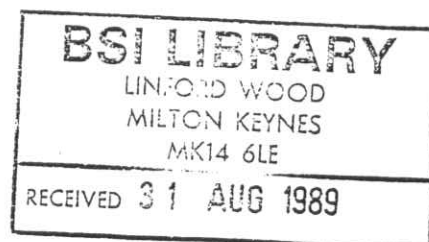


JIS

JAPANESE INDUSTRIAL STANDARD

**Cold Rolled Stainless Steel
Strip for Springs**

JIS G 4313—1988



Translated and Published

by

Japanese Standards Association

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

JAPANESE INDUSTRIAL STANDARD

J I S

Cold Rolled Stainless Steel Strip
for Springs

G 4313-1988

1. Scope

This Japanese Industrial Standard specifies the stainless steel strips for springs, hereinafter referred to as the "strips", mainly intended for the use of leaf and spiral springs.

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 Jan. 1, 1991.

2. Grade and Designation

Strips shall be classified into 4 grades, and their designations and classes shall be as shown in Table 1.

Table 1. Designation of Grade and Classification

Designation of grade	Class
SUS 301-CSP SUS 304-CSP	Austenite
SUS 420J2-CSP	Martensite
SUS 631-CSP	Precipitation hardening

3. Mechanical Properties

The strips shall be tested in accordance with 8.1 and the resulting mechanical properties shall be as specified below.

- (1) The hardness and bend of the strips shall be as given in Table 2.

In the bend test, however, the test piece shall be bent without developing crackings on the outside of the bent portion.

Table 2. Hardness and Bend

Designation of grade	Symbol of temper	As cold rolled, or either as solution-treated or as-annealed			As precipitation-hardened	
		Hardness HV	Bend		Symbol of heat treatment	Hardness HV
			V-bend	W-bend		
SUS 301-CSP	$\frac{1}{2}$ H	310 min.	Twice the thickness at most	2.5 times the thickness at most	—	—
	$\frac{3}{4}$ H	370 min.	2.5 times the thickness at most	3 times the thickness at most	—	—
	H	430 min.	—	—	—	—
	EH	490 min.	—	—	—	—
SUS 304-CSP	$\frac{1}{2}$ H	250 min.	Twice the thickness at most	Twice the thickness at most for thickness 0.5 mm or under, 2.5 times the thickness at most for thickness over 0.5 mm	—	—
	$\frac{3}{4}$ H	310 min.	2.5 times the thickness at most	3 times the thickness at most	—	—
	H	370 min.	—	—	—	—
SUS 420J2-CSP	0	210 max.	—	—	—	—
SUS 631-CSP	0	200 max.	0.5 time the thickness at most	1 time the thickness at most	TH1050 RH950	345 min. 392 min.
	$\frac{1}{2}$ H	350 min.	1.5 times the thickness at most	Twice the thickness at most	CH	380 min.
	$\frac{3}{4}$ H	400 min.	—	—	CH	450 min.
	H	450 min.	—	—	CH	530 min.

Remarks 1. The extent of bending is given by the inside radius, and the angle of bending shall be 90° for both V and W bends. The W bend test shall be conducted instead of V bend, when specified by the purchaser.

2. The precipitation hardening heat treatment for SUS 631-CSP shall be as specified below.

(1) For the strips with temper symbol 0;

TH1050: Hold at 760 ± 15°C for 90 min, cool down to 15°C or below within 1 h, hold for 30 min, hold at 565 ± 10°C for 90 min and air-cool.

RH950: Hold at 955 ± 10°C for 10 min, air-cool down to ambient temperature, cool down to -73 ± 6°C within 24 hours, hold for 8 hours, hold at 510 ± 10°C for 60 min and air-cool.

(2) For the strips with temper symbol $\frac{1}{2}$ H, $\frac{3}{4}$ H and H;
CH: Hold at 475 ± 10°C for 1 h and air-cool.

- (2) When the tensile test is conducted instead of the bend and hardness tests specified in Table 2 by the specification of purchaser, the proof stress, tensile strength and elongation of strips shall conform to Table 3-1 or Table 3-2.

Table 3-1. Tensile Strength, Proof Stress and Elongation

(Applicable till the end of 1990)

Designation of grade	Symbol of temper	As cold rolled or as solution-treated			As precipitation-hardened		
		Proof stress kgf/mm ² {N/mm ² }	Tensile strength kgf/mm ² {N/mm ² }	Elongation %	Symbol of heat treatment	Proof stress kgf/mm ² {N/mm ² }	Tensile strength kgf/mm ² {N/mm ² }
SUS 301-CSP	$\frac{1}{2}$ H	52 min. {510} min.	95 min. {932} min.	10 min.	—	—	—
	$\frac{3}{4}$ H	76 min. {745} min.	115 min. {1 128} min.	5 min.	—	—	—
	H	105 min. {1 030} min.	135 min. {1 324} min.	—	—	—	—
	EH	130 min. {1 275} min.	160 min. {1 569} min.	—	—	—	—
SUS 304-CSP	$\frac{1}{2}$ H	48 min. {471} min.	80 min. {785} min.	6 min.	—	—	—
	$\frac{3}{4}$ H	68 min. {667} min.	95 min. {932} min.	3 min.	—	—	—
	H	90 min. {883} min.	115 min. {1 128} min.	—	—	—	—
SUS 631-CSP	0	—	105 max. {1 030} max.	20 min.	TH1050 RH950	98 min. {961} min. 105 min. {1 030} min.	116 min. {1 138} min. 125 min. {1 226} min.
	$\frac{1}{2}$ H	—	110 min. {1 079} min.	5 min.	CH	90 min. {883} min.	125 min. {1 226} min.
	$\frac{3}{4}$ H	—	120 min. {1 177} min.	—	CH	110 min. {1 079} min.	145 min. {1 422} min.
	H	—	145 min. {1 422} min.	—	CH	135 min. {1 324} min.	175 min. {1 716} min.

Remark: The tensile test shall not be applied to the thickness under 0.30 mm.

Table 3-2. Tensile Strength, Proof Stress and Elongation

(Applicable on and after Jan. 1, 1991)

Designation of grade	Symbol of temper	As cold rolled or as solution-treated			As precipitation-hardened		
		Proof stress N/mm ²	Tensile strength N/mm ²	Elongation %	Symbol of heat treatment	Proof stress N/mm ²	Tensile strength N/mm ²
SUS 301-CSP	$\frac{1}{2}$ H	510 min.	930 min.	10 min.	—	—	—
	$\frac{3}{4}$ H	745 min.	1130 min.	5 min.	—	—	—
	H	1030 min.	1320 min.	—	—	—	—
	EH	1275 min.	1570 min.	—	—	—	—
SUS 304-CSP	$\frac{1}{2}$ H	470 min.	780 min.	6 min.	—	—	—
	$\frac{3}{4}$ H	665 min.	930 min.	3 min.	—	—	—
	H	880 min.	1130 min.	—	—	—	—
SUS 631-CSP	0	—	1030 max.	20 min.	TH1050 RH950	960 min. 1030 min.	1140 min. 1230 min.
	$\frac{1}{2}$ H	—	1080 min.	5 min.	CH	880 min.	1230 min.
	$\frac{3}{4}$ H	—	1180 min.	—	CH	1080 min.	1420 min.
	H	—	1420 min.	—	CH	1320 min.	1720 min.

Remark: The tensile test shall not be applied to the thickness under 0.30 mm.

4. Shape, Dimensions and Tolerances

4.1 Preferred Thickness The preferred thicknesses of the strips shall be as given in Table 4.

Table 4. Preferred Thicknesses

Unit: mm			
0.10	0.30	0.60	1.20
0.12	0.35	0.70	1.40
0.15	0.40	0.80	1.60
0.20	0.45	0.90	
0.25	0.50	1.00	
0.28	0.55	1.10	

4.2 Thickness Tolerances The thickness tolerances for the strips shall be as specified in Table 5. The purchaser should specify the thickness tolerances (symbol ET), if necessary.

The thickness shall be measured at any point not less than 10 mm from a side edge. The purchaser, however, may specify the measuring point.

Table 5. Thickness Tolerances

Unit: mm

Thickness \ Width	Thickness tolerance		Thickness tolerance (Symbol ET)	
	Up to 160	160 and over, up to 250	Up to 80	80 and over, up to 250
0.10 and over, up to and incl. 0.16	± 0.015	± 0.020	± 0.008	± 0.008
Over 0.16, up to and incl. 0.25	± 0.020	± 0.025	± 0.010	± 0.015
Over 0.25, up to and incl. 0.40	± 0.025	± 0.030	± 0.015	± 0.020
Over 0.40, up to and incl. 0.60	± 0.030	± 0.040	± 0.020	± 0.025
Over 0.60, up to and incl. 0.80	± 0.040	± 0.040	± 0.025	± 0.030
Over 0.80, up to and incl. 1.00	± 0.040	± 0.050	± 0.030	± 0.035
Over 1.00, up to and incl. 1.25	± 0.050	± 0.050	± 0.035	± 0.040
Over 1.25, up to and incl. 1.60	± 0.050	± 0.060	± 0.040	± 0.045

4.3 Width Tolerances

The width tolerances of the strips shall be as specified in Table 6.

Table 6. Width Tolerances

Unit: mm

Thickness \ Width	Width tolerance		
	Up to 80	80 and over, up to 160	160 and over, up to 250
Up to and incl. 0.60	± 0.10	± 0.15	± 0.20
Over 0.60, up to and incl. 1.00	± 0.15	± 0.20	± 0.25
Over 1.00, up to and incl. 1.60	± 0.20	± 0.20	± 0.30

4.4 Camber The permissible maximum value of camber for the strips shall be as specified in Table 7. However, the camber tolerances not exceeding 0.5 time the figures in Table 7 may be specified by agreement between the parties concerned.

Table 7. Permissible Maximum Value of Camber

Unit: mm

Width	Maximum value of camber in any length of 1 m
10 and over, up to 20	8
20 and over, up to 40	6
40 and over, up to 80	3
80 and over	1

Remark: The figures in Table 7 shall be applied to the strips having the ratio $\left(\frac{W}{T}\right)$ of 10 or over with (W) and (T) defined as the width and the thickness, respectively.

4.5 Flatness For the strips of the thickness tolerances with the symbol ET, the permissible maximum value of flatness (S) transverse to the rolling direction shall be calculated as follows:

$$\text{Maximum value (mm) of flatness } (S) = \frac{\text{Width}}{55} \times 0.2$$

The calculated value shall be rounded off to two places of decimals.

5. Appearance

The strips shall be free from defects that are detrimental to practical use.

6. Material

The materials for the strips shall be as specified in JIS G 4306.

7. Manufacturing Process

The strips shall be manufactured by cold rolling. After cold rolling, SUS 420J2-CSP shall be annealed and SUS 631-CSP-0 solution treated.

8. Tests

8.1 Mechanical Test

8.1.1 General General matters of the mechanical tests shall be as specified in JIS G 0303.

8.1.2 Method of Sampling Test Specimens Take one test specimen from each lot of the same heat, temper and thickness.

8.1.3 Number of Test Pieces Take one test piece from each one test specimen.

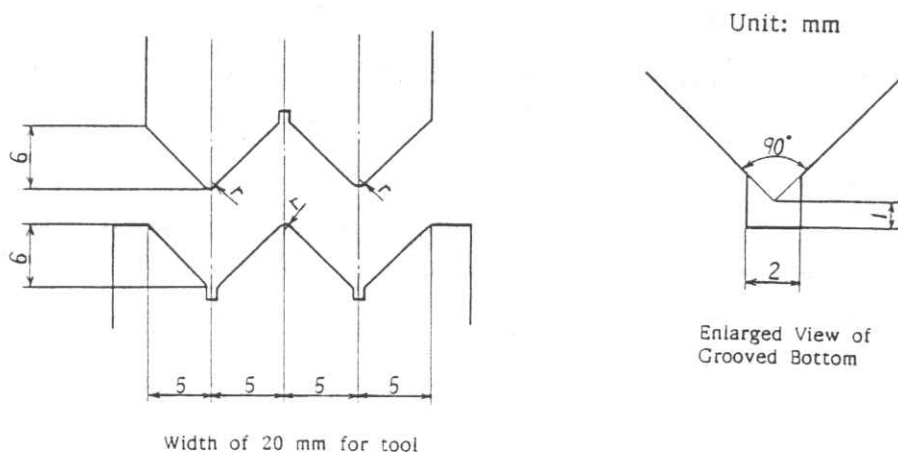
8.1.4 Test Piece The hardness test piece, bend test piece and tensile test piece shall be as follows:

- (1) A portion of a bend or tensile test piece may serve as a hardness test piece.
- (2) A bend test piece shall be No. 4 test piece specified in JIS Z 2204, and shall be taken so its longitudinal axis is at right angles to the rolling direction of strip.
- (3) Either No. 13 B or No. 14 B test piece specified in JIS Z 2201 taken in the longitudinal direction of the strip shall serve as a tensile test piece.

8.1.5 Test Methods The methods of hardness test, bend test and tensile test shall be as follows:

- (1) The hardness test method shall be as specified in JIS Z 2244. However, the standard test temperature shall be at $20 \pm 5^\circ\text{C}$.
- (2) The V-bend test shall be in accordance with the V block test method specified in JIS Z 2248. However, this test shall not be applied to the strips under 30 mm in width or over 1.0 mm in thickness.
- (3) In the W-bend test, the strips shall be bent to the specified shape using the bending tool shown in Fig. 1. However, this test shall not be applied to the strips under 30 mm in width or over 0.8 mm in thickness.

Fig. 1. W Bending Tool

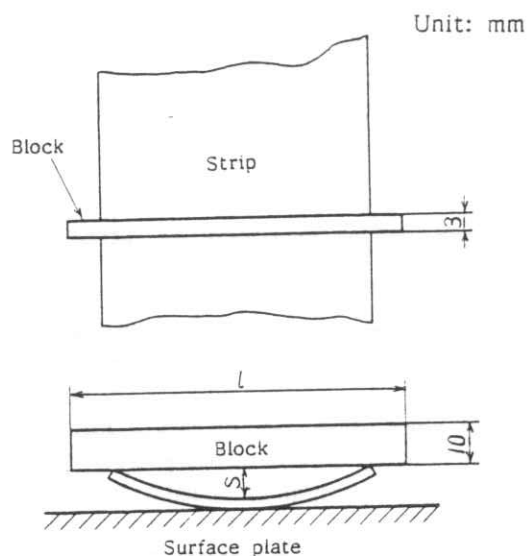


- (4) The tensile test method shall be as specified in JIS Z 2241. However, the standard test temperature shall be $20 \pm 5^\circ\text{C}$, and in measuring the tensile strength, the tensile speed shall be such that the increment of strain in the parallel part of the test piece is 40 to 80 % per min.

8.2 Flatness Test In the flatness test of strips, place a strip cut in proper length on the surface plate as shown in Fig. 2 and measure the gap "S" between the middle of the strip and the steel block with a thickness gauge or a wire gauge.

The length (L) of the steel block shall be 75 mm for the strips narrower than 70 mm, and 110 mm for 70 mm or wider. However, for the strips over 100 mm in width, this test shall not be applied.

Fig. 2. Flatness Test Method



9. Inspection

The inspection shall be as follows:

- (1) General matters of inspection shall be as specified in JIS G 0303.
- (2) The test results of mechanical properties, shape, dimensions and appearance shall conform to the requirements specified in 3., 4. and 5.

10. Marking

The strips having passed the inspection shall be legibly marked with the following items on each package by suitable means. When approved by the purchaser, part of the items may be omitted:

- (1) Designation of grade
- (2) Symbol of temper
- (3) Symbol of heat treatment (for precipitation hardening)
- (4) Dimension
- (5) Manufacture number or inspection number

(6) Manufacturer's name or identifying brand

Further, the strips with the thickness tolerance symbol ET shall be so indicated clearly.

11. Report

The manufacturer shall submit to the purchaser a report of the strips on the results of the tests specified or indicated and, as required, a report on dimensions, quantity and delivery condition.

Informative Reference 1. The chemical composition of the strips specified in JIS G 4306 are shown in Reference Tables 1 to 3.

Reference Table 1. Chemical Composition of Austenitic Strip

Unit: %

Designation of grade	C	Si	Mn	P	S	Ni	Cr	Others
SUS 301	0.15 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	6.00 to 8.00	16.00 to 18.00	-
SUS 304	0.08 max.	1.00 max.	2.00 max.	0.045 max.	0.030 max.	8.00 to 10.50	18.00 to 20.00	-

Reference Table 2. Chemical Composition of Martensitic Strip

Unit: %

Designation of grade	C	Si	Mn	P	S	Cr
SUS 420J2	0.26 to 0.40	1.00 max.	1.00 max.	0.040 max.	0.030 max.	12.00 to 14.00

Remark: Within 0.60 % of Ni may be contained.

Reference Table 3. Chemical Composition of Precipitation Hardening Strip

Unit: %

Designation of grade	C	Si	Mn	P	S	Ni	Cr	Al
SUS 631	0.09 max.	1.00 max.	1.00 max.	0.040 max.	0.030 max.	6.50 to 7.75	16.00 to 18.00	0.75 to 1.50

Informative Reference 2. Preferred Width It is recommended that the purchaser of strips should use the preferred width given in Reference Table 4.

Reference Table 4. Preferred Width

Unit: mm

10	20	40	80	160
13	25	50	100	200
16	32	63	125	250

Informative Reference 3. Threshold Value of Spring The purchaser who specifies the thickness tolerance of symbol ET may require the measurement and the report of the threshold value of spring obtained by repeated deflection test. The approximate values thereof are as shown in Reference Table 5-1 or Reference Table 5-2.

Reference Table 5-1. Threshold Value of Spring

(Values for reference till the end of 1990)

Unit: kgf/mm² {N/mm²}

Designation of grade	Symbol of temper	As cold rolled	As precipitation hardened
SUS 301-CSP	$\frac{1}{2}$ H	32 min. {314} min.	—
	$\frac{3}{4}$ H	40 min. {392} min.	—
	H	50 min. {490} min.	—
	EH	60 min. {588} min.	—
SUS 304-CSP	$\frac{1}{2}$ H	28 min. {275} min.	—
	$\frac{3}{4}$ H	34 min. {333} min.	—
	H	40 min. {392} min.	—
SUS 631-CSP	0	—	65 min. {637} min.
	$\frac{1}{2}$ H	—	65 min. {637} min.
	$\frac{3}{4}$ H	—	85 min. {834} min.
	H	—	100 min. {980.7} min.

Remark: The repeated deflection testing method shall be as specified in JIS H 3130. The deflection factor shall be 17000 kgf/mm² {166713 N/mm²} for SUS 301-CSP and SUS 304-CSP, and 19000 kgf/mm² {186326 N/mm²} for SUS 631-CSP.

Reference Table 5-2. Threshold Value of Spring
(Values for reference on and after Jan. 1, 1991)

Unit: N/mm²

Designation of grade	Symbol of temper	As cold rolled	As precipitation hardened
SUS 301-CSP	$\frac{1}{2}$ H	315 min.	—
	$\frac{3}{4}$ H	390 min.	—
	H	490 min.	—
	EH	590 min.	—
SUS 304-CSP	$\frac{1}{2}$ H	275 min.	—
	$\frac{3}{4}$ H	335 min.	—
	H	390 min.	—
SUS 631-CSP	0	—	635 min.
	$\frac{1}{2}$ H	—	635 min.
	$\frac{3}{4}$ H	—	835 min.
	H	—	980 min.

Remark: The repeated deflection testing method shall be as specified in JIS H 3130. The deflection factor shall be 167000 N/mm² for SUS 301-CSP and SUS 304-CSP, and 186000 N/mm² for SUS 631-CSP.

Informative Reference 4. The relations between the condition of heat treatment and the resulting hardness for SUS 420J2-CSP are approximately as shown in Reference Table 6.

Reference Table 6. Relation between Condition of Heat Treatment and Resulting Hardness

Heat treatment °C		Hardness HV
Quenching	Tempering	
900	300 to 400	410 to 460
950	300 to 400	460 to 510
1000	300 to 400	490 to 540
1050	300 to 400	510 to 570

Applicable Standards:

- JIS G 0303-General Rules for Inspection of Steel
- JIS G 4306-Hot Rolled Stainless Steel Strip
- JIS Z 2201-Test Pieces for Tensile Test for Metallic Materials
- JIS Z 2204-Bend Test Pieces for Metallic Materials
- JIS Z 2241-Method of Tensile Test for Metallic Materials
- JIS Z 2244-Method of Vickers Hardness Test
- JIS Z 2248-Method of Bend Test for Metallic Materials

Reference Standard:

- JIS H 3130-Copper Beryllium Alloy, Phosphor Bronze and Nickel Silver-Sheets,
Plates and Strips for Springs

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