

Carbon Steel Wires for Cold Heading and Cold Forging

1. Scope

This Japanese Industrial Standard specifies carbon steel wires for cold heading and cold forging, hereinafter referred to as the "wires", used for bolts, nuts, rivets, machine tapping screws etc. and various parts made by cold heading and cold forging.

2. Class and Symbol

The classes of wires shall be classified into 6 classes of rimmed steels, 10 classes of aluminum-killed steels and 21 classes of killed steels and their symbols shall conform to Table 1 and Table 2.

3. Materials

The wire rods used for wires shall conform to JIS G 3507.

4. Manufacturing Method

4.1 The wires shall be manufactured in accordance with process-D or process-DA.

Provided that, the wires may be manufactured in accordance with other methods than above mentioned by agreement between the purchaser and the manufacturer.

Process-D : Process-D is to finish the wire rod by means of cold drawing.

Process-DA: Process-DA is as follows. After cold drawn, the wire rod is annealed and then it shall be finished by cold drawing.

4.2 The class of surface coating of wire may be designated by the purchaser.

5. Mechanical Properties

The mechanical properties of the wires manufactured by process-D and process-DA shall conform to Table 1 for process-D and Table 2 for process-DA.

Provided that, as for the wires manufactured by the other method than above mentioned, shall be determined by agreement between the purchaser and the manufacturer.

Table 1. Mechanical Properties

Symbol	Classified by diameter mm
SWCH 6R	3 and under
SWCH 8R	Over 3 to 4 incl.
SWCH 10R	Over 4 to 5 incl.
SWCH 6A	Over 5
SWCH 8A	
SWCH 10A	
SWCH 12R	3 and under
SWCH 15R	Over 3 to 4 incl.
SWCH 12A	Over 4 to 5 incl.
SWCH 15A	Over 5
SWCH 10K	
SWCH 12K	
SWCH 17R	3 and under
SWCH 16A	Over 3 to 4 incl.
SWCH 18A	Over 4 to 5 incl.
SWCH 20A	Over 5
SWCH 15K	
SWCH 19A	
SWCH 16K	3 to 4 incl.
SWCH 17K	Over 4 to 5 incl.
SWCH 18K	Over 5 to 30 incl.
SWCH 20K	
SWCH 22A	3 to 4 incl.
SWCH 22K	Over 4 to 5 incl.
SWCH 25K	Over 5

Note (1) The gauge length is 50 mm. Where D is the diameter of the wire.

Remark: In this Standard, 1 N/mm² = 1 kgf/cm².

Table 1. Mechanical Properties of Wires Manufactured by Process-D

Symbol of class	Classified by diameter mm	Tensile strength kgf/mm ² (N/mm ²)	Drawing %	Reference	
				Elongation (%) ⁽¹⁾	Hardness H _{RB}
SWCH 6R	3 and under	55 min. (539 min.)	45 min.	—	—
SWCH 8R					
SWCH 10R					
SWCH 6A					
SWCH 8A	Over 3 to 4 incl.	45 min. (441 min.)	45 min.	—	—
SWCH 10A	Over 4 to 5 incl.	40 min. (392 min.)	45 min.	—	—
SWCH 12R	Over 5	35 min. (343 min.)	45 min.	11 min.	85 max.
SWCH 12R	3 and under	60 min. (588 min.)	45 min.	—	—
SWCH 15R					
SWCH 12A					
SWCH 15A					
SWCH 10K	Over 3 to 4 incl.	50 min. (490 min.)	45 min.	—	—
SWCH 12K	Over 4 to 5 incl.	42 min. (412 min.)	45 min.	—	—
SWCH 17R	Over 5	37 min. (363 min.)	45 min.	10 min.	90 max.
SWCH 17R	3 and under	70 min. (686 min.)	45 min.	—	—
SWCH 16A					
SWCH 18A					
SWCH 20A					
SWCH 15K	Over 3 to 4 incl.	60 min. (588 min.)	45 min.	—	—
SWCH 19A	Over 4 to 5 incl.	50 min. (490 min.)	45 min.	—	—
SWCH 16K	Over 5	42 min. (412 min.)	45 min.	8 min.	92 max.
SWCH 17K	3 to 4 incl.	65 min. (637 min.)	45 min.	—	—
SWCH 18K					
SWCH 20K					
SWCH 22A					
SWCH 16K	Over 4 to 5 incl.	55 min. (539 min.)	45 min.	—	—
SWCH 17K	Over 5 to 30 incl.	45 min. (441 min.)	45 min.	7 min.	95 max.
SWCH 22A	3 to 4 incl.	70 min. (686 min.)	45 min.	—	—
SWCH 22K					
SWCH 25K					
SWCH 22K	Over 4 to 5 incl.	58 min. (569 min.)	45 min.	—	—
SWCH 25K	Over 5	48 min. (471 min.)	45 min.	6 min.	98 max.

Note ⁽¹⁾ The gauge length of the tension test piece shall be 5D.
Where D is the diameter.

Remark: In this Standard, the particulars in () are in accordance with the International System of Units (SI) and given for reference only, where 1 N/mm² = 1 MPa.

Table 2. Mechanical Properties of Wires Manufactured by Process-DA

Symbol of class	Tensile strength kgf/mm ² (N/mm ²)	Drawing %	Reference	
			Elongation (¹) %	Hardness H _R B
SWCH 6R SWCH 8R SWCH 10R SWCH 6A SWCH 8A SWCH 10A	30 min. (294) min.	55 min.	15 min.	80 max.
SWCH 12R SWCH 15R SWCH 12A SWCH 15A SWCH 10K SWCH 12K	35 min. (343) min.	55 min.	14 min.	83 max.
SWCH 17R SWCH 16A SWCH 18A SWCH 20A SWCH 15K	38 min. (373) min.	55 min.	13 min.	85 max.
SWCH 19A SWCH 16K SWCH 17K SWCH 18K SWCH 20K	42 min. (412) min.	55 min.	13 min.	86 max.
SWCH 22A SWCH 22K SWCH 25K	45 min. (441) min.	55 min.	12 min.	88 max.
SWCH 24K SWCH 27K	48 min. (471) min.	55 min.	12 min.	92 max.
SWCH 30K SWCH 33K SWCH 35K	63 max. (618) max.	55 min.	12 min.	92 max.
SWCH 38K SWCH 40K SWCH 43K	68 max. (667) max.	55 min.	11 min.	94 max.
SWCH 41K SWCH 45K SWCH 48K SWCH 50K	72 max. (706) max.	55 min.	10 min.	97 max.

Note (¹) The gauge length of the tension test piece shall be 5D.
Where, D is the diameter.

Remark: Concerning the wires of low carbon steel of SWCH 27 or less, and used for the parts to be heat treated, the upper limit of tensile strength may be determined lower value than above mentioned by agreement between the parties concerned.

6. Decarburized Depth

Concerning the wires of SWCH decarburized depth is designated by

Table 3. Limit

Diameter of wire	Ferr
8 and under	
Over 8 to 14 incl.	
Over 14 to 20 incl.	
Over 20	

7. Globular Structure

Concerning wires manufactured by the purchaser, the grade of globular structure shall be designated by the purchaser and the manufacturer. In this case, the grade of globular structure shall be designated by Photograph No. 1 to No. 6.

8. Appearance and Surface Flaw

The surface of wires shall be free from rust, and on cold heading and cold drawing.

9. Dimensions and Tolerance

The tolerance on diameter and diameter tolerance

Table 4. Tolerance

Diameter of wire	Grade of tolerance
3 and under	
Over 3 to 6 incl.	
Over 6 to 10 incl.	
Over 10 to 18 incl.	
Over 18 to 30 incl.	
Over 30	

f Wires Manufactured by Process-DA

Drawing %	Reference	
	Elongation (1) %	Hardness H _{RB}
min.	15 min.	80 max.
min.	14 min.	83 max.
min.	13 min.	85 max.
min.	13 min.	86 max.
min.	12 min.	88 max.
min.	12 min.	92 max.
min.	12 min.	92 max.
min.	11 min.	94 max.
min.	10 min.	97 max.

on test piece shall be 5D.

carbon steel of SWCH 27 or less, and
treated, the upper limit of tensile
lower value than above mentioned by
res concerned.

Decarburized Depth

Concerning the wires of SWCH 30K to SWCH 50K, when the limit of tolerance on the mean decarburized depth is designated by the purchaser, it shall conform to Table 3.

Table 3. Limit of Tolerance on Mean Decarburized Depth

Unit: mm

Diameter of wire	Ferrite decarburized depth	Total decarburized depth
8 and under	0.03 max.	0.12 max.
Over 8 to 14 incl.	0.04 max.	0.15 max.
Over 14 to 20 incl.	0.05 max.	0.20 max.
Over 20	0.06 max.	0.25 max.

7. Globular Structure

Concerning wires manufactured by process-DA, when the globular annealing is designated by the purchaser, the grade of globular structure shall be determined by agreement between the purchaser and the manufacturer.

In this case, the grade of globular structure on SWCH 30K to SWCH 50K shall conform to Photograph No. 1 to No. 6.

8. Appearance and Surface Flaw

The surface of wires shall be free from harmful defects such as remarkable scale, flaw and rust, and on cold heading and cold forging the wires, shall be free from harmful surface flaw.

9. Dimensions and Tolerance

The tolerance on diameter and deviation of diameter shall conform to Table 4.

Table 4. Tolerance on Diameter and Deviation of Diameter

Unit: mm

Grade of tolerance Diameter of wire	Grade 9 (h 9)		Grade 10 (h 10)	
	Tolerance	Deviation of diameter	Tolerance	Deviation of diameter
3 and under	0 -0.025	0.013 max.	0 -0.040	0.020 max.
Over 3 to 6 incl.	0 -0.030	0.015 max.	0 -0.048	0.024 max.
Over 6 to 10 incl.	0 -0.036	0.018 max.	0 -0.058	0.029 max.
Over 10 to 18 incl.	0 -0.043	0.022 max.	0 -0.070	0.035 max.
Over 18 to 30 incl.	0 -0.052	0.026 max.	0 -0.084	0.042 max.
Over 30	0 -0.062	0.031 max.	0 -0.100	0.050 max.

- Remarks 1. The deviation of diameter shall mean the difference between the maximum and the minimum of diameters on the same section of the wire.
2. The particulars in brackets shall conform to JIS B 0401.

10. Test

10.1 Tension Test The method of tension test shall conform to the provisions specified in JIS Z 2241.

10.2 Detection of Decarburization The testing method shall conform to measuring method with microscope of 3.2 in JIS G 0558. In this case, the mean decarburized depth of wire section shall be obtained as follows. By setting the part of maximum carburized depth as basis, 4 points equally divided on the circumference shall be measured and averaged.

10.3 Globular Structure Test The surface under test shall be investigated by a microscope of 400 magnification, and the grade of globular shall be classified into No. 1 to No. 6 by Photograph 1.

11. Inspection

11.1 Concerning mechanical properties, decarburized depth and globular structure, one test piece shall be taken from each per lot of the same heat, same dimensions and same heat treatment and shall conform to the provisions of 5, 6, and 7, by conducting the test specified in 10.

11.2 Appearance and Surface Flaw The appearance and surface flaw of the wires shall be inspected by naked eye and shall conform to the provisions of 8.

11.3 Tolerance on Diameter and Deviation of Diameter The diameter of the wires shall be measured with a micrometer specified in JIS B 7502, and shall conform to the provisions of 9.

12. Marking

Each coil of wire, passed the inspection shall clearly indicate the following items. Provided that, a part of marking may be omitted when the purchaser's agreements are obtained.

- (1) Symbol of class.
- (2) Mark of manufacturing method.
Process-D: D, Process-DA: DA
- (3) Diameter of wire and its grade of tolerance.
- (4) Mass of coil.
- (5) Manufacturing number or coil number.
- (6) Heat number or inspection number.
- (7) Year and month of manufacture.
- (8) Manufacturer's name or its mark.

13. Report

The manufacturer shall submit the report to the purchaser.

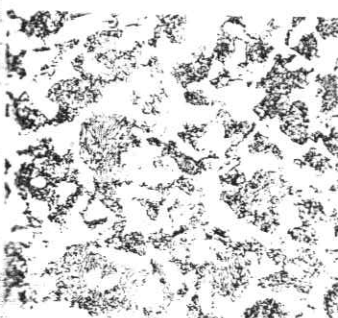
Photograph 1



No. 1



No. 3



No. 5

the difference between the maximum
the same section of the wire.
conform to JIS B 0401.

all conform to the provisions specified in

method shall conform to measuring method
the mean decarburized depth of wire
part of maximum carburized depth as
shall be measured and averaged.

test shall be investigated by a microscope
be classified into No. 1 to No. 6 by

red depth and globular structure, one test
the same dimensions and same heat
and 7. by conducting the test specified

and surface flaw of the wires shall be
ions of 8.

for The diameter of the wires shall be
and shall conform to the provisions of 9.

ely indicate the following items.
the purchaser's agreements are

Report

The manufacturer shall submit the report of specified items, when required by the
purchaser.

Photograph 1. Grade of Globular Structure

Magnification: $400 \left(\times \frac{3}{5} \right)$



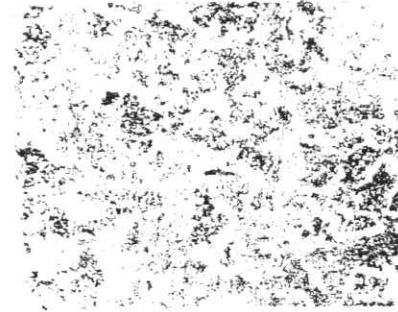
No. 1



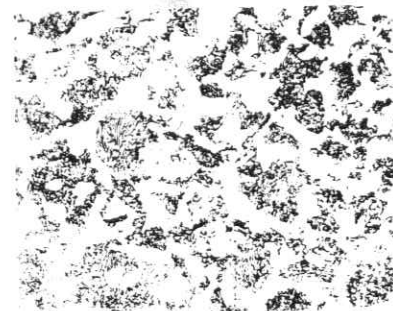
No. 2



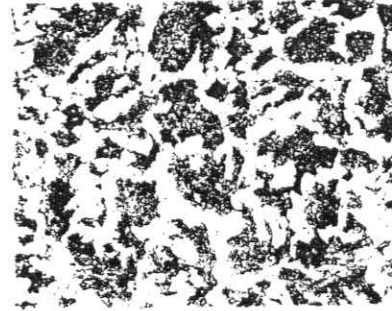
No. 3



No. 4



No. 5



No. 6

Reference Chemical Composition of Carbon Steel Wire Rods for Cold Heading and Cold Forging (by Ladle Analysis)

Symbol of class	Chemical composition %					
	C	Si	Mn	P	S	Al
SWRCH 6R	0.08 max.	-	0.60 max.	0.040 max.	0.040 max.	-
SWRCH 8R	0.10 max.	-	0.60 max.	0.040 max.	0.040 max.	-
SWRCH 10R	0.08 to 0.13	-	0.30 to 0.60	0.040 max.	0.040 max.	-
SWRCH 12R	0.10 to 0.15	-	0.30 to 0.60	0.040 max.	0.040 max.	-
SWRCH 15R	0.13 to 0.18	-	0.30 to 0.60	0.040 max.	0.040 max.	-
SWRCH 17R	0.15 to 0.20	-	0.30 to 0.60	0.040 max.	0.040 max.	-
SWRCH 6A	0.08 max.	0.10 max.	0.60 max.	0.030 max.	0.035 max.	0.02 min.
SWRCH 8A	0.10 max.	0.10 max.	0.60 max.	0.030 max.	0.035 max.	0.02 min.
SWRCH 10A	0.08 to 0.13	0.10 max.	0.30 to 0.60	0.030 max.	0.035 max.	0.02 min.
SWRCH 12A	0.10 to 0.15	0.10 max.	0.30 to 0.60	0.030 max.	0.035 max.	0.02 min.
SWRCH 15A	0.13 to 0.18	0.10 max.	0.30 to 0.60	0.030 max.	0.035 max.	0.02 min.
SWRCH 16A	0.13 to 0.18	0.10 max.	0.60 to 0.90	0.030 max.	0.035 max.	0.02 min.
SWRCH 18A	0.15 to 0.20	0.10 max.	0.60 to 0.90	0.030 max.	0.035 max.	0.02 min.
SWRCH 19A	0.15 to 0.20	0.10 max.	0.70 to 1.00	0.030 max.	0.035 max.	0.02 min.
SWRCH 20A	0.18 to 0.23	0.10 max.	0.30 to 0.60	0.030 max.	0.035 max.	0.02 min.
SWRCH 22A	0.18 to 0.23	0.10 max.	0.70 to 1.00	0.030 max.	0.035 max.	0.02 min.
SWRCH 10K	0.08 to 0.13	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 12K	0.10 to 0.15	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 15K	0.13 to 0.18	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 16K	0.13 to 0.18	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 17K	0.15 to 0.20	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 18K	0.15 to 0.20	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 20K	0.18 to 0.23	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 22K	0.18 to 0.23	0.10 to 0.35	0.70 to 1.00	0.030 max.	0.035 max.	-
SWRCH 24K	0.19 to 0.25	0.10 to 0.35	1.35 to 1.65	0.030 max.	0.035 max.	-
SWRCH 25K	0.22 to 0.28	0.10 to 0.35	0.30 to 0.60	0.030 max.	0.035 max.	-
SWRCH 27K	0.22 to 0.29	0.10 to 0.35	1.20 to 1.50	0.030 max.	0.035 max.	-
SWRCH 30K	0.27 to 0.33	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 33K	0.30 to 0.36	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 35K	0.32 to 0.38	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 38K	0.35 to 0.41	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 40K	0.37 to 0.43	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 41K	0.36 to 0.44	0.10 to 0.35	1.35 to 1.65	0.030 max.	0.035 max.	-
SWRCH 43K	0.40 to 0.46	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 45K	0.42 to 0.48	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 48K	0.45 to 0.51	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-
SWRCH 50K	0.47 to 0.53	0.10 to 0.35	0.60 to 0.90	0.030 max.	0.035 max.	-

Remark: In the symbol of class, the end letter shall mean as follows:
R: Rimmed steel
A: Alumikilled steel
K: Killed steel

Wire Ropes for

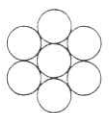
1. Scope

This Japanese Industrial Standard specifies wire ropes referred to as "Ropes", to be applied mainly for m

2. Classification

2.1 Classification by Construction Ropes shall be classified as shown in Table 1.

Table 1. Construction

Construction	7 wires strand	19
Rope Designation	1 x 7	
Cross section		

2.2 Classification by Lay Types of lay shall be classified as follows:
For ropes 1 x 7 and 1 x 19, lay direction shall, in general, be right lay for outer wires, and in the case of rope 1 x 19 the outer wires shall be laid to each other.
For ropes 7 x 7 and 7 x 19, lay type and direction shall be right lay and in the opposite directions to each other with t