above-mentioned Table shall comply with the agreement upon with the purchaser.

Remark 2:

The rounding of the numerical value shall comply with JIS Z 8401 - Rules for Rounding off of Numerical Values.

7. Tolerance on Weight

The tolerance on weight of steel bar in case being specified by the purchaser, shall comply with Table 6. Provided that the calculating method for tolerance shall be denoted in percentage of dividing the difference between the calculated weight and actually scaled weight by the calculated weight.

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Table 6

| Diameter, side or width across flats | Tolerance | Application                                                                                                                                                                                    |
|--------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Under 10 mm                          | ±7 %      | Applicable to each lot (1 ton min.) of the same dimension. Provided that applicable to each lot of 10 pieces or more in case of number of pieces corresponding to 1 ton not suffice 10 pieces. |
| 10 mm to 16 mm, excl.                | ±5 %      |                                                                                                                                                                                                |
| 16 mm to 28 mm, excl.                | ±4 %      |                                                                                                                                                                                                |
| 28 mm and over                       | ±3.5 %    |                                                                                                                                                                                                |

**8. Appearance**

- (1) The steel bar and bar-in-coil shall be free from injurious defect in use. Provided that the bar-in-coil is possibly inclusive of some abnormal portions because of no occasion to remove the portion including the defect in general through the inspection.
- (2) In case of the steel bar having the injurious surface defect, the manufacturer may remove the defect by chipping or grinding. Provided that the conditions in this case shall comply with the following respective items:
  - (a) The dimension (diameter, side or width across flats) of steel bar after being repaired shall be not less than 95 % of the expressed dimension.
  - (b) The repaired portion of steel bar shall be cleanly finished and smoothed on the boundary with the surface as it is rolled.

Round Steel



D: diameter

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Attached Table 1

Table 7

| Diameter<br>(mm) | Sectional<br>area (cm <sup>2</sup> ) | Unit weight<br>(kg/m) | Diameter<br>(mm) | Sectional<br>area (cm <sup>2</sup> ) | Unit<br>weight<br>(kg/m) |
|------------------|--------------------------------------|-----------------------|------------------|--------------------------------------|--------------------------|
| 6                | 0.2827                               | 0.222                 | (45)             | 15.90                                | 12.5                     |
| 7                | 0.3848                               | 0.302                 | 46               | 16.62                                | 13.0                     |
| 8                | 0.5027                               | 0.395                 | 48               | 18.10                                | 14.2                     |
| 9                | 0.6362                               | 0.499                 | 50               | 19.64                                | 15.4                     |
| 10               | 0.7854                               | 0.617                 | (52)             | 21.24                                | 16.7                     |
| 11               | 0.9503                               | 0.746                 | 55               | 23.76                                | 18.7                     |
| 12               | 1.131                                | 0.888                 | 56               | 24.63                                | 19.3                     |
| 13               | 1.327                                | 1.04                  | 60               | 28.27                                | 22.2                     |
| (14)             | 1.539                                | 1.21                  | 64               | 32.17                                | 25.3                     |
| 16               | 2.011                                | 1.58                  | 65               | 33.18                                | 26.0                     |
| (18)             | 2.545                                | 2.00                  | (68)             | 36.32                                | 28.5                     |
| 19               | 2.835                                | 2.23                  | 70               | 38.48                                | 30.2                     |
| 20               | 3.142                                | 2.47                  | 75               | 44.18                                | 34.7                     |
| 22               | 3.801                                | 2.98                  | 80               | 50.27                                | 39.5                     |
| 24               | 4.524                                | 3.55                  | 85               | 56.75                                | 44.5                     |
| 25               | 4.909                                | 3.85                  | 90               | 63.62                                | 49.9                     |
| (27)             | 5.726                                | 4.49                  | 95               | 70.88                                | 55.6                     |
| 28               | 6.158                                | 4.83                  | 100              | 78.54                                | 61.7                     |
| 30               | 7.069                                | 5.55                  | 110              | 95.03                                | 74.6                     |
| 32               | 8.042                                | 6.31                  | 120              | 113.1                                | 88.8                     |
| (33)             | 8.553                                | 6.71                  | 130              | 132.7                                | 104                      |
| 36               | 10.18                                | 7.99                  | 140              | 153.9                                | 121                      |
| 38               | 11.34                                | 8.90                  | 150              | 176.7                                | 139                      |
| (39)             | 11.95                                | 9.38                  | 160              | 201.1                                | 158                      |
| 42               | 13.85                                | 10.9                  | 180              | 254.5                                | 200                      |
|                  |                                      |                       | 200              | 314.2                                | 247                      |

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APPENDIX 2 Dimensions, Mass and Permissible Variations of Hot Rolled Steel Sections (JIS G 3192 - 1994)

## 1. Scope

This Japanese Industrial Standard specifies the dimensions, mass and their tolerances of hot rolled steel sections as well as the appearance, shapes and permissible variations thereof.

## Remark 1:

The application of this Standard is specified in the relevant product standards.

## Remark 2:

The following standard is cited in this Standard: JIS Z 8401 Rules for rounding off of numerical values

## 2. Definition

For the main term used in this Standard, the following definition applies:  
Steel sections

The steels which are hot rolled to the sectional shape specified in 3., and then cut in specified length to be supplied.

## 3. Sectional Shape and Classification

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

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**Table 1 Sectional Shape of Steel Sections and Classification**

| Classification |                              | Sectional shape diagram |
|----------------|------------------------------|-------------------------|
| Angles         | Equal legs                   |                         |
|                | Unequal legs                 |                         |
|                | Unequal legs and thicknesses |                         |
| I sections     |                              |                         |
| Channels       |                              |                         |
| Bulb flats     |                              |                         |
| T sections     |                              |                         |
| H sections     |                              |                         |

**4. Expression of Size**

The size of the steel sections shall be expressed by each sectional dimension in millimeter and the length in meter.

**5. Standard Dimensions**

The standard dimensions shall be as follows:

- (1) The standard sectional dimensions of the steel sections shall be given in Attached Tables 1 to 8.
- (2) The standard lengths of the steel sections shall be as given in Table 2.

**Table 2 Standard Length (Unit: m)**

|     |     |     |     |     |      |      |      |      |      |      |
|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| 6.0 | 6.5 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 |
|-----|-----|-----|-----|-----|------|------|------|------|------|------|

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#### 6. Shape and Dimensional Tolerances

The shape and dimensional tolerances of the steel sections shall be as follows. The tolerances of the steel sections other than those specified in (1) and (2) shall be agreed upon between the purchaser and supplier.

- (1) The shapes and dimensional tolerances of the angles, I sections, channels, bulb flats and T sections shall be as given in Table 3.
- (2) The shape and dimensional tolerances of the H sections shall be as given in Table 4. The tolerances on ends-out-of-square, however, shall be applied on the request of the purchaser.

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Table 3 Shapes and Dimensional Tolerances of Angles, I Sections, Channels, Bulb Flats and T Sections (Unit: mm)

| Dimension                                       |                                                            | Tolerance                                                                                                        | Remarks                                         |      |
|-------------------------------------------------|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------|
| Leg length (A or 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                                                                                                             |                                                 |      |
| Thickness (t, t <sub>1</sub> , t <sub>2</sub> ) | 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                                            |      |
|                                                 | 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                                            |      |
| Length                                          | 7 m or under                                               | ±1.5                                                                                                             |                                                 |      |
|                                                 | Over 7 m                                                   | Add 5 mm to the plus side tolerance given in the above column for every 1 m increase in lengths or its fraction. |                                                 |      |
|                                                 |                                                            |                                                                                                                  |                                                 |      |
| Out-of-square (T)                               | I section                                                  | 2.0 % or under of width B                                                                                        |                                                 |      |
|                                                 | Sections excluding I and T sections                        | 2.5 % or under of width of flange B (or leg length)                                                              |                                                 |      |
| Bend                                            | I and T sections                                           | 0.20 % or under of length                                                                                        | To be applied to bend such as sweep and camber. |      |
|                                                 | Sections excluding I and T sections                        | 0.30 % or under of length                                                                                        |                                                 |      |
| Web-off-center (S)                              | 300 or under in width B                                    | ±3.0                                                                                                             | $S = \frac{b_1 - b_2}{2}$                       |      |

Remark:  
The purchaser may designate that the out-of-square shall be 2 % or under of the leg length for equal leg angles 200 mm or more in leg length.

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Table 4 Shape and Dimensional Tolerances of H Sections (Unit: mm)

| Dimension                |                                                                 | Tolerance                                                                                                       | Remarks                                          |
|--------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| Width (B)                | Under 100 in nominal width                                      | ±2.0                                                                                                            |                                                  |
|                          | 100 or over to and excl. 200 in nominal width                   | ±2.5                                                                                                            |                                                  |
|                          | 200 or over in nominal width                                    | ±3.0                                                                                                            |                                                  |
| Depth (H)                | Under 400 in nominal depth                                      | ±2.0                                                                                                            |                                                  |
|                          | 400 or over to and excl. 600 in nominal depth                   | ±3.0                                                                                                            |                                                  |
|                          | 600 or over in nominal depth                                    | ±4.0                                                                                                            |                                                  |
|                          | Thickness                                                       |                                                                                                                 |                                                  |
| Flange (t <sub>2</sub> ) | 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 (t <sub>1</sub> )                                           | 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                                                    | ±0                                                                                                              |                                                  |
|                          | Over 7 m                                                        | Add 5 mm to the plus side tolerance given in the above column for every 1 m increase in length or its fraction. |                                                  |
| Out-of-square (T)        | 300 or under in nominal depth                                   | 1.0 % or under of width B, provided that 1.5 mm is the minimum.                                                 |                                                  |
|                          | Over 300 in nominal depth                                       | 1.2 % or under of width B, provided that 1.5 mm is the minimum.                                                 |                                                  |
| Bend                     | 300 or under in nominal depth                                   | 0.15 % or under of length                                                                                       | To be applied to bend such as sweep and chamber. |
|                          | Over 300 in nominal depth                                       | 0.10 % or under of length                                                                                       |                                                  |
| Web-off-center (S)       | 300 or under in nominal depth and 200 or under in nominal width | ±2.5                                                                                                            | $S = \frac{b_1 - b_2}{2}$                        |
|                          | Over 300 in nominal depth and over 200 in nominal width         | ±3.5                                                                                                            |                                                  |
| Concavity of web (W)     | Under 400 in nominal depth                                      | 2.0                                                                                                             |                                                  |
|                          | 400 or over to and excl. 600                                    | 2.5                                                                                                             |                                                  |
|                          | 600 or over                                                     | 3.0                                                                                                             |                                                  |
| Ends-out-of-square (e)   |                                                                 | 1.6 % or under of width B or of depth H, provided that 3.0 mm is the minimum.                                   |                                                  |

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**7. Mass**

The mass of the steel sections shall be as follows:

- (1) The mass of the steel sections shall, as a rule, be expressed by theoretical mass in kilogram.
- (2) The method for calculation of mass of the steel sections shall be in accordance with Table 5 based on the nominal dimensions.
- (3) The sectional area and unit mass of the steel sections obtained in terms of the standard sectional dimension in accordance with (2) are as shown in Attached Tables 1 to 8. Besides the sectional area and unit mass, Attached Tables 1 to 8 show the position of gravity center, the geometrical moment of inertia, the radius of gyration of area and the modulus of sections for informative reference.

Table 5 Method for Calculation of Mass

| Calculating step                   | Calculation method                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Number of figures in calculated result                                                       |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Basic mass (kg/cm <sup>2</sup> ·m) | 0.785 (mass per cm <sup>2</sup> sectional area per meter length)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -----                                                                                        |
| Sectional area (cm <sup>2</sup> )  | The values calculated by the following formulae shall be multiplied by 1/100.<br>For equal leg angles<br>$t(2A-t)+0.215(r_1^2-2r_2^2)$<br>For unequal leg angles<br>$t(A+B-t)+0.215(r_1^2-2r_2^2)$<br>For unequal leg and unequal thickness angles<br>$At_1+t_2(B-t_1)+0.215(r_1^2-r_2^2)$<br>For I sections<br>$Ht_1+2t_2(B-t_1)+0.615(r_1^2-r_2^2)$<br>For channels<br>$Ht_1+2t_2(B-t_1)+0.349(r_1^2-r_2^2)$<br>For bulb flats<br>$At+dr_1+0.289d(2r_1+d)-0.215(r_1^2+r_2^2)$<br>For T sections<br>$Bt_2+0.307r_1^2+482.6$<br>For H sections<br>$t_1(H-2t_2)+2Bt_2+0.858r^2$ | Round off to 4 significant figures.                                                          |
| Unit mass (kg/m)                   | Basic mass (kg/cm <sup>2</sup> ·m) × Sectional area (cm <sup>2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Round off to 3 significant figures. For those exceeding 1000 kg, round off to integer in kg. |
| Mass of single piece (kg)          | Unit mass (kg/m) × Length (m)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Round off to 3 significant figures. For those exceeding 1000 kg, round off to integer in kg. |
| Total mass (kg)                    | Mass of single piece (kg) × Total number of pieces of the same size                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Round off to integer in kg.                                                                  |

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## Remark 1:

The calculation method for the sectional area of the steel sections other than those given in Table 5 shall be agreed upon between the purchaser and supplier.

## Remark 2:

The symbols which are used for the calculation of the sectional area stand for the sectional dimensions of the steel section, and the relation of the symbols to the respective parts of the section is shown in Attached Tables 1 to 8.

## Remark 3:

The rounding off of the numerical values shall be in accordance with JIS Z 8401.

## 8. Tolerance on Mass

When the mass tolerances for steel sections are designated by the purchaser, they shall conform to Table 6. In this case, the tolerances on mass shall be expressed in percentage of the difference between the theoretical mass and actual mass to the theoretical mass.

Table 6 Tolerances on Mass

| Thickness   | Tolerance  | Remarks                                                                                                                                                                                     |
|-------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Under 10 mm | $\pm 5 \%$ | (1) Thicker nominal values shall be applied.                                                                                                                                                |
| 10 mm over  | $\pm 4 \%$ | (2) To be applied to one lot of the same size (1 t or over).<br>When the number of pieces corresponding to 1 t does not amount to 10, it shall be applied to each lot of 10 or more pieces. |

## 9. Appearance

The appearance of the steel sections shall be as follows:

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

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### 9.1 Conditioning with Grinder

- (1) The sectional dimensions of the 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.
- (2) The conditioned parts of the steel sections shall be finished neatly, and the boundary between the repaired portions and as rolled surface shall be smoothly finished.

### 9.2 Repair by Welding

- (1) The harmful defects of the steel sections shall be repaired by welded overlay after complete removal by means of appropriate method such as chipping or grinding.
- (2) The depth of the defect-removed portion previous to repair by welding shall be not more than 30 % of the nominal thickness. For the toe of the flange of the steel sections, however, the depth shall fall within the nominal thickness of the flange from the edge (12 mm max.).
- (3) The repaired area by welding shall fall within 2 % of the whole surface area of the steel sections.
- (4) The weld repairing shall be carried out by suitable means according to the kind of steel products.
- (5) The welded part of the steel sections shall be free from undercut or overlaps around the fringe of welds. The reinforcement of weld shall be at least 1.5 mm or over in height from the rolled surface, and this shall be removed by chipping, grinding, etc. and neatly finished as high as the rolled surface.
- (6) The heat-treated steel sections themselves shall be heat-treated once again after the repair by welding.

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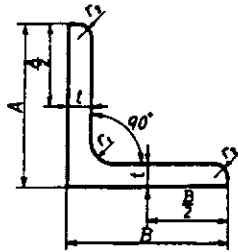
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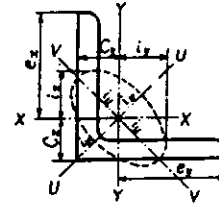
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Attached Table 1 Standard Sectional Dimensions of Equal Leg Angles and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = at^3$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 ( $a$  = sectional area)



| Standard sectional dimension<br>mm |    |                |                | Sectional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative references                    |                |                |                |                                                  |                           |                |                |                                  |                           |                |                |                                          |  |
|------------------------------------|----|----------------|----------------|--------------------------------------|----------------------|-------------------------------------------|----------------|----------------|----------------|--------------------------------------------------|---------------------------|----------------|----------------|----------------------------------|---------------------------|----------------|----------------|------------------------------------------|--|
| A × B                              | t  | r <sub>1</sub> | r <sub>2</sub> |                                      |                      | Position of<br>center of<br>gravity<br>cm |                |                |                | Geometrical moment of inertia<br>cm <sup>4</sup> |                           |                |                | Radius of gyration of area<br>cm |                           |                |                | Modulus<br>of section<br>cm <sup>3</sup> |  |
|                                    |    |                |                |                                      |                      | C <sub>x</sub>                            | C <sub>y</sub> | I <sub>x</sub> | I <sub>y</sub> | Maximum<br>I <sub>u</sub>                        | Minimum<br>I <sub>v</sub> | i <sub>x</sub> | i <sub>y</sub> | Maximum<br>i <sub>u</sub>        | Minimum<br>i <sub>v</sub> | Z <sub>x</sub> | Z <sub>y</sub> |                                          |  |
| 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           |                                          |  |
| 100 × 100                          | 10 | 10             | 7              | 19.00                                | 14.9                 | 2.82                                      | 2.82           | 175            | 175            | 278                                              | 72.0                      | 3.04           | 3.04           | 3.83                             | 1.95                      | 24.4           | 24.4           |                                          |  |
| 100 × 100                          | 13 | 10             | 7              | 24.31                                | 19.1                 | 2.94                                      | 2.94           | 220            | 220            | 348                                              | 91.1                      | 3.00           | 3.00           | 3.78                             | 1.94                      | 31.1           | 31.1           |                                          |  |
| 120 × 120                          | 8  | 12             | 5              | 18.76                                | 14.7                 | 3.24                                      | 3.24           | 258            | 258            | 410                                              | 106                       | 3.71           | 3.71           | 4.67                             | 2.38                      | 29.5           | 29.5           |                                          |  |
| 130 × 130                          | 9  | 12             | 6              | 22.74                                | 17.9                 | 3.53                                      | 3.53           | 366            | 366            | 583                                              | 150                       | 4.01           | 4.01           | 5.06                             | 2.57                      | 38.7           | 38.7           |                                          |  |
| 130 × 130                          | 12 | 12             | 8.5            | 29.76                                | 23.4                 | 3.64                                      | 3.64           | 467            | 467            | 743                                              | 192                       | 3.96           | 3.96           | 5.00                             | 2.54                      | 49.9           | 49.9           |                                          |  |
| 130 × 130                          | 15 | 12             | 8.5            | 36.75                                | 28.8                 | 3.76                                      | 3.76           | 568            | 568            | 902                                              | 234                       | 3.93           | 3.93           | 4.95                             | 2.53                      | 61.5           | 61.5           |                                          |  |
| 150 × 150                          | 12 | 14             | 7              | 34.77                                | 27.3                 | 4.14                                      | 4.14           | 740            | 740            | 1180                                             | 304                       | 4.61           | 4.61           | 5.82                             | 2.96                      | 68.1           | 68.1           |                                          |  |
| 150 × 150                          | 15 | 14             | 10             | 42.74                                | 33.6                 | 4.24                                      | 4.24           | 888            | 888            | 1410                                             | 365                       | 4.56           | 4.56           | 5.75                             | 2.92                      | 82.6           | 82.6           |                                          |  |
| 150 × 150                          | 19 | 14             | 10             | 53.38                                | 41.9                 | 4.40                                      | 4.40           | 1090           | 1090           | 1730                                             | 451                       | 4.52           | 4.52           | 5.69                             | 2.91                      | 103            | 103            |                                          |  |
| 175 × 175                          | 12 | 15             | 11             | 40.52                                | 31.8                 | 4.73                                      | 4.73           | 1170           | 1170           | 1860                                             | 480                       | 5.38           | 5.38           | 6.78                             | 3.44                      | 91.8           | 91.8           |                                          |  |
| 175 × 175                          | 15 | 15             | 11             | 50.21                                | 39.4                 | 4.85                                      | 4.85           | 1440           | 1440           | 2290                                             | 589                       | 5.35           | 5.35           | 6.75                             | 3.42                      | 114            | 114            |                                          |  |
| 200 × 200                          | 15 | 17             | 12             | 57.75                                | 45.3                 | 5.46                                      | 5.46           | 2180           | 2180           | 3470                                             | 891                       | 6.14           | 6.14           | 7.75                             | 3.93                      | 150            | 150            |                                          |  |
| 200 × 200                          | 20 | 17             | 12             | 76.00                                | 59.7                 | 5.67                                      | 5.67           | 2820           | 2820           | 4490                                             | 1160                      | 6.09           | 6.09           | 7.68                             | 3.90                      | 197            | 197            |                                          |  |
| 200 × 200                          | 25 | 17             | 12             | 93.75                                | 73.6                 | 5.86                                      | 5.86           | 3420           | 3420           | 5420                                             | 1410                      | 6.04           | 6.04           | 7.61                             | 3.88                      | 242            | 242            |                                          |  |
| 250 × 250                          | 25 | 21             | 12             | 119.1                                | 93.7                 | 7.10                                      | 7.10           | 6450           | 6450           | 11000                                            | 2860                      | 7.63           | 7.63           | 9.62                             | 4.90                      | 388            | 388            |                                          |  |
| 250 × 250                          | 35 | 24             | 18             | 162.6                                | 128                  | 7.45                                      | 7.45           | 9110           | 9110           | 14400                                            | 3790                      | 7.49           | 7.49           | 9.42                             | 4.83                      | 519            | 519            |                                          |  |

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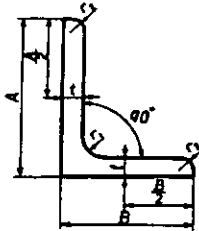
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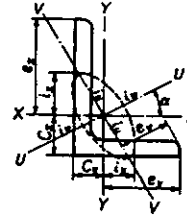
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**TSG3290G**

Attached Table 2 Standard Sectional Dimensions of Unequal Leg Angles and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = at^3$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 ( $a$  = sectional area)



| Standard sectional dimension<br>mm |    |                |                | Sectional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative reference                     |                |                                                     |                |                                |                                |                                  |                |                                |                                |       |                                          |                |
|------------------------------------|----|----------------|----------------|--------------------------------------|----------------------|-------------------------------------------|----------------|-----------------------------------------------------|----------------|--------------------------------|--------------------------------|----------------------------------|----------------|--------------------------------|--------------------------------|-------|------------------------------------------|----------------|
| A × B                              | t  | r <sub>1</sub> | r <sub>2</sub> |                                      |                      | Position of<br>center of<br>gravity<br>cm |                | Geometrical moment<br>of inertia<br>cm <sup>4</sup> |                |                                |                                | Radius of gyration of area<br>cm |                |                                |                                | tan α | Modulus<br>of section<br>cm <sup>3</sup> |                |
|                                    |    |                |                |                                      |                      | C <sub>x</sub>                            | C <sub>y</sub> | I <sub>x</sub>                                      | I <sub>y</sub> | Maxi-<br>mum<br>I <sub>u</sub> | Mini-<br>mum<br>I <sub>v</sub> | i <sub>x</sub>                   | i <sub>y</sub> | Maxi-<br>mum<br>i <sub>u</sub> | Mini-<br>mum<br>i <sub>v</sub> |       | Z <sub>x</sub>                           | Z <sub>y</sub> |
| 90 × 75                            | 9  | 8.5            | 6              | 14.04                                | 11.0                 | 2.75                                      | 2.00           | 109                                                 | 68.1           | 143                            | 34.1                           | 2.78                             | 2.20           | 3.19                           | 1.56                           | 0.676 | 17.4                                     | 12.4           |
| 100 × 75                           | 7  | 10             | 5              | 11.87                                | 9.32                 | 3.06                                      | 1.83           | 118                                                 | 56.9           | 144                            | 30.8                           | 3.15                             | 2.19           | 3.49                           | 1.61                           | 0.548 | 17.0                                     | 10.0           |
| 100 × 75                           | 10 | 10             | 7              | 16.50                                | 13.0                 | 3.17                                      | 1.94           | 159                                                 | 76.1           | 194                            | 41.3                           | 3.11                             | 2.15           | 3.43                           | 1.58                           | 0.543 | 23.3                                     | 13.7           |
| 125 × 75                           | 7  | 10             | 5              | 13.62                                | 10.7                 | 4.10                                      | 1.64           | 219                                                 | 60.4           | 243                            | 36.4                           | 4.01                             | 2.11           | 4.23                           | 1.64                           | 0.362 | 26.1                                     | 10.3           |
| 125 × 75                           | 10 | 10             | 7              | 19.00                                | 14.9                 | 4.22                                      | 1.75           | 299                                                 | 80.8           | 330                            | 49.0                           | 3.96                             | 2.06           | 4.17                           | 1.61                           | 0.357 | 36.1                                     | 14.1           |
| 125 × 75                           | 13 | 10             | 7              | 24.31                                | 19.1                 | 4.35                                      | 1.87           | 376                                                 | 101            | 415                            | 61.9                           | 3.93                             | 2.04           | 4.13                           | 1.60                           | 0.352 | 46.1                                     | 17.9           |
| 125 × 90                           | 10 | 10             | 7              | 20.50                                | 16.1                 | 3.95                                      | 2.22           | 318                                                 | 138            | 380                            | 76.2                           | 3.94                             | 2.59           | 4.30                           | 1.93                           | 0.505 | 37.2                                     | 20.3           |
| 125 × 90                           | 13 | 10             | 7              | 26.26                                | 20.6                 | 4.07                                      | 2.34           | 401                                                 | 173            | 477                            | 96.3                           | 3.91                             | 2.57           | 4.26                           | 1.91                           | 0.501 | 47.5                                     | 25.9           |
| 150 × 90                           | 9  | 12             | 6              | 20.94                                | 16.4                 | 4.95                                      | 1.99           | 485                                                 | 133            | 537                            | 80.4                           | 4.81                             | 2.52           | 5.06                           | 1.96                           | 0.361 | 48.2                                     | 19.0           |
| 150 × 90                           | 12 | 12             | 8.5            | 27.36                                | 21.5                 | 5.07                                      | 2.10           | 619                                                 | 167            | 685                            | 102                            | 4.76                             | 2.47           | 5.00                           | 1.93                           | 0.357 | 62.3                                     | 24.3           |
| 150 × 100                          | 9  | 12             | 6              | 21.84                                | 17.1                 | 4.76                                      | 2.30           | 502                                                 | 181            | 579                            | 104                            | 4.79                             | 2.88           | 5.15                           | 2.18                           | 0.439 | 49.1                                     | 23.5           |
| 150 × 100                          | 12 | 12             | 8.5            | 28.56                                | 22.4                 | 4.88                                      | 2.41           | 642                                                 | 228            | 738                            | 132                            | 4.74                             | 2.83           | 5.09                           | 2.15                           | 0.435 | 63.4                                     | 30.1           |
| 150 × 100                          | 15 | 12             | 8.5            | 35.25                                | 27.7                 | 5.00                                      | 2.53           | 782                                                 | 276            | 897                            | 161                            | 4.71                             | 2.80           | 5.04                           | 2.14                           | 0.431 | 78.2                                     | 37.0           |

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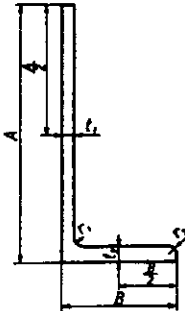
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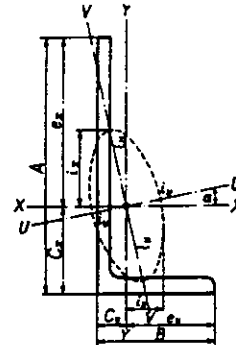
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**TSG3290G**

Attached Table 3 Standard Sectional Dimensions of Unequal Leg and Unequal Thickness Angles and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = ai^2$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 ( $a$  = sectional area)



| Standard sectional dimension<br>mm |                |                |                |                | Sectional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative reference                     |                |                                                     |                |                           |                           |                                  |                |                           |                           |         |                                          |                |
|------------------------------------|----------------|----------------|----------------|----------------|--------------------------------------|----------------------|-------------------------------------------|----------------|-----------------------------------------------------|----------------|---------------------------|---------------------------|----------------------------------|----------------|---------------------------|---------------------------|---------|------------------------------------------|----------------|
| A × B                              | t <sub>1</sub> | t <sub>2</sub> | r <sub>1</sub> | r <sub>2</sub> |                                      |                      | Position of<br>center of<br>gravity<br>cm |                | Geometrical moment<br>of inertia<br>cm <sup>4</sup> |                |                           |                           | Radius of gyration of area<br>cm |                |                           |                           | tan α   | Modulus<br>of section<br>cm <sup>3</sup> |                |
|                                    |                |                |                |                |                                      |                      | C <sub>x</sub>                            | C <sub>y</sub> | I <sub>x</sub>                                      | I <sub>y</sub> | Maximum<br>I <sub>u</sub> | Minimum<br>I <sub>v</sub> | i <sub>x</sub>                   | i <sub>y</sub> | Maximum<br>i <sub>u</sub> | Minimum<br>i <sub>v</sub> |         | Z <sub>x</sub>                           | Z <sub>y</sub> |
| 200 × 90                           | 9              | 14             | 14             | 7              | 29.66                                | 23.3                 | 6.36                                      | 2.15           | 1 210                                               | 200            | 1 290                     | 125                       | 6.39                             | 2.60           | 6.58                      | 2.05                      | 0.263   | 88.7                                     | 29.2           |
| 250 × 90                           | 10             | 15             | 17             | 8.5            | 37.47                                | 29.4                 | 8.61                                      | 1.92           | 2 440                                               | 223            | 2 520                     | 147                       | 8.08                             | 2.44           | 8.20                      | 1.98                      | 0.182   | 149                                      | 31.5           |
| 250 × 90                           | 12             | 16             | 17             | 8.5            | 42.95                                | 33.7                 | 8.99                                      | 1.89           | 2 790                                               | 238            | 2 870                     | 160                       | 8.07                             | 2.35           | 8.18                      | 1.93                      | 0.173   | 174                                      | 33.5           |
| 300 × 90                           | 11             | 16             | 19             | 9.5            | 46.22                                | 36.3                 | 11.0                                      | 1.76           | 4 370                                               | 245            | 4 440                     | 168                       | 9.72                             | 2.30           | 9.80                      | 1.90                      | 0.136   | 229                                      | 33.8           |
| 300 × 90                           | 13             | 17             | 19             | 9.5            | 52.67                                | 41.3                 | 11.3                                      | 1.75           | 4 940                                               | 259            | 5 020                     | 181                       | 9.68                             | 2.22           | 9.76                      | 1.85                      | 0.128   | 265                                      | 35.8           |
| 350 × 100                          | 12             | 17             | 22             | 11             | 57.74                                | 45.3                 | 13.0                                      | 1.87           | 7 440                                               | 362            | 7 550                     | 251                       | 11.3                             | 2.50           | 11.4                      | 2.08                      | 0.124   | 338                                      | 44.5           |
| 400 × 100                          | 13             | 18             | 24             | 12             | 68.59                                | 53.8                 | 15.4                                      | 1.77           | 11 500                                              | 388            | 11 600                    | 277                       | 12.9                             | 2.38           | 13.0                      | 2.01                      | 0.099 6 | 467                                      | 47.1           |

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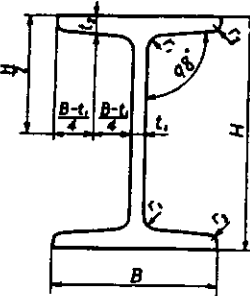




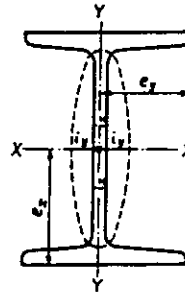
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**TSG3290G**

Attached Table 4 Standard Sectional Dimensions of I Sections and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = a^2$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 ( $a$  = sectional area)



| Standard sectional dimension<br>mm | Sectional area<br>cm <sup>2</sup> | Unit mass<br>kg/m | Informative references              |                |                                                  |                |                                  |                |                                       |                |      |      |       |      |
|------------------------------------|-----------------------------------|-------------------|-------------------------------------|----------------|--------------------------------------------------|----------------|----------------------------------|----------------|---------------------------------------|----------------|------|------|-------|------|
|                                    |                                   |                   | Position of center of gravity<br>cm |                | Geometrical moment of inertia<br>cm <sup>4</sup> |                | Radius of gyration of area<br>cm |                | Modulus of section<br>cm <sup>3</sup> |                |      |      |       |      |
|                                    |                                   |                   | C <sub>x</sub>                      | C <sub>y</sub> | I <sub>x</sub>                                   | I <sub>y</sub> | i <sub>x</sub>                   | i <sub>y</sub> | Z <sub>x</sub>                        | Z <sub>y</sub> |      |      |       |      |
| 100 × 75                           | 5                                 | 8                 | 7                                   | 3.5            | 16.43                                            | 12.9           | 0                                | 0              | 281                                   | 47.3           | 4.14 | 1.70 | 56.2  | 12.6 |
| 125 × 75                           | 5.5                               | 9.5               | 9                                   | 4.5            | 20.45                                            | 16.1           | 0                                | 0              | 538                                   | 57.5           | 5.13 | 1.68 | 86.0  | 15.3 |
| 150 × 75                           | 5.5                               | 9.5               | 9                                   | 4.5            | 21.83                                            | 17.1           | 0                                | 0              | 819                                   | 57.5           | 6.12 | 1.62 | 109   | 15.3 |
| 150 × 125                          | 8.5                               | 14                | 13                                  | 6.5            | 46.15                                            | 36.2           | 0                                | 0              | 1 760                                 | 385            | 6.18 | 2.89 | 235   | 61.6 |
| 180 × 100                          | 6                                 | 10                | 10                                  | 5              | 30.06                                            | 23.6           | 0                                | 0              | 1 670                                 | 138            | 7.45 | 2.14 | 186   | 27.5 |
| 200 × 100                          | 7                                 | 10                | 10                                  | 5              | 33.06                                            | 26.0           | 0                                | 0              | 2 170                                 | 138            | 8.11 | 2.05 | 217   | 27.7 |
| 200 × 150                          | 9                                 | 16                | 15                                  | 7.5            | 64.16                                            | 50.4           | 0                                | 0              | 4 460                                 | 753            | 8.34 | 3.43 | 446   | 100  |
| 250 × 125                          | 7.5                               | 12.5              | 12                                  | 6              | 48.79                                            | 38.3           | 0                                | 0              | 5 180                                 | 337            | 10.3 | 2.63 | 414   | 53.9 |
| 250 × 125                          | 10                                | 19                | 21                                  | 10.5           | 70.73                                            | 55.5           | 0                                | 0              | 7 310                                 | 538            | 10.2 | 2.76 | 585   | 86.0 |
| 300 × 150                          | 8                                 | 13                | 12                                  | 6              | 61.58                                            | 48.3           | 0                                | 0              | 9 480                                 | 588            | 12.4 | 3.09 | 632   | 78.4 |
| 300 × 150                          | 10                                | 18.5              | 19                                  | 9.5            | 83.47                                            | 65.5           | 0                                | 0              | 12 700                                | 886            | 12.3 | 3.26 | 849   | 118  |
| 300 × 150                          | 11.5                              | 22                | 23                                  | 11.5           | 97.88                                            | 76.8           | 0                                | 0              | 14 700                                | 1 080          | 12.2 | 3.32 | 978   | 143  |
| 350 × 150                          | 9                                 | 15                | 13                                  | 6.5            | 74.58                                            | 58.5           | 0                                | 0              | 15 200                                | 702            | 14.3 | 3.07 | 870   | 93.5 |
| 350 × 150                          | 12                                | 24                | 25                                  | 12.5           | 111.1                                            | 87.2           | 0                                | 0              | 22 400                                | 1 180          | 14.2 | 3.26 | 1 280 | 158  |
| 400 × 150                          | 10                                | 18                | 17                                  | 8.5            | 91.73                                            | 72.0           | 0                                | 0              | 24 100                                | 864            | 16.2 | 3.07 | 1 200 | 115  |
| 400 × 150                          | 12.5                              | 25                | 27                                  | 13.5           | 122.1                                            | 95.8           | 0                                | 0              | 31 700                                | 1 240          | 16.1 | 3.18 | 1 580 | 165  |
| 450 × 175                          | 11                                | 20                | 19                                  | 9.5            | 116.8                                            | 91.7           | 0                                | 0              | 39 200                                | 1 510          | 18.3 | 3.60 | 1 740 | 173  |
| 450 × 175                          | 13                                | 26                | 27                                  | 13.5           | 146.1                                            | 115            | 0                                | 0              | 48 800                                | 2 020          | 18.3 | 3.72 | 2 170 | 231  |
| 600 × 190                          | 13                                | 25                | 25                                  | 12.5           | 169.4                                            | 133            | 0                                | 0              | 98 400                                | 2 460          | 24.1 | 3.81 | 3 280 | 259  |
| 600 × 190                          | 16                                | 35                | 38                                  | 19             | 224.5                                            | 176            | 0                                | 0              | 130 000                               | 3 540          | 24.1 | 3.97 | 4 330 | 373  |

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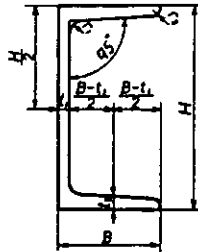
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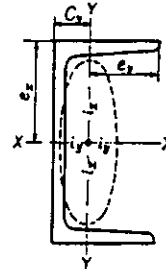
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Attached Table 5 Standard Sectional Dimensions of Channels and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = ai^2$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 (a = sectional area)



| Standard sectional dimension<br>mm |                |                |                |                | Sec-<br>tional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative reference                     |                |                                                     |                |                                     |                |                                          |                |
|------------------------------------|----------------|----------------|----------------|----------------|-------------------------------------------|----------------------|-------------------------------------------|----------------|-----------------------------------------------------|----------------|-------------------------------------|----------------|------------------------------------------|----------------|
| H × B                              | t <sub>1</sub> | t <sub>2</sub> | r <sub>1</sub> | r <sub>2</sub> |                                           |                      | Position of<br>center of<br>gravity<br>cm |                | Geometrical moment<br>of inertia<br>cm <sup>4</sup> |                | Radius of gyration<br>of area<br>cm |                | Modulus<br>of section<br>cm <sup>3</sup> |                |
|                                    |                |                |                |                |                                           |                      | C <sub>x</sub>                            | C <sub>y</sub> | I <sub>x</sub>                                      | I <sub>y</sub> | i <sub>x</sub>                      | i <sub>y</sub> | Z <sub>x</sub>                           | Z <sub>y</sub> |
| 75 × 40                            | 5              | 7              | 8              | 4              | 8.818                                     | 6.92                 | 0                                         | 1.28           | 75.3                                                | 12.2           | 2.92                                | 1.17           | 20.1                                     | 4.47           |
| 100 × 50                           | 5              | 7.5            | 8              | 4              | 11.92                                     | 9.36                 | 0                                         | 1.54           | 188                                                 | 26.0           | 3.97                                | 1.48           | 37.6                                     | 7.52           |
| 125 × 65                           | 6              | 8              | 8              | 4              | 17.11                                     | 13.4                 | 0                                         | 1.90           | 424                                                 | 61.8           | 4.98                                | 1.90           | 67.8                                     | 13.4           |
| 150 × 75                           | 6.5            | 10             | 10             | 5              | 23.71                                     | 18.6                 | 0                                         | 2.28           | 861                                                 | 117            | 6.03                                | 2.22           | 115                                      | 22.4           |
| 150 × 75                           | 9              | 12.5           | 15             | 7.5            | 30.59                                     | 24.0                 | 0                                         | 2.31           | 1 050                                               | 147            | 5.86                                | 2.19           | 140                                      | 28.3           |
| 180 × 75                           | 7              | 10.5           | 11             | 5.5            | 27.20                                     | 21.4                 | 0                                         | 2.13           | 1 380                                               | 131            | 7.12                                | 2.19           | 153                                      | 24.3           |
| 200 × 80                           | 7.5            | 11             | 12             | 6              | 31.33                                     | 24.5                 | 0                                         | 2.21           | 1 950                                               | 168            | 7.88                                | 2.32           | 195                                      | 29.1           |
| 200 × 90                           | 8              | 13.5           | 14             | 7              | 38.65                                     | 30.3                 | 0                                         | 2.74           | 2 490                                               | 277            | 8.02                                | 2.68           | 249                                      | 44.2           |
| 250 × 90                           | 9              | 13             | 14             | 7              | 44.07                                     | 34.6                 | 0                                         | 2.40           | 4 180                                               | 294            | 9.74                                | 2.58           | 334                                      | 44.5           |
| 250 × 90                           | 11             | 14.5           | 17             | 8.5            | 51.17                                     | 40.2                 | 0                                         | 2.40           | 4 680                                               | 329            | 9.56                                | 2.54           | 374                                      | 49.9           |
| 300 × 90                           | 9              | 13             | 14             | 7              | 48.57                                     | 38.1                 | 0                                         | 2.22           | 6 440                                               | 309            | 11.5                                | 2.52           | 429                                      | 45.7           |
| 300 × 90                           | 10             | 15.5           | 19             | 9.5            | 55.74                                     | 43.8                 | 0                                         | 2.34           | 7 410                                               | 360            | 11.5                                | 2.54           | 494                                      | 54.1           |
| 300 × 90                           | 12             | 16             | 19             | 9.5            | 61.90                                     | 48.6                 | 0                                         | 2.28           | 7 870                                               | 379            | 11.3                                | 2.48           | 525                                      | 56.4           |
| 380 × 100                          | 10.5           | 16             | 18             | 9              | 69.39                                     | 54.5                 | 0                                         | 2.41           | 14 500                                              | 535            | 14.5                                | 2.78           | 763                                      | 70.5           |
| 380 × 100                          | 13             | 16.5           | 18             | 9              | 78.96                                     | 62.0                 | 0                                         | 2.33           | 15 600                                              | 565            | 14.1                                | 2.67           | 823                                      | 73.6           |
| 380 × 100                          | 13             | 20             | 24             | 12             | 85.71                                     | 67.3                 | 0                                         | 2.54           | 17 600                                              | 655            | 14.3                                | 2.76           | 926                                      | 87.8           |

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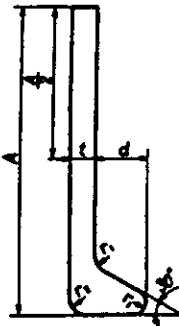
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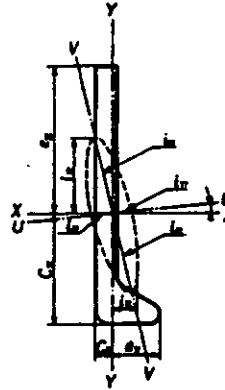
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**TSG3290G**

Attached Table 6 Standard Sectional Dimensions of Bulb Flats and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = at^3$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 (a = sectional area)



| Standard sectional dimensions<br>mm |     |      |                |                | Sectional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative reference                     |                |                                                     |                                |                |                |                                  |                                |                |                |         |                                          |      |
|-------------------------------------|-----|------|----------------|----------------|--------------------------------------|----------------------|-------------------------------------------|----------------|-----------------------------------------------------|--------------------------------|----------------|----------------|----------------------------------|--------------------------------|----------------|----------------|---------|------------------------------------------|------|
| A                                   | t   | d    | r <sub>1</sub> | r <sub>2</sub> |                                      |                      | Position of<br>center of<br>gravity<br>cm |                | Geometrical moment<br>of inertia<br>cm <sup>4</sup> |                                |                |                | Radius of gyration of area<br>cm |                                |                |                | tan α   | Modulus<br>of section<br>cm <sup>3</sup> |      |
|                                     |     |      |                |                | C <sub>x</sub>                       | C <sub>y</sub>       | I <sub>x</sub>                            | I <sub>y</sub> | Max-<br>imum<br>I <sub>x</sub>                      | Min-<br>imum<br>I <sub>x</sub> | i <sub>x</sub> | i <sub>y</sub> | Max-<br>imum<br>i <sub>x</sub>   | Min-<br>imum<br>i <sub>x</sub> | Z <sub>x</sub> | Z <sub>y</sub> |         |                                          |      |
| 180                                 | 9.5 | 23   | 7              | 2              | 21.06                                | 16.5                 | 7.49                                      | 0.746          | 671                                                 | 9.48                           | 678            | 7.24           | 5.64                             | 0.671                          | 5.65           | 0.591          | 0.056 8 | 63.8                                     | 3.79 |
| 200                                 | 10  | 26.5 | 8              | 2              | 25.23                                | 19.8                 | 8.16                                      | 0.834          | 997                                                 | 15.1                           | 1 000          | 11.4           | 6.29                             | 0.773                          | 6.30           | 0.672          | 0.061 1 | 84.2                                     | 5.35 |
| 230                                 | 11  | 30   | 9              | 2              | 31.98                                | 25.1                 | 9.36                                      | 0.927          | 1 680                                               | 24.2                           | 1 680          | 18.3           | 7.24                             | 0.870                          | 7.25           | 0.755          | 0.059 9 | 123                                      | 7.62 |
| 250                                 | 12  | 33   | 10             | 2              | 38.13                                | 29.9                 | 10.1                                      | 1.02           | 2 360                                               | 35.2                           | 2 370          | 26.4           | 7.87                             | 0.960                          | 7.88           | 0.832          | 0.061 2 | 159                                      | 10.1 |

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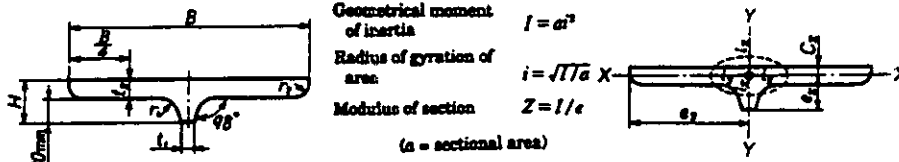
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Attached Table 7 Standard Sectional Dimensions of T Sections and Their Sectional Area, Unit Mass and Sectional Characteristics



| Nominal dimension | Standard sectional dimension<br>mm |                |                |                |                |                | Sectional area<br>cm <sup>2</sup> | Unit mass<br>kg/m | Informative reference               |                |                                                  |       |                                  |      |                                       |      |
|-------------------|------------------------------------|----------------|----------------|----------------|----------------|----------------|-----------------------------------|-------------------|-------------------------------------|----------------|--------------------------------------------------|-------|----------------------------------|------|---------------------------------------|------|
|                   | B                                  | H              | t <sub>1</sub> | t <sub>2</sub> | r <sub>1</sub> | r <sub>2</sub> |                                   |                   | Position of center of gravity<br>cm |                | Geometrical moment of inertia<br>cm <sup>4</sup> |       | Radius of gyration of area<br>cm |      | Modulus of section<br>cm <sup>3</sup> |      |
|                   | C <sub>x</sub>                     | C <sub>y</sub> | I <sub>x</sub> | I <sub>y</sub> | i <sub>x</sub> | i <sub>y</sub> |                                   |                   | Z <sub>x</sub>                      | Z <sub>y</sub> |                                                  |       |                                  |      |                                       |      |
| B × t             |                                    |                |                |                |                |                |                                   |                   |                                     |                |                                                  |       |                                  |      |                                       |      |
| 150 × 9           | 150                                | 39             | 12             | 9              | 8              | 3              | 18.52                             | 14.5              | 0.934                               | 0              | 16.5                                             | 254   | 0.942                            | 3.70 | 5.55                                  | 33.8 |
| 150 × 12          | 150                                | 42             | 12             | 12             | 8              | 3              | 23.02                             | 10.1              | 1.02                                | 0              | 20.7                                             | 338   | 0.949                            | 3.83 | 6.52                                  | 45.1 |
| 150 × 15          | 150                                | 45             | 12             | 15             | 8              | 3              | 27.52                             | 21.6              | 1.13                                | 0              | 25.9                                             | 423   | 0.971                            | 3.92 | 7.70                                  | 56.4 |
| 200 × 12          | 200                                | 42             | 12             | 12             | 8              | 3              | 29.02                             | 22.8              | 0.935                               | 0              | 22.3                                             | 799   | 0.877                            | 5.25 | 6.83                                  | 79.9 |
| 200 × 16          | 200                                | 46             | 12             | 16             | 8              | 3              | 37.02                             | 29.1              | 1.09                                | 0              | 30.5                                             | 1 070 | 0.907                            | 5.37 | 8.68                                  | 107  |
| 200 × 19          | 200                                | 49             | 12             | 19             | 8              | 3              | 43.02                             | 33.8              | 1.22                                | 0              | 38.5                                             | 1 270 | 0.946                            | 5.43 | 10.4                                  | 127  |
| 200 × 22          | 200                                | 52             | 12             | 22             | 8              | 3              | 49.02                             | 38.5              | 1.35                                | 0              | 48.3                                             | 1 470 | 0.993                            | 5.47 | 12.6                                  | 147  |
| 250 × 16          | 250                                | 46             | 12             | 16             | 20             | 3              | 46.05                             | 36.2              | 1.06                                | 0              | 33.6                                             | 2 080 | 0.854                            | 6.72 | 9.49                                  | 167  |
| 250 × 19          | 250                                | 49             | 12             | 19             | 20             | 3              | 53.55                             | 42.0              | 1.19                                | 0              | 43.1                                             | 2 470 | 0.897                            | 6.80 | 11.6                                  | 198  |
| 250 × 22          | 250                                | 52             | 12             | 22             | 20             | 3              | 61.05                             | 47.9              | 1.33                                | 0              | 55.0                                             | 2 870 | 0.949                            | 6.85 | 14.2                                  | 229  |
| 250 × 25          | 250                                | 55             | 12             | 25             | 20             | 3              | 68.55                             | 53.8              | 1.46                                | 0              | 69.6                                             | 3 260 | 1.01                             | 6.90 | 17.2                                  | 261  |

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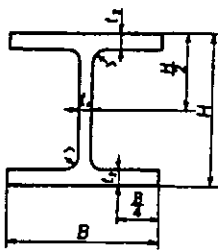
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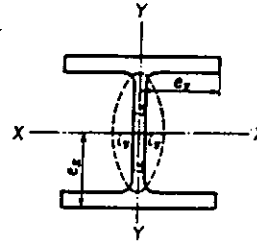
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Attached Table 8 Standard Sectional Dimensions of H Sections and Their Sectional Area, Unit Mass and Sectional Characteristics



Geometrical moment of inertia  $I = at^3$   
 Radius of gyration of area  $i = \sqrt{I/a}$   
 Modulus of section  $Z = I/e$   
 ( $a$  = sectional area)



| Nominal dimension<br>(depth x width) | Standard sectional dimension<br>mm |                |                |    | Sectional<br>area<br>cm <sup>2</sup> | Unit<br>mass<br>kg/m | Informative reference                               |                |                                     |                |                                          |                |
|--------------------------------------|------------------------------------|----------------|----------------|----|--------------------------------------|----------------------|-----------------------------------------------------|----------------|-------------------------------------|----------------|------------------------------------------|----------------|
|                                      | H x B                              | t <sub>1</sub> | t <sub>2</sub> | r  |                                      |                      | Geometrical moment<br>of inertia<br>cm <sup>4</sup> |                | Radius of gyration<br>of area<br>cm |                | Modulus<br>of section<br>cm <sup>3</sup> |                |
|                                      |                                    |                |                |    |                                      |                      | I <sub>x</sub>                                      | I <sub>y</sub> | i <sub>x</sub>                      | i <sub>y</sub> | Z <sub>x</sub>                           | Z <sub>y</sub> |
| 100 x 50                             | 100 x 50                           | 5              | 7              | 8  | 11.85                                | 9.30                 | 187                                                 | 14.8           | 3.98                                | 1.12           | 37.5                                     | 5.91           |
| 100 x 100                            | 100 x 100                          | 6              | 8              | 8  | 21.59                                | 16.9                 | 378                                                 | 134            | 4.18                                | 2.49           | 75.6                                     | 26.7           |
| 125 x 60                             | 125 x 60                           | 6              | 8              | 8  | 16.69                                | 13.1                 | 409                                                 | 29.1           | 4.95                                | 1.32           | 65.5                                     | 9.71           |
| 125 x 125                            | 125 x 125                          | 6.5            | 9              | 8  | 30.00                                | 23.6                 | 839                                                 | 293            | 5.29                                | 3.13           | 134                                      | 46.9           |
| 150 x 75                             | 150 x 75                           | 5              | 7              | 8  | 17.85                                | 14.0                 | 666                                                 | 49.5           | 6.11                                | 1.66           | 88.8                                     | 13.2           |
| 150 x 100                            | 148 x 100                          | 6              | 9              | 8  | 26.35                                | 20.7                 | 1 000                                               | 150            | 6.17                                | 2.39           | 135                                      | 30.1           |
| 150 x 150                            | 150 x 150                          | 7              | 10             | 8  | 39.65                                | 31.1                 | 1 620                                               | 563            | 6.40                                | 3.77           | 216                                      | 75.1           |
| 175 x 90                             | 175 x 90                           | 5              | 8              | 8  | 22.90                                | 18.0                 | 1 210                                               | 97.5           | 7.26                                | 2.06           | 138                                      | 21.7           |
| 175 x 175                            | 175 x 175                          | 7.5            | 11             | 13 | 51.42                                | 40.4                 | 2 900                                               | 984            | 7.50                                | 4.37           | 331                                      | 112            |
| 200 x 100                            | 198 x 99                           | 4.5            | 7              | 8  | 22.69                                | 17.8                 | 1 540                                               | 113            | 8.25                                | 2.24           | 156                                      | 22.9           |
|                                      | 200 x 100                          | 5.5            | 8              | 8  | 26.67                                | 20.9                 | 1 810                                               | 134            | 8.23                                | 2.24           | 181                                      | 26.7           |
| 200 x 150                            | 194 x 150                          | 6              | 9              | 8  | 38.11                                | 29.9                 | 2 630                                               | 507            | 8.30                                | 3.65           | 271                                      | 67.6           |
| 200 x 200                            | 200 x 200                          | 8              | 12             | 13 | 63.53                                | 49.9                 | 4 720                                               | 1 600          | 8.62                                | 5.02           | 472                                      | 160            |
|                                      | *200 x 204                         | 12             | 12             | 13 | 71.53                                | 56.2                 | 4 980                                               | 1 700          | 8.35                                | 4.88           | 498                                      | 167            |
| 250 x 125                            | 248 x 124                          | 5              | 8              | 8  | 31.99                                | 25.1                 | 3 450                                               | 255            | 10.4                                | 2.82           | 278                                      | 41.1           |
|                                      | 250 x 125                          | 6              | 9              | 8  | 36.97                                | 29.0                 | 3 960                                               | 294            | 10.4                                | 2.82           | 317                                      | 47.0           |
| 250 x 175                            | 244 x 175                          | 7              | 11             | 13 | 55.49                                | 43.6                 | 6 040                                               | 984            | 10.4                                | 4.21           | 495                                      | 112            |
| 250 x 250                            | 250 x 250                          | 9              | 14             | 13 | 91.43                                | 71.8                 | 10 700                                              | 3 650          | 10.8                                | 6.32           | 860                                      | 292            |
|                                      | *250 x 255                         | 14             | 14             | 13 | 103.9                                | 81.6                 | 11 400                                              | 3 880          | 10.5                                | 6.11           | 912                                      | 304            |
| 300 x 150                            | 298 x 149                          | 5.5            | 8              | 13 | 40.80                                | 32.0                 | 6 320                                               | 442            | 12.4                                | 3.29           | 424                                      | 59.3           |
|                                      | 300 x 150                          | 6.5            | 9              | 13 | 46.78                                | 36.7                 | 7 210                                               | 508            | 12.4                                | 3.29           | 481                                      | 67.7           |
| 300 x 200                            | 294 x 200                          | 8              | 12             | 13 | 71.05                                | 55.8                 | 11 100                                              | 1 600          | 12.5                                | 4.75           | 756                                      | 160            |
| 300 x 300                            | *294 x 302                         | 12             | 12             | 13 | 106.3                                | 83.4                 | 16 600                                              | 5 510          | 12.5                                | 7.20           | 1 130                                    | 365            |
|                                      | 300 x 300                          | 10             | 15             | 13 | 118.4                                | 93.0                 | 20 200                                              | 6 750          | 13.1                                | 7.55           | 1 350                                    | 450            |
|                                      | 300 x 305                          | 15             | 15             | 13 | 133.4                                | 105                  | 21 300                                              | 7 100          | 12.6                                | 7.30           | 1 420                                    | 466            |
| 350 x 175                            | 346 x 174                          | 6              | 9              | 13 | 52.45                                | 41.2                 | 11 000                                              | 791            | 14.5                                | 3.88           | 638                                      | 91.0           |
|                                      | 350 x 175                          | 7              | 11             | 13 | 62.91                                | 49.4                 | 13 500                                              | 984            | 14.6                                | 3.96           | 771                                      | 112            |
| 350 x 250                            | 340 x 250                          | 9              | 14             | 13 | 99.53                                | 78.1                 | 21 200                                              | 3 650          | 14.6                                | 6.05           | 1 250                                    | 292            |

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Attached Table 8 (Continued)

| Nominal dimension<br>(depth × width) | Standard sectional dimension<br>mm |                |                |    | Sectional area<br>cm <sup>2</sup> | Unit mass<br>kg/m | Informative reference                            |                |                                  |                |                                       |                |
|--------------------------------------|------------------------------------|----------------|----------------|----|-----------------------------------|-------------------|--------------------------------------------------|----------------|----------------------------------|----------------|---------------------------------------|----------------|
|                                      | H × B                              | t <sub>1</sub> | t <sub>2</sub> | r  |                                   |                   | Geometrical moment of inertia<br>cm <sup>4</sup> |                | Radius of gyration of area<br>cm |                | Modulus of section<br>cm <sup>3</sup> |                |
|                                      |                                    |                |                |    |                                   |                   | I <sub>x</sub>                                   | I <sub>y</sub> | i <sub>x</sub>                   | i <sub>y</sub> | Z <sub>x</sub>                        | Z <sub>y</sub> |
| 350 × 350                            | *344 × 348                         | 10             | 16             | 13 | 144.0                             | 113               | 32 800                                           | 11 200         | 15.1                             | 8.84           | 1 910                                 | 646            |
|                                      | 350 × 350                          | 12             | 19             | 13 | 171.9                             | 135               | 39 800                                           | 13 600         | 15.2                             | 8.89           | 2 280                                 | 776            |
| 400 × 200                            | 396 × 199                          | 7              | 11             | 13 | 71.41                             | 56.1              | 19 800                                           | 1 450          | 16.6                             | 4.50           | 999                                   | 145            |
|                                      | 400 × 200                          | 8              | 13             | 13 | 83.37                             | 65.4              | 23 500                                           | 1 740          | 16.8                             | 4.56           | 1 170                                 | 174            |
| 400 × 300                            | 390 × 300                          | 10             | 16             | 13 | 133.2                             | 105               | 37 900                                           | 7 200          | 16.9                             | 7.35           | 1 940                                 | 480            |
| 400 × 400                            | *388 × 402                         | 15             | 15             | 22 | 178.5                             | 140               | 49 000                                           | 16 300         | 16.6                             | 9.55           | 2 520                                 | 809            |
|                                      | *394 × 398                         | 11             | 18             | 22 | 186.8                             | 147               | 56 100                                           | 18 900         | 17.3                             | 10.1           | 2 850                                 | 951            |
|                                      | 400 × 400                          | 13             | 21             | 22 | 218.7                             | 172               | 66 600                                           | 22 400         | 17.5                             | 10.1           | 3 330                                 | 1 120          |
|                                      | *400 × 408                         | 21             | 21             | 22 | 250.7                             | 197               | 70 900                                           | 23 800         | 16.8                             | 9.75           | 3 540                                 | 1 170          |
|                                      | *414 × 405                         | 18             | 28             | 22 | 295.4                             | 232               | 92 800                                           | 31 000         | 17.7                             | 10.2           | 4 480                                 | 1 530          |
|                                      | *428 × 407                         | 20             | 35             | 22 | 360.7                             | 283               | 119 000                                          | 39 400         | 18.2                             | 10.4           | 5 570                                 | 1 930          |
|                                      | *458 × 417                         | 30             | 50             | 22 | 528.6                             | 415               | 187 000                                          | 60 500         | 18.8                             | 10.7           | 8 170                                 | 2 900          |
|                                      | *498 × 432                         | 45             | 70             | 22 | 770.1                             | 605               | 298 000                                          | 94 400         | 19.7                             | 11.1           | 12 000                                | 4 370          |
| 450 × 200                            | 446 × 199                          | 8              | 12             | 13 | 82.97                             | 65.1              | 28 100                                           | 1 580          | 18.4                             | 4.36           | 1 260                                 | 159            |
|                                      | 450 × 200                          | 9              | 14             | 13 | 95.43                             | 74.9              | 32 900                                           | 1 870          | 18.6                             | 4.43           | 1 460                                 | 187            |
| 450 × 300                            | 440 × 300                          | 11             | 18             | 13 | 153.9                             | 121               | 54 700                                           | 8 110          | 18.9                             | 7.26           | 2 490                                 | 540            |
| 500 × 200                            | 496 × 199                          | 9              | 14             | 13 | 99.29                             | 77.9              | 40 800                                           | 1 840          | 20.3                             | 4.31           | 1 650                                 | 185            |
|                                      | 500 × 200                          | 10             | 16             | 13 | 112.2                             | 88.2              | 46 800                                           | 2 140          | 20.4                             | 4.36           | 1 870                                 | 214            |
|                                      | *506 × 201                         | 11             | 19             | 13 | 129.3                             | 102               | 55 500                                           | 2 580          | 20.7                             | 4.46           | 2 190                                 | 256            |
| 500 × 300                            | 482 × 300                          | 11             | 15             | 13 | 141.2                             | 111               | 58 300                                           | 6 760          | 20.3                             | 6.92           | 2 420                                 | 450            |
|                                      | 488 × 300                          | 11             | 18             | 13 | 159.2                             | 125               | 68 900                                           | 8 110          | 20.8                             | 7.14           | 2 820                                 | 540            |
| 600 × 200                            | 596 × 199                          | 10             | 15             | 13 | 117.8                             | 92.5              | 66 600                                           | 1 980          | 23.8                             | 4.10           | 2 240                                 | 199            |
|                                      | 600 × 200                          | 11             | 17             | 13 | 131.7                             | 103               | 75 600                                           | 2 270          | 24.0                             | 4.16           | 2 520                                 | 227            |
|                                      | *606 × 201                         | 12             | 20             | 13 | 149.8                             | 118               | 88 300                                           | 2 720          | 24.3                             | 4.26           | 2 910                                 | 270            |
| 600 × 300                            | 582 × 300                          | 12             | 17             | 13 | 169.2                             | 133               | 98 900                                           | 7 660          | 24.2                             | 6.73           | 3 400                                 | 511            |
|                                      | 588 × 300                          | 12             | 20             | 13 | 187.2                             | 147               | 114 000                                          | 9 010          | 24.7                             | 6.94           | 3 890                                 | 601            |
|                                      | *594 × 302                         | 14             | 23             | 13 | 217.1                             | 170               | 134 000                                          | 10 600         | 24.8                             | 6.98           | 4 500                                 | 700            |
| 700 × 300                            | *692 × 300                         | 13             | 20             | 18 | 207.5                             | 163               | 168 000                                          | 9 020          | 28.5                             | 6.59           | 4 870                                 | 601            |
|                                      | 700 × 300                          | 13             | 24             | 18 | 231.5                             | 182               | 197 000                                          | 10 800         | 29.2                             | 6.83           | 5 640                                 | 721            |
| 800 × 300                            | *792 × 300                         | 14             | 22             | 18 | 239.5                             | 188               | 248 000                                          | 9 920          | 32.2                             | 6.44           | 6 270                                 | 661            |
|                                      | 800 × 300                          | 14             | 26             | 18 | 263.5                             | 207               | 286 000                                          | 11 700         | 33.0                             | 6.67           | 7 160                                 | 781            |
| 900 × 300                            | *890 × 299                         | 15             | 23             | 18 | 266.9                             | 210               | 339 000                                          | 10 300         | 35.6                             | 6.20           | 7 610                                 | 687            |
|                                      | 900 × 300                          | 16             | 28             | 18 | 305.8                             | 240               | 404 000                                          | 12 600         | 36.4                             | 6.43           | 8 990                                 | 842            |
|                                      | *912 × 302                         | 18             | 34             | 18 | 360.1                             | 283               | 491 000                                          | 15 700         | 36.9                             | 6.59           | 10 800                                | 1 040          |

Remark 1:

The H sections given in the same column with respect to the nominal dimension have the same inner depth.

Remark 2:

Those sizes without asterisk are given for merchant sizes.

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**TSG3290G**

APPENDIX 3 Dimensions, Mass and Permissible Variations of Hot Rolled Steel Plates, Sheets and Strip (JIS G 3193 - 1990)

1. Scope

(1) This Japanese Industrial Standard specifies the dimensions, mass and tolerances thereon of the hot rolled steel plate, sheet and strip as well as the appearance, shape and permissible variations thereof. However, this Standard is not applicable to the flat steel.

Remark:

The units and numerical values given in { } in this Standard are based on the International System of Units (SI) and are appended for informative reference.

Further, the traditional units accompanied by numerical values in this Standard shall be converted to the SI units and numerical values on January 1, 1991.

(2) This Standard is applicable to the relevant product standards.

2. Expression of Size

The expression of size of the steel plate, sheet and strip shall be as follows:

- (1) The size of the steel plate and sheet shall be expressed by thickness, width and length in millimeters.
- (2) The size of the steel strip shall be expressed by thickness and width in millimeters.

3. Standard Dimensions

The standard dimensions shall be as follows:

(1) The standard thicknesses of the steel plate, sheet and strip shall be as given in Table 1.

Table 1 Standard Thickness (Unit: mm)

|      |      |      |      |        |      |      |        |      |       |      |
|------|------|------|------|--------|------|------|--------|------|-------|------|
| 1.2  | 1.4  | 1.6  | 1.8  | 2.0    | 2.3  | 2.5  | (2.6)  | 2.8  | (2.9) | 3.2  |
| 3.6  | 4.0  | 4.5  | 5.0  | 5.6    | 6.0  | 6.3  | 7.0    | 8.0  | 9.0   | 10.0 |
| 11.0 | 12.0 | 12.7 | 13.0 | 14.0   | 15.0 | 16.0 | (17.0) | 18.0 | 19.0  | 20.0 |
| 22.0 | 25.0 | 25.4 | 28.0 | (30.0) | 32.0 | 36.0 | 38.0   | 40.0 | 45.0  | 50.0 |

Remark 1:

The standard thickness not in parentheses should preferably be used.

Remark 2:

For the steel strip and cut lengths therefrom, the standard thicknesses of 12.7 mm or under shall be applied.

(2) The standard widths of the steel plate, sheet and strip shall be as given in Table 2.

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Table 2 Standard Thickness (Unit: mm)

|      |       |      |      |      |      |      |      |      |
|------|-------|------|------|------|------|------|------|------|
| 600  | 630   | 670  | 710  | 750  | 800  | 850  | 900  | 914  |
| 950  | 1000  | 1060 | 1100 | 1120 | 1180 | 1200 | 1219 | 1250 |
| 1300 | 1320  | 1400 | 1500 | 1524 | 1600 | 1700 | 1800 | 1829 |
| 1900 | 2000  | 2100 | 2134 | 2438 | 2500 | 2600 | 2800 | 3000 |
| 3048 | ----- |      |      |      |      |      |      |      |

Remark 1:

For the steel strip and cut lengths therefrom, the standard widths of 2000 mm or under shall be applied.

Remark 2:

For the steel plate, excluding the cut lengths from the steel strip, the standard widths of 914 mm, 1219 mm and 1400 mm or over shall be applied.

(3) The standard lengths of the steel plate and sheet shall be as given in Table 3.

Table 3 Standard Length of Steel Plate and Sheet (Unit: mm)

|       |       |       |       |      |      |      |      |      |
|-------|-------|-------|-------|------|------|------|------|------|
| 1829  | 2438  | 3048  | 6000  | 6096 | 7000 | 8000 | 9000 | 9144 |
| 10000 | 12000 | 12192 | ----- |      |      |      |      |      |

Remark:

The lengths given in the above Table shall not be applied to the cut lengths from the steel strip.

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4. Tolerances on Shape and Dimension

The tolerances on shape and dimension for the steel plate, sheet and strip shall be as follows: However, they shall not be applied to the irregular portions of both ends of the steel strip.

(1) The tolerances on thickness for the steel plate, sheet and strip shall be as given in Table 4.

Table 4 Tolerance on Thickness (Unit: mm)

| Thickness                      | Width      |                                |                                |                                |                                |                                |
|--------------------------------|------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
|                                | Under 1600 | 1600 or over to and excl. 2000 | 2000 or over to and excl. 2500 | 2500 or over to and excl. 3150 | 3150 or over to and excl. 4000 | 4000 or over to and excl. 5000 |
| Under 1.25                     | ±0.16      | -----                          | -----                          | -----                          | -----                          | -----                          |
| 1.25 or over to and excl. 1.60 | ±0.18      | -----                          | -----                          | -----                          | -----                          | -----                          |
| 1.60 or over to and excl. 2.00 | ±0.19      | ±0.23                          | -----                          | -----                          | -----                          | -----                          |
| 2.00 or over to and excl. 2.50 | ±0.20      | ±0.25                          | -----                          | -----                          | -----                          | -----                          |
| 2.50 or over to and excl. 3.15 | ±0.22      | ±0.29                          | ±0.29                          | -----                          | -----                          | -----                          |
| 3.15 or over to and excl. 4.00 | ±0.24      | ±0.34                          | ±0.34                          | -----                          | -----                          | -----                          |
| 4.00 or over to and excl. 5.00 | ±0.45      | ±0.55                          | ±0.55                          | ±0.65                          | -----                          | -----                          |
| 5.00 or over to and excl. 6.30 | ±0.50      | ±0.60                          | ±0.60                          | ±0.75                          | ±0.75                          | -----                          |
| 6.30 or over to and excl. 10.0 | ±0.55      | ±0.65                          | ±0.65                          | ±0.80                          | ±0.80                          | ±0.9                           |
| 10.0 or over to and excl. 16.0 | ±0.55      | ±0.65                          | ±0.65                          | ±0.80                          | ±0.80                          | ±1.0                           |
| 16.0 or over to and excl. 25.0 | ±0.65      | ±0.75                          | ±0.75                          | ±0.95                          | ±0.95                          | ±1.1                           |
| 25.0 or over to and excl. 40.0 | ±0.70      | ±0.80                          | ±0.80                          | ±1.0                           | ±1.0                           | ±1.2                           |
| 40.0 or over to and excl. 63.0 | ±0.80      | ±0.95                          | ±0.95                          | ±1.1                           | ±1.1                           | ±1.3                           |
| 63.0 or over to and excl. 100  | ±0.9       | ±1.1                           | ±1.1                           | ±1.3                           | ±1.3                           | ±1.5                           |
| 100 or over to and excl. 160   | ±1.3       | ±1.5                           | ±1.5                           | ±1.7                           | ±1.7                           | ±1.9                           |
| 160 or over to and excl. 200   | ±1.6       | ±1.8                           | ±1.8                           | ±1.9                           | ±1.9                           | ±2.1                           |
| 200 or over to and excl. 250   | ±1.8       | ±1.9                           | ±1.9                           | ±2.0                           | ±2.0                           | ±2.2                           |
| 250 or over to and excl. 300   | ±2.0       | ±2.1                           | ±2.1                           | ±2.2                           | ±2.2                           | ±2.5                           |
| 300 or over to and incl. 350   | ±2.1       | ±2.3                           | ±2.3                           | ±2.4                           | ±2.4                           | ±2.8                           |

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Remark 1:

Either plus side or minus side of the thickness tolerances given in the above Table may be limited on request. The total tolerances in this case shall be equal to those given in Table 4.

Remark 2:

Thickness shall be measured at any point on the steel strip not less than 25 mm from a side edge for the mill edge strip 50 mm or over in width and cut lengths therefrom, and on the center line for those less than 50 mm in width. For the cut edge steel strip 30 mm or over in width and cut lengths therefrom, measurement shall be made at any point not less than 15 mm from a side edge, and on the center line for those less than 30 mm in width. Thickness shall be measured at any point inward the scheduled cutting line concerning width for the as-rolled steel plate (with untrimmed edge), and at any point not less than 15 mm from the aforementioned line for the cut edge plate.

(2) The tolerances on width of the steel plate, sheet and strip shall be as given in Table 5.

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Table 5 Tolerance on Width (Unit: mm)

| Width                          | Thickness                      | Tolerance                                   |                                       |                   |   |                              |   |                |
|--------------------------------|--------------------------------|---------------------------------------------|---------------------------------------|-------------------|---|------------------------------|---|----------------|
|                                |                                | Mill edge                                   |                                       | Cut edge          |   |                              |   |                |
|                                |                                | Steel plate as rolled (with untrimmed edge) | Steel strip and cut lengths therefrom | A Normal cut edge |   | B Resheared or fine cut edge |   | C Slitted edge |
|                                |                                |                                             |                                       | +                 | - | +                            | - |                |
| Under 160                      | Under 3.15                     | ---                                         | ±2                                    | 5                 | 0 | 2.0                          | 0 | ±0.3           |
|                                | 3.15 or over to and excl. 6.00 |                                             |                                       | 5                 |   | 3.0                          |   | ±0.5           |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 10                |   | 4.0                          |   | ---            |
|                                | 20.0 or over                   |                                             |                                       | 10                |   | ---                          |   |                |
| 160 or over to and excl. 250   | Under 3.15                     | ---                                         | ±2                                    | 5                 | 0 | 2.0                          | 0 | ±0.4           |
|                                | 3.15 or over to and excl. 6.00 |                                             |                                       | 5                 |   | 3.0                          |   | ±0.5           |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 10                |   | 4.0                          |   | ---            |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 250 or over to and excl. 400   | Under 3.15                     | 0                                           | ±5                                    | 5                 | 0 | 2.0                          | 0 | ±0.5           |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             |                                       | 5                 |   | 3.0                          |   | ±0.5           |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 10                |   | 4.0                          |   | ---            |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 400 or over to and excl. 630   | Under 3.15                     | 0                                           | +20                                   | 10                | 0 | 3.0                          | 0 | ±0.5           |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             | 0                                     | 10                |   | 3.0                          |   | ±0.5           |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 10                |   | 5.0                          |   | ---            |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 630 or over to and excl. 1000  | Under 3.15                     | 0                                           | +25                                   | 10                | 0 | 4.0                          | 0 | ---            |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             | 0                                     | 10                |   | 4.0                          |   |                |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 10                |   | 6.0                          |   |                |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 1000 or over to and excl. 1250 | Under 3.15                     | 0                                           | +30                                   | 10                | 0 | 4.0                          | 0 | ---            |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             | 0                                     | 10                |   | 4.0                          |   |                |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 15                |   | 6.0                          |   |                |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 1250 or over to and excl. 1600 | Under 3.15                     | 0                                           | +35                                   | 10                | 0 | 4.0                          | 0 | ---            |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             | 0                                     | 10                |   | 4.0                          |   |                |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 15                |   | 6.0                          |   |                |
|                                | 20.0 or over                   |                                             |                                       | 15                |   | ---                          |   |                |
| 1600 or over                   | Under 3.15                     | 0                                           | +40                                   | 10                | 0 | 4.0                          | 0 | ---            |
|                                | 3.15 or over to and excl. 6.00 | + Not specified                             | 0                                     | 10                |   | 4.0                          |   |                |
|                                | 6.00 or over to and excl. 20.0 |                                             |                                       | 1.2 %             |   | 6.0                          |   |                |
|                                | 20.0 or over                   |                                             |                                       | 1.2 %             |   | ---                          |   |                |

Remark:

For the mill edge steel strip less than 400 mm in width and cut lengths therefrom, the width tolerance on minus side may be limited to zero. In this case, the tolerances on plus side shall be twice the values given in Table 5.

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(3) The tolerances on length for the steel plate and sheet shall be as given in Table 6.

Table 6 Tolerance on Length of Steel Plate and Sheet (Unit: mm)

| Length       | Thickness    | Tolerance           |                                 |
|--------------|--------------|---------------------|---------------------------------|
|              |              | A<br>Normal cutting | B<br>Reshearing or fine cutting |
| Under 6300   | Under 6.00   | +25<br>0            | +5<br>0                         |
|              | 6.00 or over | +25<br>0            | +10<br>0                        |
| 6300 or over | Under 6.00   | +0.5 %<br>0         | +10<br>0                        |
|              | 6.00 or over | +0.5 %<br>0         | +15<br>0                        |

Remark:

Tolerance B does not apply to that of 20 mm or over in width.

(4) The maximum value of camber for the steel plate, sheet and strip shall be as given in Tables 7 and 8.

Table 7 Camber for Steel Plate and Sheet (Unit: mm)

| Length                          | Width                        |                               |                        |
|---------------------------------|------------------------------|-------------------------------|------------------------|
|                                 | 250 or over to and excl. 630 | 630 or over to and excl. 1000 | 1000 or over           |
| Under 2500                      | 5                            | 4                             | 3                      |
| 2500 or over to and excl. 4000  | 8                            | 6                             | 5                      |
| 4000 or over to and excl. 6300  | 12                           | 10                            | 8                      |
| 6300 or over to and excl. 10000 | 20                           | 16                            | 12                     |
| 10000 or over                   | 20 in any 10000 length       | 16 in any 10000 length        | 12 in any 10000 length |

Remark 1:

For the tolerances on camber of the steel plate and sheet under 250 mm in width, Table 8 shall be applied.

Remark 2:

This Table shall not be applied to the sheet plate and sheet as rolled (with untrimmed edge).

Remark 3:

For determination of camber of the steel plate and sheet, it shall be in accordance with Fig. 1.

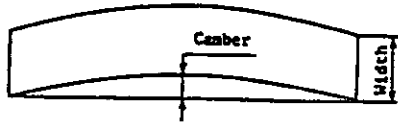
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Unit: mm

(For steel plate under 10000 mm in length)



(For steel plate 10000 mm or over in length)

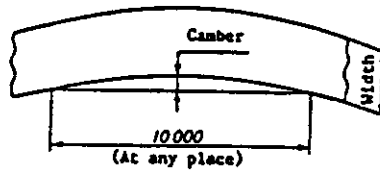


Fig. 1 Application of Camber of Steel Plate and Sheet

Table 8 Camber of Steel Strip (Unit: mm)

| Width       | Maximum value        |
|-------------|----------------------|
| Under 250   | 8 in any 2000 length |
| 250 or over | 5 in any 2000 length |

Remark:

The application of camber of the steel strip shall be in accordance with Fig. 2.

Unit: mm

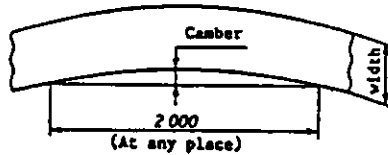


Fig. 2 Application of Camber of Steel Strip

(5) The maximum deviation of flatness of the steel plate and sheet shall be as given in Table 9.

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Table 9 Flatness of Steel Plate and Sheet (Unit: mm)

| Thickness                       | Width      |                                |                                |                                |              |
|---------------------------------|------------|--------------------------------|--------------------------------|--------------------------------|--------------|
|                                 | Under 1250 | 1250 or over to and excl. 1600 | 1600 or over to and excl. 2000 | 2000 or over to and excl. 3000 | 3000 or over |
| Under 1.60                      | 18         | 20                             | ---                            | ---                            | ---          |
| 1.60 or over to and excl. 3.15  | 16         | 18                             | 20                             | ---                            | ---          |
| 3.15 or over to and excl. 4.00  | 16         |                                | ---                            | ---                            | ---          |
| 4.00 or over to and excl. 6.00  | 14         |                                | ---                            | 24                             | 25           |
| 6.00 or over to and excl. 10.0  | 13         |                                | ---                            | 21                             | 22           |
| 10.0 or over to and excl. 25.0  | 12         |                                | ---                            | 16                             | 17           |
| 25.0 or over to and excl. 40.0  | 9          |                                | ---                            | 13                             | 14           |
| 40.0 or over to and excl. 63.0  | 8          |                                | ---                            | 11                             | 11           |
| 63.0 or over to and excl. 200   | 7          |                                | ---                            | 10                             | 10           |
| 200 or over up to and incl. 350 | 20         |                                |                                |                                |              |

## Remark 1:

This Table shall not be applied to the stretcher levelled steel plate and sheet for delivery.

## Remark 2:

The values given in the above Table shall be applied to any 2000 mm length. For the steel plate and sheet less than 2000 mm in length, the values shall be applied to the full length. For the steel plate and sheet over 2000 mm in wave pitch, the values given in the above Table shall be applied to any pitch of the wave. For those over 4000 mm in wave pitch, however, the above values shall be applied to any 4000 mm length.

## Remark 3:

The deviation from the flatness shall be determined as the difference between the maximum deviation of convex side uppermost from the flat surface and the thickness of the steel plate and sheet themselves.

## Remark 4:

Unless otherwise specified, one and half time the maximum deviation from flatness shall be applied to the steel plate and sheet of the specified minimum tensile strength of 58 kgf/mm<sup>2</sup> [569 N/mm<sup>2</sup>] till the end of 1990, to those of 570 N/mm<sup>2</sup> on and after January 1, 1991, to those of the specified minimum yield point of 44 kgf/mm<sup>2</sup> [431 N/mm<sup>2</sup>] till the end of 1990, to those of 430 N/mm<sup>2</sup> on and after January 1, 1991, and to the steel plate and sheet of equivalent tensile test characteristics achieved and adjusted by chemical composition, hardness and treatment of quench and temper.

## Remark 5:

This Table shall not be applied to the as-rolled steel plate and sheet (with untrimmed edge).

## Remark 6:

Measurement of flatness, as a rule, shall be made on a flat surface plate.

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- (6) The out-of-square of cut length from cut edged steel strip shall be expressed in  $A/W$  as shown in Fig. 3 and shall not exceed 1.0 %.

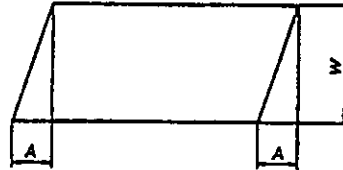


Fig. 3 Out-of-square of Cut Lengths from Strip

Remark:

A is the measured value, and W is the nominal width.

## 5. Mass

### 5.1 Mass of Steel Plate and Sheet

The mass of the steel plate and sheet shall be as follows:

- (1) The mass of the steel plate and sheet shall generally be the theoretical mass expressed in kilogrammes.
- (2) The method for calculation of mass of the steel plate and sheet shall be in accordance with Table 10 based on their nominal dimensions. For the steel plate and sheet which are specified to limit either plus side or minus side of their thickness tolerances given in Table 4 in accordance with 4. (1), the mean value of the maximum and minimum thicknesses in each range of tolerance shall be used instead of the nominal thicknesses.

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Table 10 Method for Calculation of Mass of Steel Plate and Sheet

| Step of calculation                            | Calculation method                                                                                                        | Number of figures in calculated result                                                        |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Basic mass (kg/mm·m <sup>2</sup> )             | 7.85 (mass per mm thickness per m <sup>2</sup> area)                                                                      | -----                                                                                         |
| Unit mass (kg/m <sup>2</sup> )                 | Basic mass (kg/mm·m <sup>2</sup> ) × Thickness of plate or sheet (mm)                                                     | Round off to 4 significant figures                                                            |
| Area of steel plate or sheet (m <sup>2</sup> ) | Width (m) × Length (m)                                                                                                    | Round off to 4 significant figures                                                            |
| Mass of single plate or sheet (kg)             | Unit mass (kg/m <sup>2</sup> ) × Area (m <sup>2</sup> )                                                                   | Round off to 3 significant figures. For those exceeding 1000 kg, integer, round off to in kg. |
| Neither bundled nor packed                     | Total mass (kg)<br>Mass of single plate or sheet (kg) × Number of plates or sheets of the same size                       | Round off to integer in kg.                                                                   |
| Bundled or packed                              | Mass of single bundle (kg)<br>Mass of single plate or sheet (kg) × Number of plates or sheets per bundle of the same size | Round off to integer in kg.                                                                   |
|                                                | Total mass (kg)<br>Sum of mass of each bundle                                                                             | Integer in kg.                                                                                |

Remark 1:

Rounding off the numerical values shall be in accordance with JIS Z 8401.

Remark 2:

When the steel plates or sheets are bundled (or packed) the total mass may be calculated as follows:

Mass of single sheet (kg) × Number of plates or sheets of the same size.

### 5.2 Mass of Steel Strip

The mass of the steel strip shall be as follows:

- (1) The mass of the steel strip shall generally be the actual mass expressed in kilogrammes.
- (2) For the mass of the steel strip, the maximum mass of each coil shall generally be specified by agreement, where not less than 75 % of the total number of steel strip shall be not less than 70 % of the specified mass and the rest may include shorter steel strip of 30 % to 70 % excluding in specified mass.

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## 6. Appearance

The appearance of the steel plates, sheets and strip shall be as follows:

- (1) The steel plate, sheet and strip shall be free from defects that are detrimental to practical use. For the steel strip, however, some irregular portions may be included therein, since generally the steel strip is afforded no opportunity to inspect readily and to remove such defective parts.
- (2) For the steel strip and cut lengths the reform, the provision concerning harmful surface defects shall generally be applied to one side of the surfaces. The term "one side of the surfaces" means the outside surface for the steel strip and the upper side surface for the cut lengths therefrom.
- (3) In the case where there is any harmful defect on the surface of the steel plate and sheet, the manufacturer may remove or repair the defect by grinding or welding. In this case, the operation shall be as follows:
  - (a) Conditioning with Grinder
    - (i) The thickness of the steel plate and sheet after conditioning shall fall within the tolerances on thickness.
    - (ii) The conditioned parts of the steel plate and sheet shall be finished neatly, and the boundary between the repaired portions on the as-rolled surface shall be smoothly finished.
  - (b) Repair by Welding
    - (i) The harmful defects of the steel plate and sheet shall be removed thoroughly by suitable means such as chipping or grinding prior to welding. The depth of the removed part shall be not more than 20 % of the nominal thickness, and the total conditioned area on the one side surface shall not exceed 2 % of the area of one side of the steel plate and sheet.
    - (ii) The repair by welding shall be carried out by suitable means for the kind of steel product.
    - (iii) The welded part of the steel plate and sheet shall be free from undercuts or overlaps around the fringe of welds. The reinforcement of weld shall be at least 1.5 mm or over height from the rolled surface and this shall be removed by chipping, grinding, etc. and neatly finished as high as the rolled surface.
    - (iv) The heat-treated steel plate and sheet themselves shall be heat treated once again after the repair by welding.

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APPENDIX 4 Shape, Dimension, Weight and Tolerance for Hot Rolled Flat Steel (JIS G 3194 - 1966)

1. Scope

- (1) This standard specified dimension, weight and tolerance thereon as well as appearance, shape and allowable limit thereto of flat steel which is manufactured by hot rolling.
- (2) The application of this standard shall be specified in the respective manufacture standard.

2. Definition

The flat steel so called in this standard shall be defined as the steel which had been hot rolled on four surfaces with rectangular cross-sections and is supplied by being cut into a prescribed length.

3. Expression of Dimension

The dimension of flat steel shall be expressed in mm for the thickness and width, and in m for the length.

4. Standard Dimension

- (1) The cross-sectional dimension of flat steel shall comply with Table 1 Appended.
- (2) The standard length of flat steel shall comply with Table 1.

Table 1 (Unit: mm)

|      |      |     |     |     |     |     |     |     |     |      |      |      |      |
|------|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| 3.5  | 4.0  | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 |
| 14.0 | 15.0 |     |     |     |     |     |     |     |     |      |      |      |      |

5. Shape and Dimensional Tolerance

The shape and dimensional tolerance for flat steel shall comply with Table 2.

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Table 2

| Division        |                            | Tolerance                                                                                     | Resume                                                                               |
|-----------------|----------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Thickness       | Less than 6.0 mm           | ±0.3 mm                                                                                       |                                                                                      |
|                 | 6.0 mm up to 12 mm, excl.  | ±0.4 mm                                                                                       |                                                                                      |
|                 | 12 mm and over             | ±0.4 % Provided that be ±1.2 mm for the maximum value                                         |                                                                                      |
| Width           | Less than 50 mm            | ±0.8 mm                                                                                       |                                                                                      |
|                 | 50 mm and over             | ±1.6 % Provided that be ±3.5 mm for the maximum value                                         |                                                                                      |
| Length          | 7 m and under              | $^{+10}_0$ mm                                                                                 |                                                                                      |
|                 | Over 7 m                   | Add 5 mm to above-mentioned plus tolerance for every increment of 1 m length or the fractions |                                                                                      |
| Corner drop (C) | 9 mm and over in thickness | 15 % max. of thickness Provided that be 4 mm for the maximum value                            |   |
| Lateral warpage |                            | Be within 0.3 % of total length. Provided that be 4 mm per m of optional length               |  |
| Flatness        |                            | As to 50 mm min. in width be within 8 mm for every 2 m of optional length                     |                                                                                      |

6. Weight

- (1) The weight of flat steel shall comply as a rule with the calculated weight and shall be expressed in kg.
- (2) The calculating method for the weight of flat steel shall comply with Table 3, however, the dimension in this case shall be of the expressed dimension.
- (3) The cross-sectional area and unit weight for the standard cross-sectional dimension of flat steel which is found from (2) shall comply with Table Appended.

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Table 3

| Sequence of calculation              | Calculating method                                                       | Number of result figures                                                                                                                      |
|--------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Basic weight (kg/cm <sup>2</sup> /m) | 0.785 (Weight of 1 m in length × 1 cm <sup>2</sup> in sectional area)    |                                                                                                                                               |
| Sectional area (cm <sup>2</sup> )    | Width (mm) × Thickness (mm) × 1/100                                      | Round off in numerical value to 4 places of significant figures                                                                               |
| Unit weight (kg/m)                   | Basic weight (kg/cm <sup>2</sup> /m) × Sectional area (cm <sup>2</sup> ) | Round off in numerical value to 3 places of significant figures                                                                               |
| Weight per piece (kg)                | Unit weight (kg/m) × Length (m)                                          | Round off in numerical value to 3 places of significant figures. Provided that round off those exceeding 1000 kg in the integral value of kg. |
| Gross total weight (kg)              | Weight per piece (kg) × Number of piece of the same dimension            | Round off in the integral value of kg                                                                                                         |

Remark:

The rounding method for numerical value shall comply with JIS Z 8401 - Rules for Rounding off of Numerical Values.

7. Tolerance on Weight

The tolerance on weight of flat steel shall, when being designated by the purchaser, comply with Table 4. Provided that the calculating method for the tolerance shall be shown in percentage of dividing the difference between the calculated weight and actually scaled weight by the calculated weight.

Table 4

| Thickness       | Tolerance | Application                                                                                                                                                                                                |
|-----------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Less than 10 mm | ±5 %      | To apply to one lot (1 ton min.) of the same dimension. Provided that when the number of pieces corresponding to 1 ton does not reach 10 pieces, this shall be applicable to one lot of 10 pieces or more. |
| 10 mm and over  | ±4 %      |                                                                                                                                                                                                            |

8. Appearance

- (1) The flat steel shall be free from injurious defects in the use.
- (2) In case of injurious defects existing on the surface of flat steel, the manufacturer may remove or mend the defects by means of grinder or welding. Provided that the conditions in this case shall comply with the following respective items:

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### 8.1 Repair by Grinder

- (1) The thickness of flat steel after being repaired shall be within the range of tolerance on thickness.
- (2) The repaired portion of flat steel shall be cleanly finished and smoothed on the boundary with the surface as it is rolled.

### 8.2 Mend by Welding

- (1) The injurious defect of flat steel shall be thoroughly removed prior to welding by a suitable method such as chipping or grinding. The depth of removed portion shall be not more than 20 % of the expressed thickness of flat steel, and the total mended area on single side surface shall be not more than 2 % of the single side area in the flat steel.
- (2) The mend by welding shall be carried out by a relevant method in response to the type of the flat steel.
- (3) The welded place in the flat steel shall be free from undercut or overlap on the edge. The reinforcement of weld shall be at least not less than 1.5 mm from the rolled surface, shall be removed by a method such as chipping or grinding and shall be cleanly finished to the same height as the rolled surface.
- (4) The flat steel which was heat-treated (inclusive of annealing) shall be heat-treated anew on the flat steel proper itself after being weld-mended.

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Table Appended Standard Cross-Sectional Dimension, Sectional Area and Unit Weight of Flat Steel

| Standard sectional dimension |             | Sectional area<br>cm <sup>2</sup> | Unit weight<br>kg/m | Standard sectional dimension |             | Sectional area<br>cm <sup>2</sup> | Unit weight<br>kg/m | Standard sectional dimension |             | Sectional area<br>cm <sup>2</sup> | Unit weight<br>kg/m | Standard sectional dimension |             | Sectional area<br>cm <sup>2</sup> | Unit weight<br>kg/m |
|------------------------------|-------------|-----------------------------------|---------------------|------------------------------|-------------|-----------------------------------|---------------------|------------------------------|-------------|-----------------------------------|---------------------|------------------------------|-------------|-----------------------------------|---------------------|
| Thickness<br>mm              | Width<br>mm |                                   |                     | Thickness<br>mm              | Width<br>mm |                                   |                     | Thickness<br>mm              | Width<br>mm |                                   |                     | Thickness<br>mm              | Width<br>mm |                                   |                     |
| 4.5                          | 25          | 1.123                             | 0.88                | 9                            | 180         | 16.20                             | 12.7                | 16                           | 300         | 48.00                             | 37.7                | 25                           | 180         | 45.00                             | 35.3                |
| 4.5                          | 32          | 1.440                             | 1.13                | 9                            | 200         | 18.00                             | 14.1                | 19                           | 38          | 7.220                             | 5.67                | 25                           | 200         | 50.00                             | 39.2                |
| 4.5                          | 38          | 1.710                             | 1.34                | 9                            | 230         | 20.70                             | 16.2                | 19                           | 44          | 8.360                             | 6.56                | 25                           | 230         | 57.50                             | 45.1                |
| 4.5                          | 44          | 1.980                             | 1.55                | 9                            | 250         | 22.50                             | 17.7                | 19                           | 50          | 9.500                             | 7.46                | 25                           | 250         | 62.50                             | 49.1                |
| 4.5                          | 50          | 2.250                             | 1.77                | 12                           | 25          | 3.000                             | 2.36                | 19                           | 65          | 12.35                             | 9.69                | 25                           | 280         | 70.00                             | 55.0                |
| 6                            | 25          | 1.500                             | 1.18                | 12                           | 32          | 3.840                             | 3.01                | 19                           | 75          | 14.25                             | 11.2                | 25                           | 300         | 75.00                             | 58.9                |
| 6                            | 32          | 1.920                             | 1.51                | 12                           | 38          | 4.560                             | 3.58                | 19                           | 90          | 17.10                             | 13.4                | 28                           | 100         | 28.00                             | 22.0                |
| 6                            | 38          | 2.280                             | 1.79                | 12                           | 44          | 5.280                             | 4.14                | 19                           | 100         | 19.00                             | 14.9                | 28                           | 125         | 35.00                             | 27.5                |
| 6                            | 44          | 2.640                             | 2.07                | 12                           | 50          | 6.000                             | 4.71                | 19                           | 125         | 23.75                             | 18.6                | 28                           | 150         | 42.00                             | 33.0                |
| 6                            | 50          | 3.000                             | 2.36                | 12                           | 65          | 7.800                             | 6.12                | 19                           | 150         | 28.50                             | 22.4                | 28                           | 180         | 50.40                             | 39.4                |
| 6                            | 65          | 3.900                             | 3.06                | 12                           | 75          | 9.000                             | 7.06                | 19                           | 180         | 34.20                             | 26.8                | 28                           | 200         | 54.00                             | 44.0                |
| 6                            | 75          | 4.500                             | 3.53                | 12                           | 90          | 10.80                             | 8.48                | 19                           | 200         | 38.00                             | 29.8                | 28                           | 230         | 64.40                             | 50.6                |
| 6                            | 90          | 5.400                             | 4.24                | 12                           | 100         | 12.00                             | 9.43                | 19                           | 230         | 43.70                             | 34.3                | 28                           | 250         | 70.00                             | 55.0                |
| 6                            | 100         | 6.000                             | 4.71                | 12                           | 125         | 15.00                             | 11.8                | 19                           | 250         | 47.50                             | 37.3                | 28                           | 280         | 78.40                             | 61.5                |
| 6                            | 125         | 7.500                             | 5.89                | 12                           | 150         | 18.00                             | 14.1                | 19                           | 280         | 53.20                             | 41.8                | 28                           | 300         | 84.00                             | 65.9                |
| 8                            | 25          | 2.000                             | 1.57                | 12                           | 180         | 21.60                             | 17.0                | 19                           | 300         | 57.00                             | 44.7                | 32                           | 100         | 32.00                             | 25.1                |
| 8                            | 32          | 2.560                             | 2.01                | 12                           | 200         | 24.00                             | 18.8                | 22                           | 50          | 11.00                             | 8.64                | 32                           | 125         | 40.00                             | 31.4                |
| 8                            | 38          | 3.040                             | 2.39                | 12                           | 230         | 27.60                             | 21.7                | 22                           | 65          | 14.30                             | 11.2                | 32                           | 150         | 48.00                             | 37.7                |
| 8                            | 44          | 3.520                             | 2.76                | 12                           | 250         | 30.00                             | 23.6                | 22                           | 75          | 16.50                             | 13.0                | 32                           | 180         | 57.60                             | 45.2                |
| 8                            | 50          | 4.000                             | 3.14                | 12                           | 280         | 33.60                             | 26.4                | 22                           | 90          | 19.80                             | 15.5                | 32                           | 200         | 64.00                             | 50.2                |
| 8                            | 65          | 5.200                             | 4.08                | 12                           | 300         | 36.00                             | 28.3                | 22                           | 100         | 22.00                             | 17.3                | 32                           | 230         | 73.60                             | 57.8                |
| 8                            | 75          | 6.000                             | 4.71                | 16                           | 32          | 5.120                             | 4.02                | 22                           | 125         | 27.50                             | 21.6                | 32                           | 250         | 80.00                             | 62.8                |
| 8                            | 90          | 7.200                             | 5.65                | 16                           | 38          | 6.080                             | 4.77                | 22                           | 150         | 33.00                             | 25.9                | 32                           | 280         | 89.60                             | 70.3                |
| 8                            | 100         | 8.000                             | 6.28                | 16                           | 44          | 7.040                             | 5.53                | 22                           | 180         | 39.60                             | 31.1                | 32                           | 300         | 94.00                             | 73.4                |
| 8                            | 125         | 10.00                             | 7.85                | 16                           | 50          | 8.000                             | 6.28                | 22                           | 200         | 44.00                             | 34.5                | 36                           | 100         | 36.00                             | 28.3                |
| 9                            | 25          | 2.250                             | 1.77                | 16                           | 65          | 10.40                             | 8.16                | 22                           | 230         | 50.60                             | 39.7                | 36                           | 125         | 45.00                             | 35.3                |
| 9                            | 32          | 2.880                             | 2.26                | 16                           | 75          | 12.00                             | 9.42                | 22                           | 250         | 55.00                             | 43.2                | 36                           | 150         | 54.00                             | 42.4                |
| 9                            | 38          | 3.420                             | 2.68                | 16                           | 90          | 14.40                             | 11.3                | 22                           | 280         | 61.60                             | 48.4                | 36                           | 180         | 64.80                             | 50.9                |
| 9                            | 44          | 3.960                             | 3.11                | 16                           | 100         | 16.00                             | 12.6                | 22                           | 300         | 66.00                             | 51.8                | 36                           | 200         | 72.00                             | 56.5                |
| 9                            | 50          | 4.500                             | 3.53                | 16                           | 125         | 20.00                             | 15.7                | 25                           | 50          | 12.50                             | 9.81                | 36                           | 230         | 82.80                             | 65.0                |
| 9                            | 65          | 5.850                             | 4.59                | 16                           | 150         | 24.00                             | 18.8                | 25                           | 65          | 16.25                             | 12.8                | 36                           | 250         | 90.00                             | 70.6                |
| 9                            | 75          | 6.750                             | 5.30                | 16                           | 180         | 28.80                             | 22.6                | 25                           | 75          | 18.75                             | 14.7                | 36                           | 280         | 100.8                             | 79.1                |
| 9                            | 90          | 8.100                             | 6.34                | 16                           | 200         | 32.00                             | 25.1                | 25                           | 90          | 22.50                             | 17.7                | 36                           | 300         | 108.0                             | 84.8                |
| 9                            | 100         | 9.000                             | 7.06                | 16                           | 230         | 36.80                             | 28.9                | 25                           | 100         | 25.00                             | 19.6                |                              |             |                                   |                     |
| 9                            | 125         | 11.25                             | 8.83                | 16                           | 250         | 40.00                             | 31.4                | 25                           | 125         | 31.25                             | 24.5                |                              |             |                                   |                     |
| 9                            | 150         | 13.50                             | 10.6                | 16                           | 280         | 44.80                             | 35.2                | 25                           | 150         | 37.50                             | 29.4                |                              |             |                                   |                     |

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