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Contents

Page

1 Scope ····· 1
2 Normative references ····· 1
3 Grade, symbol of grade and designation ····· 1
3.1 Grade and symbol of grade ····· 1
3.2 Designation ····· 1
4 Manufacturing method ····· 2
5 Chemical composition ····· 2
6 Mechanical properties ····· 2
7 Shape, dimensions and unit mass ····· 2
7.1 Shape ····· 2
7.2 Dimensions and unit mass ····· 3
7.3 Straightness ····· 3
8 Appearance ····· 4
9 Tests ····· 4
9.1 Sampling ····· 4
9.2 Chemical analysis ····· 4
9.3 Mechanical tests ····· 4
9.4 Measurement of unit mass ····· 5
9.5 Measurement of straightness ····· 5
10 Inspection ····· 5
10.1 Inspection ····· 5
10.2 Reinspection ····· 5
11 Marking ····· 6
12 Report ····· 6
Annex A (normative) Testing velocity in tensile strength test ····· 7
Annex B (normative) Relaxation test conditions ····· 8

Foreword

This Japanese Industrial Standard has been 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 Japan Wire Products Association (JWPA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS G 3137**:2008), which has been technically revised.

However, **JIS G 3137**: 2008 may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 19 August 2021.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, published patent application or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, published patent application or utility model rights.

Small diameter steel bars for prestressed concrete

1 Scope

This Japanese Industrial Standard specifies requirements for small diameter steel bars mainly used for prestressed concrete manufactured by pre-tensioning (hereafter referred to as steel bars).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0320 *Standard test method for heat analysis of steel products*

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

JIS G 0415 *Steel and steel products — Inspection documents*

JIS Z 2241 *Metallic materials — Tensile testing — Method of test at room temperature*

JIS Z 2276 *Method of tensile stress relaxation test for metallic materials*

JIS Z 8401 *Rounding of numbers*

3 Grade, symbol of grade and designation

3.1 Grade and symbol of grade

Steel bars are classified into Grade C and Grade D, and further subclassified into 4 grades. The symbols for respective grades are given in Table 1.

Table 1 Grade and symbol of grade

Grade	Symbol of grade [a)]
Grade C	SBPDN 1080/1230
	SBPDL 1080/1230
Grade D	SBPDN 1275/1420
	SBPDL 1275/1420
Note [a)] N and L indicate that the relaxation value is 4.0 % or under and 2.5 % or under, respectively.	

3.2 Designation

The steel bars are designated as given in Table 2.

Table 2 Designation

Designation					
7.1 mm	9.0 mm	10.0 mm	10.7 mm	11.2 mm	12.6 mm

4 Manufacturing method

The steel bars shall be manufactured from hot-rolled killed steels by quenching and tempering. The deforming work of applying continuous spiral grooves, uniform bumps or dents on the surface of the bars shall be performed during hot-rolling or cold-working.

5 Chemical composition

Steel bars shall be tested in accordance with **9.2**, and the resultant heat analysis values shall be as given in Table 3. Elements not given in this table may be added as necessary.

Table 3 Chemical composition

Unit: %

P	S	Cu
0.030 max.	0.035 max.	0.30 max.

6 Mechanical properties

The mechanical properties of steel bars shall be tested in accordance with **9.3**, and the resultant values shall be as given in Table 4.

Table 4 Mechanical properties

Symbol of grade	Proof stress or yield point [a] N/mm²	Tensile strength N/mm²	Elongation %	Relaxation value %
SBPDN 1080/1230	1 080 min.	1 230 min.	5 min.	4.0 max.
SBPDL 1080/1230				2.5 max.
SBPDN 1275/1420	1 275 min.	1 420 min.	5 min.	4.0 max.
SBPDL 1275/1420				2.5 max.
NOTE 1 N/mm² = 1 MPa Note [a] The proof stress is the stress giving permanent elongation of 0.2 %, and the yield point is the lower yield point.				

7 Shape, dimensions and unit mass

7.1 Shape

The shape of steel bars shall be as follows.

a) The steel bars shall be either in the form of a rod or coil.

b) The steel bars shall have an approximately circular cross-section, and shall be shaped with spiral grooves, uniform bumps or dents, either continuously or at regular intervals. An example of the shape of a steel bar with continuous spiral grooves is shown in Figure 1.

7.2 Dimensions and unit mass

The nominal diameter, nominal cross-sectional area and unit mass of steel bar are given in Table 5. Measurement of unit mass shall be as specified in **9.4**.

Figure 1 Example of shape and cross-section of steel bars

Table 5 Dimensions and unit mass of steel bars

Designation	Nominal diameter [a]	Nominal cross-sectional area (S)	Unit mass		
			Standard mass [b] (m_0)	Minimum [c]	Maximum [c]
	mm	mm^2	kg/m	kg/m	kg/m
7.1 mm	7.1	40.0	0.314	0.295	0.333
9.0 mm	9.0	64.0	0.502	0.472	0.532
10.0 mm	10.0	78.5	0.616	0.579	0.653
10.7 mm	10.7	90.0	0.707	0.665	0.749
11.2 mm	11.2	100	0.785	0.738	0.832
12.6 mm	12.6	125	0.981	0.922	1.04

NOTE Values of nominal diameter and unit mass are calculated using nominal cross-sectional area.

Notes [a] The value of nominal diameter is calculated from the nominal cross-section, assuming the steel bar to be a round bar.

[b] The standard mass is calculated by the following formula and the resultant value is rounded to three significant figures in accordance with Rule B in **JIS Z 8401**.

$m_0 = 7.85\ (g/cm^3) \times S\ (mm^2) = 0.785 \times S/100(kg/m)$

[c] The minimum value and the maximum value of unit mass are 94 % and 106 %, respectively, of the standard mass, and the resultant value is rounded to three significant figures in accordance with Rule B in **JIS Z 8401**.

7.3 Straightness

The straightness of the steel bar, when it is measured according to **9.5**, shall be not more than 30 mm in any 1 m length.

8 Appearance

The steel bars shall be free from flaws, rust or other defects detrimental to use.

9 Tests

9.1 Sampling

The test pieces shall be taken as follows.

a) The test piece to be used for the tensile test, mass measurement and straightness measurement shall be cut and taken from a group of bars from the same cast, same heat treatment, and of the same designation according to Table 6, taking care not to cause errors in the measurement.

Table 6 Sampling method and number of test pieces

Shape	Designation	Test items	
		Tensile strength, elongation, unit mass and straightness	Proof stress or yield point
Rod [a)]	All designations	One test piece taken from one end of a rod selected at random from a lot consisting of 1 000 rods or its fraction.	One test piece taken from one end of a rod selected at random from a lot consisting of 6 000 rods or its fraction.
Coil	All designations	One test piece taken from one end of a coil selected at random from a lot consisting of 5 coils or its fraction.	One test piece taken from one end of a coil selected at random from a lot consisting of 30 coils or its fraction.
Note [a)]	For steel bars that are cut out from a coil product, the sampling shall be performed on the original coil from which the steel bars are to be cut out, according to the sampling method for coils.		

b) The test piece used for a relaxation test shall be taken from one end of a rod or a coil selected at random, in length suitable for the test in **9.3.2** with a gauge length of 100 mm or more, in any occasion of changes of material or manufacturing process.

9.2 Chemical analysis

9.2.1 General matters of chemical analysis and sampling method

The chemical composition of steel material shall be determined by heat analysis. General matters of chemical analysis and sampling method shall be in accordance with Clause **8** of **JIS G 0404**.

9.2.2 Analytical method

The analytical method shall be in accordance with **JIS G 0320**.

9.3 Mechanical tests

9.3.1 Tensile test

The tensile test shall be as follows.

a) The tensile test shall be performed in accordance with **JIS Z 2241**. The testing velocity shall be within the range specified in Annex A. The tensile test pieces shall be Test piece No. 2 specified in **JIS Z 2241**. The test pieces shall be as-manufactured, i.e. shall not be given any machining treatment.

b) The proof stress or yield point shall be determined by dividing a test force for permanent elongation of 0.2 % or a test force for the lower yield point, respectively, by the nominal cross-sectional area (Table 5).

c) The tensile strength shall be determined by dividing the maximum test force during the test by the nominal cross-sectional area (Table 5).

d) The elongation shall be determined according to elongation after fracture specified in **JIS Z 2241**.

9.3.2 Relaxation test

a) The relaxation test shall be performed in accordance with **JIS Z 2276**, except that the temperature shall be ordinary temperature [(20 ± 5) °C], and the loading velocity, initial test force, initial test force holding period and relaxation period shall be in accordance with Annex B.

9.4 Measurement of unit mass

For unit mass, measure the length and mass of a test piece of 200 mm or more to 4 significant figures, and convert it to the equivalent of 1 000 mm. Round the converted value to 3 significant figures according to Rule B in **JIS Z 8401**.

9.5 Measurement of straightness

Use the test piece of 1 m or more taken according to Table 6 to determine the maximum arc depth in any 1 m length of the chord with no external force other than mass applied in the bending direction.

10 Inspection

10.1 Inspection

The inspection of steel bars shall be as follows.

a) The general matters of inspection shall be in accordance with **JIS G 0404**.

b) The chemical composition shall conform to the requirements of Clause **5**.

c) The mechanical properties shall conform to the requirements of Clause **6**.

d) The unit mass and straightness shall conform to the requirements of Clause **7**.

e) The appearance shall conform to the requirements of Clause **8**.

10.2 Reinspection

In the case where the result of the test performed on the first test piece fails to conform to the requirements specified in Clause **6**, retests may be carried out on three test

pieces, one taken from the rod or coil from which the first test piece was taken and the other two taken from one end of each of other two rods or two coils in the same lot. If all results of retests performed on the three test pieces conform to requirements specified in Clause **6**, the steel bars in the lot shall be considered to be acceptable. If any of the three fails to meet the requirements, the steel bars of the lot shall be rejected.

11 Marking

Each bundle of the steel bars found to be in conformance with all the requirements of this Standard shall be marked with the following information by a suitable means.

a) Number of this Standard and symbol of grade

b) Designation

c) Numerical quantity or mass

d) Product identification number

e) Manufacturer's name or abbreviation

12 Report

The manufacturer shall submit the inspection document to the purchaser. The report shall be in accordance with Clause **13** of **JIS G 0404**. Unless otherwise specified at the time of ordering, the type of the inspection document to be submitted shall be in accordance with **5.1** of **JIS G 0415**.

Annex A (normative)
Testing velocity in tensile strength test

The testing velocity in tensile strength test shall be in accordance with Table A.1.

Table A.1 Testing velocity in tensile strength test of steel bars

Measurement item	Stress rate control method	Testing velocity
Proof stress or yield point	Average stress rate	3 MPa・s^{-1} to 100 MPa・s^{-1}
Tensile strength	Strain rate	0.5 %/min to 50 %/min [a)]
Elongation		
Note [a)] 1 %/min = 1/6 000 s^{-1}		

Annex B (normative)
Relaxation test conditions

The loading velocity, initial test force, initial test force holding period and relaxation period to be applied in the relaxation test shall be as given in Table B.1.

Table B.1 Relaxation test conditions

Test item	Requirements
Loading velocity [a)]	200 N/(mm²·min) ± 50 N/(mm²·min) [3.33 N/(mm²·s) ± 0.83 N/(mm²·s)]
Initial test force	The value equivalent to 70 % of the lower limit value of tensile strength in Table 4, multiplied by the nominal cross-sectional area.
Initial test force holding period	Hold at the initial test force for 120 s ± 2 s.
Relaxation period	While keeping the length between grips constant, perform the test with a holding period of at least 120 h. The holding period is generally 120 h or 1 000 h. After holding for 120 h or 1 000 h, measure the test force and obtain the relaxation value (reducing ratio with respect to the initial test force). When the holding period is 120 h, obtain the relaxation value after the holding period of 1 000 hours by the extrapolation method specified in **7.3.5** of **JIS Z 2276**.
Note [a)] The loading velocity shall be the rate of increase of the test force divided by the nominal cross-sectional area.	

Errata for **JIS** (English edition) can be downloaded in PDF format at Webdesk (purchase information page) of our website (https://www.jsa.or.jp/).

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