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JIS G 3505 : 2004

(JISF)

Low carbon steel wire rods

ICS 77.140.60

Reference number : JIS G 3505 : 2004 (E)

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS G 3505** : 1996 is replaced with this Standard.

This revision has been made based on **ISO 16120-1** : 2001 *Non-alloy steel wire rod for conversion to wire—Part 1 : General requirements* and **ISO 16120-2** : 2001 *Non-alloy steel wire rod for conversion to wire—Part 2 : Specific requirements for general purpose wire rod* for the purposes of making it easier to compare this Standard with International Standards; to prepare Japanese Industrial Standard conforming with International Standards; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Date of Establishment: 1956-08-21

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

Contents

Low carbon steel wire rods

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 16120-1** *Non-alloy steel wire rod for conversion to wire—Part 1 : General requirements* and **ISO 16120-2** *Non-alloy steel wire rod for conversion to wire—Part 2 : Specific requirements for general purpose wire rod* published in 2001 with some modifications of the technical contents.

Portions underlined with dots are the matters modified from the original International Standards. The list of modifications with their explanations is given in annex 3 (informative).

1 Scope This Standard specifies low carbon steel wire rods, (hereafter referred to as "wire rods"), to be used for the manufacture of the low carbon steel wire, zinc-coated low carbon steel wire, etc. However, the wire rods for core wire of electrode shall be excluded.

Remarks 1 The purchaser may designate a part of or all of clauses **1**, **2** and **3** of special quality requirements in annex 1, in addition to the items specified in this text by preliminary agreement with the manufacturer.

Annex 1 **1 Designation of low carbon steel**

Annex 1 **2 Designation of Mn**

Annex 1 **3 Dimensional tolerance and out-of-roundness**

2 The International Standards corresponding to this Standard are as follows.

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

ISO 16120-1 : 2001 *Non-alloy steel wire rod for conversion to wire—Part 1 : General requirements* (MOD)

ISO 16120-2 : 2001 *Non-alloy steel wire rod for conversion to wire—Part 2 : Specific requirements for general purpose wire rod* (MOD)

3 Quality requirements given in the International Standard are specified in annex 2.

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 amendments) shall be applied.

3 Grade and symbol The wire rod shall be classified into 8 grades, and the symbols shall be as given in table 1.

4 Chemical composition The wire rod shall be tested in accordance with **7.1**, and the cast analysis value shall be as given in table 1.

Table 1 Chemical composition

Unit: %

Symbol of grade	C	Mn	P	S
SWRM 6	0.08 max.	0.60 max.	0.040 max.	0.040 max.
SWRM 8	0.10 max.	0.60 max.	0.040 max.	0.040 max.
SWRM 10	0.08 to 0.13	0.30 to 0.60	0.040 max.	0.040 max.
SWRM 12	0.10 to 0.15	0.30 to 0.60	0.040 max.	0.040 max.
SWRM 15	0.13 to 0.18	030 to 0.60	0.040 max.	0.040 max.
SWRM 17	0.15 to 0.20	0.30 to 0.60	0.040 max.	0.040 max.
SWRM 20	0.18 to 0.23	0.30 to 0.60	0.040 max.	0.040 max.
SWRM 22	0.20 to 0.25	0.30 to 0.60	0.040 max.	0.040 max.

Remarks : When killed steel is specified, the letter K shall be suffixed to the end of the symbol of grade.

Example : SWRM 10 K

5 Dimensions The diameter and its tolerances and out-of-roundness(1) of the wire rod shall be in accordance with the following.

Note (1) The out-of-roundness is the difference between the maximum and minimum values of diameter on the same section of the wire rod.

a) The standard diameters of the wire rod shall conform to table 2.

Table 2 Standard diameter

Unit: mm

5.5, 6, 6.4, 7, 8, 9, 9.5, 10, 11, 12, 13, 14, 15, 16, 17, 19

b) The tolerances of diameter and out-of-roundness of the wire rod shall conform to table 3.

Table 3 Tolerance and out-of-roundness

Unit: mm

Diameter	Tolerance	Out of roundness
15 or less	±0.40	0.64 max.
Over 15 up to and incl. 25	±0.50	0.80 max.
Over 25	±0.60	0.96 max.

6 Appearance The wire rod shall be free from any defects that are detrimental to practical use. However, since it is generally difficult to inspect the wire rod for detection of flaws throughout the whole length and no opportunity is afforded to remove the flaws, some imperfections may be included. Accordingly, the management of such imperfections shall be subject to the agreement between the purchaser and the supplier.

7 Test

7.1 Chemical analysis The chemical analysis shall be as follows:

a) **General requirements for chemical analysis and sampling method of specimen for analysis** The chemical composition of the wire rod shall be obtained by cast analysis, and general requirements for chemical analysis and sampling method of specimen for analysis shall be as specified in clause **8** of **JIS G 0404**.

b) **Method for chemical analysis** The method for chemical analysis shall conform to any one of the following standards.

JIS G 1211, JIS G 1212, JIS G 1213, JIS G 1214, JIS G 1215, JIS G 1253, JIS G 1256, JIS G 1257, JIS G 1258

8 Inspection The inspection shall be as given in the following.

a) General requirements for inspection shall conform to **JIS G 0404**.

b) The chemical composition shall conform to the requirements of clause **4**.

c) The dimensions shall conform to the requirements of clause **5**.

d) The appearance shall conform to the requirements of clause **6**.

e) When "Special quality requirements" in annex 1 are designated to apply by agreement between the purchaser and the supplier, the wire rod shall conform to the requirements of clauses **1**, **2** and **3** of annex 1.

9 Marking The wire rod having passed the inspection shall be marked on each coil with the following particulars by suitable means. However, when approved by the purchaser, a part of them may be omitted.

a) Symbol of grade

b) Heat number or inspection number

c) Diameter of the wire rod

d) Manufacturer's name or identifying brand

10 Report The manufacturer shall submit to the purchaser the test results on the specified items when so requested by the purchaser.

If killed steel is specified, the silicon content shall be appended in the test results.

Attached Table 1 Normative references

JIS G 0404 *Steel and steel products—General technical delivery requirements*

JIS G 1211 *Iron and steel—Methods for determination of carbon content*

JIS G 1212 *Iron and steel—Methods for determination of silicon content*

JIS G 1213 *Iron and steel—Methods for determination of manganese content*

JIS G 1214 *Iron and steel—Methods for determination of phosphorus content*

JIS G 1215 *Iron and steel—Methods for determination of sulfur content*

JIS G 1253 *Iron and steel—Method for spark discharge atomic emission spectrometric analysis*

JIS G 1256 *Iron and steel—Method for X-ray fluorescence spectrometric analysis*

JIS G 1257 *Iron and steel—Methods for atomic absorption spectrometric analysis*

JIS G 1258 *Iron and steel—Methods for inductively coupled plasma atomic emission spectrometry*

ISO 4948-1 *Steels—Classification—Part 1 : Classification of steels into unalloyed and alloy steels based on chemical composition*

ISO 4948-2 *Steels—Classification—Part 2 : Classification of unalloyed and alloy steels according to main quality classes and main property or application characteristics*

ISO 6892 *Metallic materials—Tensile testing at ambient temperature*

Annex 1 (normative)
Special quality requirements

These special quality requirements (including the marking system used at the time of application) shall be applied by agreement between the purchaser and the supplier, and the designated items shall be performed by the manufacturer.

1 Designation of low carbon steel When agreed between the purchaser and the supplier, the purchaser may designate the steel grade of low carbon given in annex 1 table 1.

Annex 1 Table 1 Chemical composition

Unit: %

Symbol of grade	C	Mn	P	S
SWRM 2	0.04 max.	0.60 max.	0.040 max.	0.040 max.
SWRM 4	0.06 max.	0.60 max.	0.040 max.	0.040 max.

2 Designation of Mn Only when the wire rod is intended for conversion to profile wires of high strength for welded steel wire fabrics, the following content may be designated by agreement between the purchaser and the supplier.

Mn : 0.60 % min. (preferably 0.60 % to 0.90 %)

3 Dimensional tolerances and out-of-roundness The purchaser may designate the requirements given in annex 1 table 2 by agreement between the purchaser and the supplier.

Annex 1 Table 2 Dimensional tolerances and out-of-roundness

Unit: mm

Diameter	Tolerance	Out of roundness
15 or less	±0.30	0.48 max.
Over 15 up to and incl. 25	±0.40	0.64 max.

Annex 2 (normative)

Quality requirements based on International Standard

This annex 2 specifies the steel grades specified in **ISO 16120-2** : 2001 *Non-alloy steel wire rod for conversion to wire—Part 2 : Specific requirements for general purpose wire rod.*

1 Scope Clause **2** of this annex 2 may be applied instead of the requirements specified in clause **4** of this text by agreement between the purchaser and the supplier. Further, when clause **2** of this annex 2 is applied, whether the requirements given in clauses **3** and **4** of annex 2 should also be applied or not shall be agreed previously between the purchaser and the supplier.

The description specified in annex 1 shall not be applied to the steel grades given in annex 2.

2 Chemical composition The chemical composition shall be as given in annex 2 table 1.

Annex 2 Table 1 Chemical composition(1)

Unit: %

Symbol of grade(2)	C	Si(3)	Mn(4)	P Upper limit value	S Upper limit value	Cr Upper limit value	Ni Upper limit value	Mo Upper limit value	Cu(5) Upper limit value	Al(6) Upper limit value
C4D	0.00 to 0.06	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C7D	0.05 to 0.09	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C9D	0.00 to 0.10	0.00 to 0.30	0.00 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	—
C10D	0.08 to 0.13	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C12D	0.10 to 0.15	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C15D	0.12 to 0.17	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C18D	0.15 to 0.20	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01
C20D	0.18 to 0.23	0.00 to 0.30	0.30 to 0.60	0.035	0.035	0.20	0.25	0.05	0.30	0.01

Notes (1) Elements not stated in this table, unless it is for the purpose of finish deoxidation, shall not be intentionally added without agreement of the purchaser. Addition of microalloying elements shall be by agreement in ordering between the manufacturer and the purchaser.

(2) Non-alloy quality steel conforming to **ISO 4948-1** and **ISO 4948-2**.

(3) When requested as wire rods for galvanizing, the lower limit of Si may be designated in ordering. The upper limit value of Si given in annex 2 table 1 may be further restricted by the agreement in ordering.

(4) For grades of C15D to C20D, a different range of Mn from the one given in annex 2 table 1 may be set by agreement between the purchaser and the manufacturer. However, for the range, the upper limit value shall not exceed 1.20 % and the lower limit value shall not be lower than 0.30 %.

(5) The upper limit value of Cu may be 0.20 % by agreement between the manufacturer and the purchaser.

(6) The range of Al may be 0.01 % to 0.06 % by agreement between the manufacturer and the purchaser. In such cases, the upper limit value of Si may be 0.1 %.

3 Surface quality test The depth of defect shall be determined by the file test. One coil per test unit 10 t shall be selected and at least three test pieces shall be sampled. The test piece shall be at least 300 mm separated from one end of the wire rod. The procedure shall be as follows:

a) Measure the diameter of the test piece.

b) Carry out filing until surface defects can not be visible with the naked eye.

c) Determine the depth of the defect by measuring the difference in diameter before and after filing. The tolerance shall not exceed the value given in annex 2 table 2.

Annex 2 Table 2 Permissible flaw depth

Unit: mm

Diameter d_N	Maximum permissible flaw depth
$5 \leq d_N \leq 12$	0.20
$12 < d_N \leq 18$	0.25
$18 < d_N \leq 30$	0.30

4 Tensile test When requested by the purchaser in ordering, the manufacturer shall carry out the test as given in **ISO 6892** and the test value of the tensile test shall be submitted.

Annex 3 (informative)

Comparison table between JIS and corresponding International Standard

JIS G 3505:2004 *Low carbon steel wire rods*					**ISO 16120-1** *Non-alloy steel wire rod for conversion to wire—Part 1: General requirements* **ISO 16120-2** *Non-alloy steel wire rod for conversion to wire—Part 2: Specific requirements for general purpose wire rod*		
(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
1 Scope	Low carbon steel wire rods (except for wire rods for core wire of electrode) to be used for manufacturing low carbon steel wire, zinc-coated low carbon steel wire, etc.	**ISO 16120-2**	1	General purpose wire rod for drawing and/or cold rolling	MOD/ deletion	**JIS** contains only low and middle carbon steels. **ISO 16120-2** also contains high carbon steel.	**JIS** standards for wire rod are divided into three according to subject wire rods such as low carbon steel wire rod (low and middle carbon steel), hard carbon steel wire rod (middle and high carbon steel), as the general purpose wire rods, and piano wire rod of high carbon steel, as the higher grade wire rod. This separation is different from that of **ISO** Standards which are divided into two, that is, for general purpose wire rod (**ISO 16120-2**) containing low carbon steel to high carbon steel and for high grade wire rod (special applications: **ISO 16120-4**). Herein, **ISO 16120-2** is conformed to grades corresponding to low carbon steel wire rod of **JIS**. The grade corresponding to hard steel wire rod in **ISO 16120-2** is conformed to **JIS G 3506** and the grade corresponding to higher grade purposes and piano wire rod **JIS G 3502** is conformed to **ISO 16120-4**.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
2 Normative references	Reference **JIS** standards are cited. (attached table 1)	**ISO 16120-2**	2	Reference **ISO** Standards are cited.	—	—	—
3 Grade and symbol	8 Grades in **JIS** and their symbols (table 1)	**ISO 16120-2**	3	30 Grades in **ISO** Standard and their symbols (table 1)	MOD/ deletion	8 Grades of low and middle carbon steel in **ISO** Standard correspond to low carbon steel wire rod.	—
4 Chemical composition	Chemical compositions are specified for 8 grades (table 1)	**ISO 16120-2**	3.2	Chemical compositions are specified for 30 grades (from low carbon steel to high carbon steel) (table 1)	MOD/ deletion	8 Grades of **ISO** Standard low and middle carbon steel correspond in chemical composition to low carbon steel wire rod. However, in **ISO** Standard, Cr, Ni, Mo, Cu and Al which are not specified in **JIS** are specified. Though Al is not especially specified in **JIS**, K is suffixed to the end of the grade symbol in the case of killed steel.	Low carbon steel wire rod in **ISO** Standard almost corresponds to those in **JIS**. Further, 8 grades of low and middle carbon steels in **ISO** Standard corresponding to **JIS** are adopted in annex 2 as they are. The part corresponding to middle and high carbon steel is adopted in **JIS** for high carbon steel wire rods (**JIS G 3506**).
5 Dimensions	a) Standard diameter of wire rod (table 2)	**ISO 16120-1**	8	Standard diameter, dimensional tolerance and mass are specified.	MOD/ deletion	**ISO** Standard specifies mass also.	**JIS** specifies the dimensions as common items in **JIS G 3194** and it is not necessary to specify the dimensions in this Standard.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
5 Dimensions (concluded)	b) Tolerance and out-of-roundness of diameter (table 3)			Out-of-roundness is not specified.		Standard diameter **JIS**: 5.5 to 19ϕ **ISO**: 5 to 30ϕ Dimensional tolerance In **JIS**, the tolerance is different according to the grade (low carbon steel wire rods, hard-steel wire rods and piano wire rods). In **ISO** Standard, it is constant without depending on the grade. However, for low carbon steel wire rods, the tolerances in both standards are not different except that **ISO** Standard specifies that tolerance for 30ϕ mm shall depend on agreement at the time of ordering for low carbon steel wire rods.	Standard diameter depends on the equipment capacity. Since dimensional tolerance should be provided for each grade, an improvement proposal has been submitted and in **ISO/DIS 16124** the specification is under study.
6 Appearance	The appearance shall be free from flaws detrimental to use. Management of imperfections shall be as agreed upon between the manufacturer and the purchaser.	**ISO 16120-2**	3.3	Surface quality and inner quality shall be sound. There is no specification for management of imperfections.	MOD/ deletion MOD/ addition	**JIS** does not mention the inner quality.	**JIS** expresses as no detrimental flaw but the concept is the same as that of **ISO**.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
7 Test	7.1 Chemical analysis a) General requirements for chemical analysis and sampling method of specimen for analysis b) Method for chemical analysis method	**ISO 16120-1**	9.4.1 9.5.1 9.5.2 9.5.3 9.5.7 Annex A	A specimen shall be sampled based on **ISO 14284**. For analysis, the test method stated in **ISO/TR 9769** shall be used. The following items are not specified in **JIS**, but in **ISO** Standard. Tensile strength (according to **ISO 6892**) Surface discontinuities (flaw depth) Core segregation/ Determination of core segregation	IDT MOD/ deletion MOD/ deletion MOD/ deletion	In **ISO** Standard, the core segregation is specified to be as agreed upon between the manufacturer and the purchaser and tensile strength is specified to be tested if requested at the time of ordering. In **JIS**, the core segregation and the tensile strength are not specified. In **ISO** Standard, the permissible value of surface discontinuities is established.	Since in Japan, 100 % continuous casting is established and variation of tensile strength is small, it is not especially specified. The data of the tensile strength of steel materials are those on the wire rods and a value of tensile strength of the wire is varied by secondary processing, heat treatment etc. therefore, the tensile strength of wire rods is only for reference. Deletion of the tensile strength test is proposed to **ISO** Standard. Whether or not the tolerable flaw depth, not specified for low carbon steel wire rods in **JIS**, shall be specified as in **ISO** Standard, is as issue in the future.
8 Inspection	Conditions for inspection are stated.	**ISO 16120-1**	9	Inspection Almost the same as in **JIS**.	MOD/ deletion	**ISO** Standard specifies all grades of the wire rods. **JIS** specifies only low carbon steel wire rods.	The same reason as that in clause 4.
9 Marking	Result report shall be made.	**ISO 16120-1**	10	Same as **JIS**.	IDT	—	—

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
10 Report	Test results shall be reported.	**ISO 16120-1**	9.1	Same as **JIS**.	IDT	—	—
Annex 1	1 Designation of low carbon steel 2 Designation of Mn 3 Dimensional tolerance and out-of-roundness	—	—		MOD/ addition		In Japan some user needs to require special quality specification. Addition of special specification based on the actual state of transaction will be proposed to **ISO**. Further, the revision of specification for the dimensional tolerance to differentiate the value according to the grade of the wire rod has been proposed to **ISO** [**ISO/DIS 16124** (former **ISO 8457-1**)].
Annex 2	Specify 8 grades of **ISO 16120-2** corresponding to low carbon steel wire rods. 1 Scope 2 Chemical composition 3 Surface quality test 4 Tensile test	**ISO 16120-2**	3.2	Chemical composition: 8 grades from C4D to C20D whose carbon content corresponds to that for low carbon steel wire rods out of the grades in **ISO 16120-2** are specified so as to correspond to the low carbon steel wire rods.	IDT	Chemical composition: upper limit of Cr, Ni, Mo, Cu and Al not specified in the text of **JIS** are specified.	**JIS** is premised on addition of no trace element. **ISO**, on the other hand specifies the upper limit value of trace element but the basic conception is the same one.
			3.3	Permissible flaw depth	MOD/ addition	Specification of surface quality test is added to the permissible flaw depth in **ISO** Standard.	The inspection method is selected by the manufacturer in **ISO** and there is practically no difference between **JIS** and **ISO** Standard.

(I) Requirements in **JIS**		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between **JIS** and the International Standards by clause Location of deviation: text, annex Indication method: dotted underlines		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
Annex 2 (concluded)			3.6	Tensile test is specified.	IDT	—	For the tensile test, refer to reasons for technical differences between **JIS** and **ISO** Standard in clause 7.
Annex 3	Comparison table between **JIS** and corresponding International Standard		—	—	—	—	—

Designated degree of correspondence between **JIS** and International Standard: MOD

Remarks 1 Symbols in sub-columns of classification by clause in the above table indicate as follows:

— IDT: Identical in technical contents.

— MOD/deletion: Deletes specification item(s) or content(s) of International Standard.

— MOD/addition: Adds specification item(s) or content(s) not included in International Standard.

2 Symbol in column of designated degree of correspondence between **JIS** and International Standard in the above table indicates as follows:

— MOD: Modifies International Standard.

Errata for JIS (English edition) are printed in *Standardization Journal*, published monthly by the Japanese Standards Association, and also provided to subscribers of JIS (English edition) in *Monthly Information*.

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