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JIS G 3507-2 : 2005

(JWPA)

Carbon steels for cold heading — Part 2 : Wires

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Reference number : JIS G 3507-2 : 2005 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minster of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal of establishing a Japanese Industrial Standard from Japan Wire Products Association (JWPA), with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Consequently JIS 3539 :1991 is replaced with this Standard.

This Standard has been made based on ISO 4954:1993 *Steels for cold heading and cold extruding* for the purpose of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

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

JIS G 3507 consists of the following 2 parts under the general title "*Carbon steels for cold heading*":

Part 1 : Wire rods

Part 2 : Wires

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

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Carbon steels for cold heading—Part 2 : Wires

Introduction This Japanese Industrial Standard has been prepared based on the second edition of ISO 4954 *Steels for cold heading and cold extruding* published in 1993 with some modifications of the technical contents.

Portions given sidelines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in annex 1 (informative).

1 Scope This part of JIS G 3507 specifies the carbon steel wires for cold heading (hereinafter referred to as "wires") to be used for the manufacture of various types of screws such as bolts, nuts, rivets, machine screws and tapping screws and various parts by cold heading.

Remarks : The International Standard corresponding to this part of JIS G 3507 is as follows.

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

ISO 4954 :1993 *Steels for cold heading and cold extruding* (MOD)

2 Normative references The standards listed in attached table 1 contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including the amendments) shall be applied.

3 Symbol of grade The wires shall be classified into 6 grades for rimmed or equivalent steel, 11 grades for aluminium-killed steel and 21 grades for killed steel, and their symbols shall be as given in table 1.

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Table 1 Symbols of grade

Symbol of grade (1)	Processing methods (3)	Remarks	Symbol of grade (1)	Processing methods (3)	Remarks
SWCH6R	Process D : D	Rimmed or equivalent steel (2)	SWCH16K	Process D : D	Killed steel
SWCH8R	Process DA : DA		SWCH17K	Process DA : DA	
SWCH10R			SWCH18K		
SWCH12R			SWCH20K		
SWCH15R			SWCH22K		
SWCH17R			SWCH24K	Process DA : DA	
SWCH6A	Process D : D	Aluminium-killed steel	SWCH25K	Process D : D	
SWCH8A	Process DA : DA			Process DA : DA	
SWCH10A			SWCH27K	Process DA : DA	
SWCH12A			SWCH30K		
SWCH15A			SWCH33K		
SWCH16A			SWCH35K		
SWCH18A			SWCH38K		
SWCH19A			SWCH40K		
SWCH20A			SWCH41K		
SWCH22A			SWCH43K		
SWCH25A			SWCH45K		
SWCH10K		Killed steel	SWCH48K		
SWCH12K			SWCH50K		
SWCH15K					

Notes (1) The symbols of grade for wires are obtained by deleting the third letter R of the symbol of a grade in JIS G 3507-1 of the wire rod to be applied.

	Wire rod	Wire
Example :	SWRCH6R	SWCH6R

(2) Rimmed steel is included.

(3) The process D means a process wherein wire rods are finished by cold working. The process DA means a process wherein wire rods having been cold worked are annealed and further finished by cold working or a process wherein wire rods are finished by cold working after annealing.

4 Material The wire rods to be used for the manufacture of the wires shall conform to JIS G 3507-1.

5 Manufacturing method The manufacturing method shall be as follows:

a) The wire shall be manufactured by process D or DA. However, manufacturing processes other than given above may be selected by agreement between the purchaser and the supplier.

b) The type of coating over the wire surface may be specified by the purchaser.

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6 Mechanical properties Wires shall be tested in accordance with 10.2, and the tensile test and the contraction of area shall conform to table 2 in the case of process D and table 3 in the case of process DA. However, in the case by processes other than process D and process DA, they shall be subjected to the agreement between the purchaser and the supplier.

Table 2 Mechanical properties of wires manufactured by process D

Symbol of steel grade	Division of wire diameter mm	Tensile strength N/mm²	Reduction of area %	(Informative) Hardness HRB
SWCH6R SWCH8R SWCH10R SWCH6A SWCH8A SWCH10A	3 max.	540 min.	—	—
	Over 3 to and incl. 4	440 min.	45 min.	
	Over 4 to and incl. 5	390 min.		
	Over 5	340 min.		85 max.
SWCH12R SWCH15R SWCH12A SWCH15A SWCH10K SWCH12K	3 max.	590 min.	—	—
	Over 3 to and incl. 4	490 min.	45 min.	
	Over 4 to and incl. 5	410 min.		
	Over 5	360 min.		90 max.
SWCH17R SWCH16A SWCH18A SWCH20A SWCH15K	3 max.	690 min.	—	—
	Over 3 to and incl. 4	590 min.	45 min.	
	Over 4 to and incl. 5	490 min.		
	Over 5	410 min.		92 max.
SWCH19A SWCH16K SWCH17K SWCH18K SWCH20K	3 or over to and incl. 4	640 min.		—
	Over 4 to and incl. 5	540 min.		
	Over 5 to and incl. 30	440 min.		95 max.
SWCH22A SWCH22K SWCH25A SWCH25K	3 or over to and incl. 4	690 min.		
	Over 4 to and incl. 5	570 min.		
	Over 5	470 min.		98 max.

Remarks 1 For wires of 20 mm or over in wire diameter, the reduction of area shall be a value 5 lower than the value in table 2. For those of diameter 3 mm or less, the reduction of area is not specified.

2 1 N/mm² = 1 MPa

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Table 3 Mechanical properties of wires manufactured by process DA

Symbol of steel grade	Tensile strength N/mm²	Reduction of area %	(Informative) Hardness HRB
SWCH6R SWCH8R SWCH10R SWCH6A SWCH8A SWCH10A	290 min.	55 min.	80 max.
SWCH12R SWCH15R SWCH12A SWCH15A SWCH10K SWCH12K	340 min.		83 max.
SWCH17R SWCH16A SWCH18A SWCH20A SWCH15K	370 min.		85 max.
SWCH19A SWCH16K SWCH17K SWCH18K SWCH20K	410 min.		86 max.
SWCH22A SWCH22K SWCH25A SWCH25K	440 min.		88 max.
SWCH24K SWCH27K	470 min.		92 max.
SWCH30K SWCH33K SWCH35K	620 max.		
SWCH38K SWCH40K SWCH43K	670 max.		94 max.
SWCH41K SWCH45K SWCH48K SWCH50K	710 max.		97 max.

Remarks 1 For the low carbon steel wires given as SWCH 6R to SWCH 27K to be used for the products which are to be heat-treated, the lower limit of the tensile strength may be settled for lower values than that given in table 3 by the agreement between the purchaser and the supplier.

2 For wires of 20 mm or over in wire diameter, the reduction of area shall be a value 5 lower than the value in table 3. For those of diameter 3 mm or less, the reduction of area is not specified.

3 1 N/mm² = 1MPa

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7 Metallographic structure

7.1 Depth of decarburized layer If specified by the purchaser, the wires of SWCH 30K to SWCH 50K shall be tested in accordance with 10.3.1, and the permissible limits of mean depth of decarburized layer shall be as specified in table 4. However, those of wires of 32 mm or over in wire diameter shall be as agreed upon between the purchaser and the supplier.

Table 4 Permissible limits of mean depth of decarburized layer

Unit : mm

Wire diameter	Depth of ferrite decarburized layer	Total depth of decarburized layer
15 or under	0.02 max.	0.15 max.
Over 15 to and incl. 25	0.03 max.	0.20 max.
Over 25 to and incl. 32	0.04 max.	0.25 max.

7.2 Spheroidized structure If specified by the purchaser, the wires produced by process DA shall be tested in accordance with 10.3.2, and the grade of spheroidized structure shall be as agreed upon by the purchaser and the supplier. In this case, the grades of the spheroidized structure of SWCH 30K to SWCH 50K shall be based on photo plates No. 1 to No. 4 in attached figure 1.

8 Tolerances on wire diameters and ovality

Wire diameters shall be measured in accordance with 10.4, and tolerances on wire diameter and ovality (4) shall be as specified in table 5.

Note (4) The ovality means the difference between the maximum and the minimum wire diameters measured in the same cross-section.

Table 5 Tolerances on wire diameter and ovality

Unit : mm

Wire diameter	Tolerances	Ovality
3 max.	0 −0.025	0.013 max.
Over 3 to and incl. 6	0 −0.030	0.015 max.
Over 6 to and incl. 10	0 −0.036	0.018 max.
Over 10 to and incl. 18	0 −0.043	0.022 max.
Over 18 to and incl. 30	0 −0.070	0.035 max.
Over 30 to and incl. 40	0 −0.100	0.050 max.
Over 40 to and incl. 50	0 −0.150	0.070 max.

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9 Appearance and surface flaw The appearance and surface flaws of wires shall conform to the following a) and b):

a) The surface of wires shall be free from detrimental scale flow, rust or the like and shall be free from flaws detrimental to use excepting those allowed in b).

b) The surface flaws of wires shall be tested in accordance with 10.5. The depth of flaws shall conform to table 6 for killed steel (including aluminum-killed steel). However, in the case where a flaw depth in necessitated to be especially controlled, they shall conform to table 7 subject to the agreement between the purchaser and the supplier. When the flaw depth is especially requested to be controlled for 15 mm max. in wire diameter of rimmed corresponding steel (including rimmed steel) the surface flaw of wires may conform to table 8 as agreed upon between the purchaser and the supplier.

Table 6 Surface flaw depth of killed steel

Unit : mm

Wire diameter	Flaw depth
50 max.	0.10 max.

Table 7 Surface flaw depth of killed steel (when especially controlled)

Unit : mm

Wire diameter	Flaw depth
15 max.	0.05 max.
Over 15 to and incl. 25	0.07 max.

Table 8 Surface flaw depth of rimmed or equivalent steel (when especially controlled)

Unit : mm

Wire diameter	Flaw depth
15 max.	0.15 max.

10 Tests

10.1 Test piece Each one of the test pieces for mechanical properties, decarburized layer depth, spheroidized structure and surface flaw depth tests shall be taken from the same cast steel respectively, and be the same size, and have the same heat treatment.

10.2 Tensile test A tensile test shall be in accordance with JIS Z 2241. For the tensile test, f) No. 9 test specimen in 5.1 (shape and dimensions of test piece) of JIS Z 2201

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shall be used.

Further, whether test piece of No. 9A or No. 9B is selected from among No.9 test pieces, it shall be subjected to the agreement between the purchaser and the supplier.

10.3 Metallographic test

10.3.1 Decarburized layer depth measuring test The decarburized layer depth measuring test shall be in accordance with 4.1. (measuring method with microscope) of JIS G 0558. In that case, the carburized layer depth measured at four positions by equally dividing the circumference adopting the position of the maximum decarburized layer depth as an origin, and the mean value thereof shall be obtained.

10.3.2 Spheroidal structure test For a spheroidal structure test, a surface to be detected is observed with a microscope with 400 magnifications, and the degree of spheroidizing is classified into No. 1 to No. 4 in accordance with attached figure 1.

10.4 Measurement of wire diameter For measurement of a wire diameter, the maximum diameter and the minimum diameter of the same section at an arbitrary position is measured with micrometer callipers as specified in JIS B 7502.

10.5 Detection test for surface flaw The method for detecting flaws shall be carried out by a suitable method such as magnetic particle testing and acid cleaning. The sample product shall be measured for surface flaw depth with a measuring device having an appropriate precision.

11 Inspection The inspection shall be as follows:

(a) General matters for inspection shall be in accordance with JIS G 0404.

(b) Mechanical properties shall be tested in accordance with 10.2 and conform to the requirements specified in clause 6.

(c) The decarburized layer depth, when specified by the purchaser, shall be tested in accordance with 10.3.1 and conform to the requirements specified in 7.1.

(d) The spheroidal structure, when specified by the purchaser, shall be tested in accordance with 10.3.2 and conform to the requirements specified in 7.2.

(e) The wire diameter shall be measured in accordance with 10.4 and conform to the requirements specified in clause 8.

(f) The surface flaws shall be tested in accordance with 10.5 and conform to the requirements specified in clause 9.

12 Marking The wires which have passed the inspection shall be clearly marked with the following particulars on each coil by suitable means. Some of the items below, however, may be omitted, if agreed between the purchaser and the supplier.

(a) Symbol of grade

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(b) Symbol of manufacturing process, with D for process D and DA for process DA

(c) Wire diameter

(d) Mass of coil

(e) Heat number

(f) Manufacture number, inspection number or coil number

(g) Year and month of manufacture

(h) Manufacturer's name or its identifying brand

13 Report The report shall conform to clause 13, (report) in JIS G 0404. When requested by the purchaser, the class of an inspection document shall be symbol 2.3 (acceptance test report) or 3.1.B (inspection certificate 3.1.B) in table 1 (summary table of inspection document) in JIS G 0415.

Attached Table 1 Normative references

JIS B 7502	*Micrometer callipers*
JIS G 0404	*Steel and steel products—General technical delivery requirements*
JIS G 0415	*Steel and steel products—Inspection documents*
JIS G 0558	*Methods of measuring decarburized depth for steel*
JIS G 3507-1	*Carbon steels for cold heading—Part 1 : Wire rods*
JIS Z 2201	*Test pieces for tensile test for metallic materials*
JIS Z 2241	*Method of tensile test for metallic materials*

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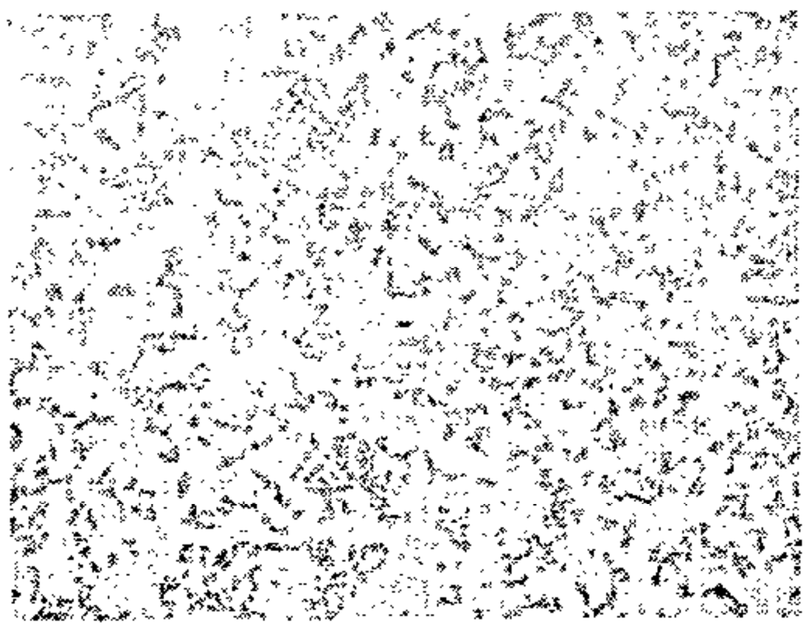
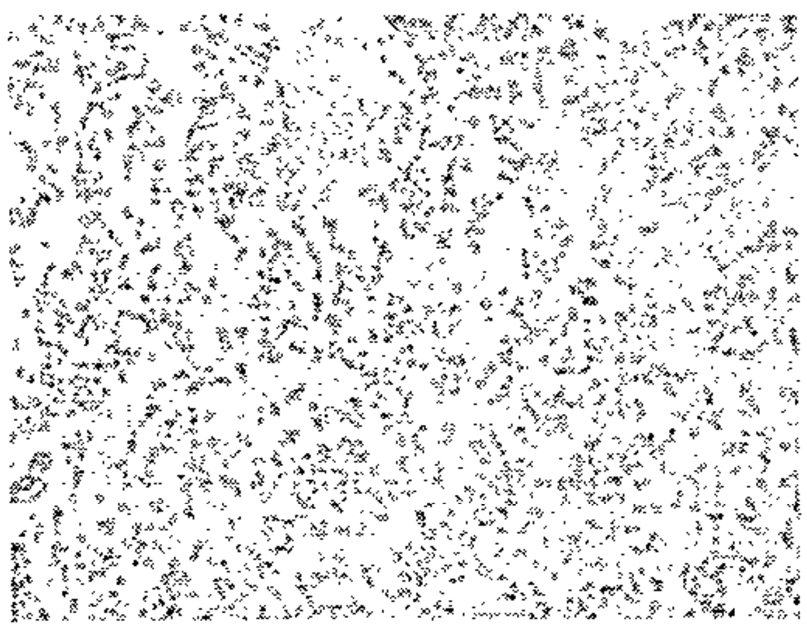
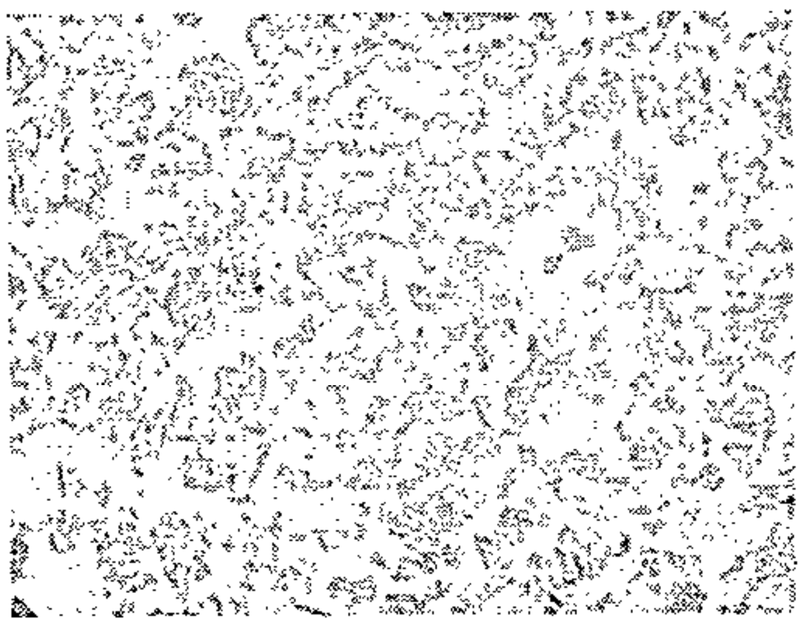
No.1



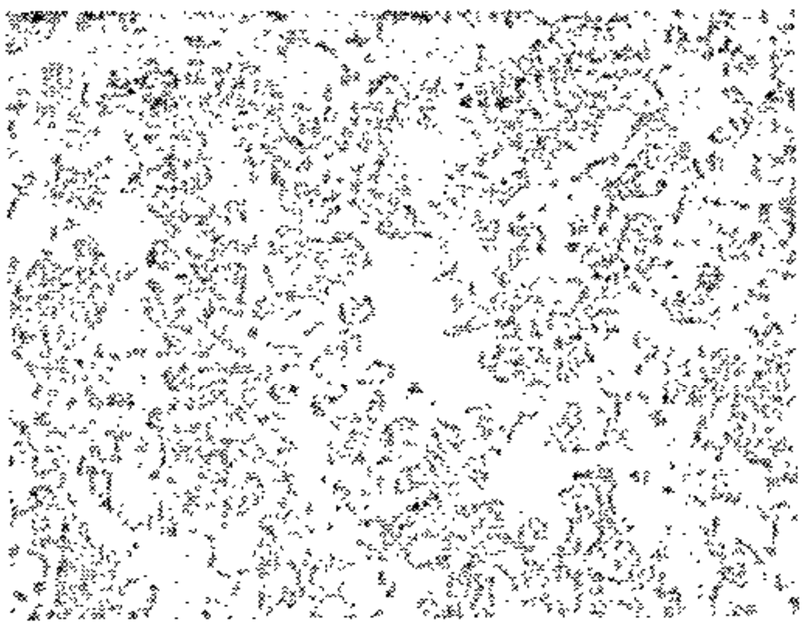
No.2



No.3



No.4



Attached Figure 1　Grade of spheroidized structure

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

JIS G 3507-2 : 2005 *Carbon steels for cold heading—Part 2: Wires*					ISO 4954: 1993 *Steels for cold heading and cold extruding*		
(I) Requirements in JIS		(II) International Standard number	(III) Content specified in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: text Indication method: continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Content of technical deviation	
1. Scope	When screws and various parts are manufactured by cold heading, carbon steel wires for cold heading to be used, are specified.	ISO 4945	1.1	Wire rods, wires and steel bars of carbon steel and alloyed steel to be used for cold heading, are specified. Constitution of the standard shall be as follows: S-1 General requirements S-2 Steels not intended for heat treatment S-3 Case-hardening steels S-4 *Steels for quenching* and tempering S-5 Stainless steels	MOD/deletion	Standard systems are different. ISO is different for each heat treatment, and wires and wire rods are not specified. JIS is classified in product and standardized by being divided in steel grade, there is no reference to heat treatment usage.	Difference of standard system is estimated due to a difference in the market being dealt in. Due to an advance of the labor division in Japan, wire rod manufacturers and wire manufacturers are divided. Further, heat treatment to be used is optionally selected according to each usage by the final use for using the wire rod.
2. Normative references	JIS G 0404, JIS G 0558, JIS Z 2201, JIS Z 2241		1.2	ISO 404, ISO 3887, ISO 6892	MOD/alteration	Items cited from JIS are *equal to the applicable* items of the corresponding ISO.	
	JIS B 7502, JIS G 0415, JIS G 3507-1				MOD/addition		Cited standard necessary as JIS is added.
				ISO 377-1, ISO 377-2, ISO 642, ISO 643, ISO 6508, ISO 9443, ISO/TR 9769,ISO 10474	MOD/deletion		Cited standard unnecessary as JIS is deleted.

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(I) Requirements in JIS		(II) International Standard number	(III) Content specified in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: text Indication method: continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Content of technical difference	
3. Symbol of grade	6 grades rimmed equivalent steel, 11 grades of aluminum-killed steel, and 21 grades of killed steel are classified into 38 grades in total. Their symbols are specified.		1.4.5	A total of 61 grades on carbon steel, alloy steel, stainless steel or the like are specified. Among these 20 grades are for carbon steel.	MOD/alteration	The method for applying grade symbol shall conform to respective rules of JIS and ISO. Among 61 grades of ISO, 20 grades correspond to those of JIS in contents.	In ISO/TC 17, for the grade symbols those fixed to each country market may be used.
4. Material	Materials to be used for manufacture of wires.		—	—	MOD/addition		Due to difference of the standard system. Though JIS classifies wire rods from wires, ISO standard does not classify them. Contents specified in JIS before amendment are continued.
5. Manufacturing method	Two classes of manufacturing methods are specified by difference of the process. The class of a surface film is specified by the purchaser.		1.4.1	When there is no agreement between the manufacturer and the purchaser, the manufacturing methods of the steel and the product are determined by the manufacturer.	MOD/alteration	ISO standard is not definitely determined.	Due to difference of the standard system. Though JIS divides wire rods from wires, ISO standard does not classify them. Contents in JIS standard before amendment are continued.

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(I) Requirements in JIS		(II) International Standard number	(III) Content specified in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: text Indication method: continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Content of technical difference	
6. Mechanical properties	Tensile strength and contraction of area are specified for each steel grade by dividing into process D, process DA and the like.		2.2.3 3.2.3 4.2.3 5.2.3	Tensile strength and contraction of area are specified for each steel grade. Non heat-treating steel Case-hardening steel Steels for quenching and tempering *Stainless steel*	MOD/alteration	Specified value of tensile strength is more strict in JIS and reduction of area is more strict in ISO.	By difference of marked needs. (JIS follows the specified contents before the amendment.)
7. Metallographic structure	7.1 Depth of decarburization layer: Ferrite decarburization layer and total decarburization layer are specified.		1.4.8.2	Ferrite decarburization layer depth is zero and total decarburization depth is specified for each heat treatment condition. Partial decarburization may be determined by the agreement between the purchaser and the supplier.	MOD/alteration	In JIS, a ferrite decarburization depth is permitted to a certain degree. Besides total decarburization layer depth is more strict in JIS.	According to a difference of the actual conditions of business, JIS follows user needs. In next improvement of ISO, amendment is proposed to include JIS contents.
	7.2 Spherodized structure: A structure degree is specified when spherodized annealing is specified by the purchaser.		1.4.7.2	Spherodized structure is qualitatively specified.	MOD/alteration	ISO standard does not definitely specify. JIS specifies a degree of structure by photograph.	Since JIS is more definitely specified, contents of JIS before amendment is followed.

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(I) Requirements in JIS		(II) International Standard number	(III) Content specified in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: annex Location of deviation: text Indication method: continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Content of technical difference	
8. Tolerances on wire diameters and ovality	Wire diameter is specified by being divided into 7 categories.		1.4.11	Though dimensions, masses and their tolerances follow specifications of existing ISO, in the case of no standards, follow the agreement between the purchaser and the supplier.	MOD/alteration	JIS determines specific values. In the ISO not determined.	Due to a difference of market needs. JIS adopts specified values conforming to domestic needs.
9. Appearance and surface flaw	Tolerable surface and surface flaw depth are specified.		1.4.8.1	Subjected to the agreement between the purchaser and the supplier.	MOD/alteration	Though JIS determines specified values, ISO standard does not determine.	Due to a difference of market needs. JIS adopts specified values conforming to domestic needs.
10. Tests	10.1 Test piece		1.5.2	Test unit or the like	IDT	—	
	10.2 Tensile test		1.5.4.3	Tensile test	IDT	—	
	10.3 Metallographic test						
	10.3.1 Decarburized layer depth—measuring test		1.5.4.7	Decarburized layer depth measuring test	IDT	—	
	10.3.2 Spherodized structure test		1.5.4.4	Structure inspection	MOD/alteration	ISO standard tests by 500 magnifications. JIS tests by 400 magnifications.	Judge the propriety by the method in JIS.

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(I) Requirements in JIS		(II) International Standard number	(III) Content specified in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause Location of deviation: text Indication method: continuous sidelines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Content of technical difference	
	10.4 Measurement of wire diameter		—	—	MOD/addition		Necessary items as JIS are specified.
	10.5 *Detection test* for surface flaw		1.5.3.6	Outer soundness	MOD/alteration	ISO standard executes a test by 6 mm≦d≦30 mm. JIS corresponds at a flaw guarantee level.	On the surface flaw-guarantee level. JIS proposes the specified value.
11. In-spection	Inspecting conditions are specified.		1.4	Requirements	MOD/addition	Though ISO standard specifies required items (item number 1.4), the inspection is not specified.	Specification items and contents required for JIS are added. They are also specified in ISO and proposed so as to be added.
12. Marking	Contents to be marked on the wires to be shipper are specified.		1.3	Ordering	MOD/addition	Though ISO standard specifies ordering (item number 1.3), the marking is not specified.	Specification items and contents required for JIS are added. They are also specified in ISO and proposed so as to be added.
13. Report	Report by JIS G 0404 and JIS G 0415.		—	—	MOD/addition	ISO standard does not specify the report.	Specification items and contents required for JIS are added. They are also specified in ISO and proposed to the added.

Designated degree of correspondence between JIS and International Standard: MOD

Remarks 1 Symbols in such columns of classification by clause in the above table indicate as fallows:
- IDT : Identical in technical contents.
- MOD/ addition : Adds the specification item(s) or content(s) which are not included in International Standard.
- MOD/deletion : Deletes the specification item(s) or content(s) of International Standard.
- MOD/ alteration : Alters the specification content(s) which are included in International Standard.

2 Symbol in columns of designated degree of correspondence between JIS and International Standard in the above table indicates as follows:
- MOD : Modifies International Standard.

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