

**INVOICE FOR ISSUE OF
TOYOTA ENGINEERING STANDARD**

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TITLE : HARD DRAWN STEEL WIRES

CLASS : **C**

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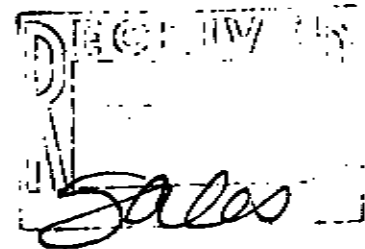
(Asterisk mark "*" in this standard denotes the changed portion from previous issue.) :

Revised ("*" omitted)
Editorial

TOYOTA MOTOR MANUFACTURING USA INC.
PURCHASING TECHNICAL SUPPORT

TOYOTA ENGINEERING STANDARD
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HARD DRAWN STEEL WIRBS

1. Scope

This standard covers hard drawn steel wire (hereinafter referred to as "wire") composing automobile components.

Remark: In this standard, units and numerical values given in { } are based on the customary units system, and are given for reference.

2. Types and Material Codes

The type and material code of wire shall be in accordance with Table 1.

Table 1

Type	Material code	Comparable JIS	Example of application
Type A	SWA		Spring, snap ring, clip, clamp, cable, tire head wire and ceiling support
Type B	SWB		
Type C	SWC		

3. Manufacturing Method

Wire material conforming to the hard drawn steel wire specified in TSG3530G shall be used. The wire shall be heat treated and then drawn under room temperature.

4. Standard Wire Diameter and Dimensional Tolerances

(1) The standard wire diameter shall be in accordance with Table 2.

Table 2

Unit: mm								
0.08	0.09	0.10	0.12	0.14	0.16	0.18	0.20	
0.23	0.26	0.29	0.32	0.35	0.40	0.45	0.50	
0.55	0.60	0.65	0.70	0.80	0.90	1.00	1.20	
1.40	1.60	1.80	2.00	2.30	2.60	2.90	3.20	
3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	
8.00	9.00	10.0	11.0	12.0	13.0			

Prepared and Written by: Metallic Material Dept. Material Engineering Div. 1	Engineering Administration Div. © TOYOTA MOTOR CORPORATION Established / 4 th Revised: Jan. 1996
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(2) Tolerances for wire diameter shall be in accordance with Table 3.

Table 3

Unit: mm	
Wire diameter	Tolerance
0.10 or less	±0.005
Over 0.10 to 0.20 incl.	±0.010
Over 0.20 to 0.50 incl.	±0.015
Over 0.50 to 1.00 incl.	±0.020
Over 1.00 to 2.00 incl.	±0.030
Over 2.00 to 3.20 incl.	±0.040
Over 3.20 to 5.50 incl.	±0.050
Over 5.50	±0.060

5. Quality

- (1) The wire shall have a cross section of substantially true circle, and shall have a smooth surface free from defects such as harmful flaws etc.
- (2) The tensile strength of wire shall be in accordance with Table 4. However, the value of tensile strength may become a little larger than those listed in the table after drawing and bluing.

Table 4

Wire dia. (mm)	Tensile strength (MPa) (kgf/mm ²)		
	Class A	Class B	Class C
0.08	2108 to 2452 {215 to 250}	2452 to 2795 {250 to 285}	2795 to 3138 {285 to 320}
0.09	2059 to 2403 {210 to 245}	2403 to 2746 {245 to 280}	2746 to 3089 {280 to 315}
0.10	2010 to 2354 {205 to 240}	2354 to 2697 {240 to 275}	2697 to 3040 {275 to 310}
0.12	1961 to 2305 {200 to 235}	2305 to 2648 {235 to 270}	2648 to 2991 {270 to 305}
0.14	1961 to 2256 {200 to 230}	2256 to 2599 {230 to 265}	2599 to 2942 {265 to 300}
0.16		2206 to 2550 {225 to 260}	2550 to 2893 {260 to 295}
0.18	1912 to 2206 {195 to 225}	2206 to 2501 {225 to 255}	2501 to 2844 {255 to 290}
0.20			2501 to 2795 {255 to 285}
0.23	1863 to 2158 {190 to 220}	2158 to 2452 {220 to 250}	2452 to 2746 {250 to 280}
0.26	1814 to 2108 {185 to 215}	2108 to 2403 {215 to 245}	2403 to 2697 {245 to 275}
0.29	1765 to 2059 {180 to 210}	2059 to 2354 {210 to 240}	2354 to 2648 {240 to 270}
0.32	1716 to 2010 {175 to 205}	2010 to 2305 {205 to 235}	2305 to 2599 {235 to 265}
0.35			
0.40	1667 to 1961 {170 to 200}	1961 to 2256 {200 to 230}	2256 to 2550 {230 to 260}

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Table 4 (Continued)

Wire dia. (mm)	Tensile strength (MPa) (kgf/mm ²)		
	Class A	Class B	Class C
0.45	1618 to 1912 (165 to 195)	1912 to 2206 (195 to 225)	2206 to 2501 (225 to 255)
0.50	1569 to 1863 (160 to 190)	1863 to 2158 (190 to 220)	2158 to 2452 (220 to 250)
0.55	1569 to 1814 (160 to 185)	1814 to 2108 (185 to 215)	2108 to 2403 (215 to 245)
0.60	1520 to 1765 (155 to 180)	1765 to 2059 (180 to 210)	2059 to 2354 (210 to 240)
0.65		1765 to 2010 (180 to 205)	2010 to 2305 (205 to 235)
0.70			2010 to 2256 (205 to 230)
0.80	1471 to 1716 (150 to 175)	1716 to 1961 (175 to 200)	1961 to 2206 (200 to 225)
0.90	1422 to 1667 (145 to 170)	1667 to 1912 (170 to 195)	1912 to 2158 (195 to 220)
1.00	1373 to 1618 (140 to 165)	1618 to 1863 (165 to 190)	1863 to 2108 (190 to 215)
1.20	1324 to 1569 (135 to 160)	1569 to 1814 (160 to 185)	1814 to 2059 (185 to 210)
1.40	1275 to 1520 (130 to 155)	1520 to 1765 (155 to 180)	1765 to 2010 (180 to 205)
1.60	1275 to 1471 (130 to 150)	1471 to 1716 (150 to 175)	1716 to 1961 (175 to 200)
1.80	1226 to 1422 (125 to 145)	1422 to 1667 (145 to 170)	1667 to 1912 (170 to 195)
2.00			1667 to 1863 (165 to 190)
2.30		1863 to 2108 (190 to 215)	2108 to 2354 (215 to 240)
2.60	1177 to 1373 (120 to 140)	1373 to 1569 (140 to 160)	1569 to 1814 (160 to 185)
2.90			1814 to 2059 (185 to 210)
3.20		2059 to 2305 (210 to 235)	2305 to 2551 (235 to 255)
3.50	1128 to 1324 (115 to 135)	1324 to 1520 (135 to 155)	1520 to 1716 (155 to 175)
4.00	1079 to 1275 (110 to 130)	1275 to 1471 (130 to 150)	1471 to 1667 (150 to 170)
4.50	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
5.00	981 to 1177 (100 to 120)	1177 to 1373 (120 to 140)	1373 to 1569 (140 to 160)
5.50	932 to 1128 (95 to 115)	1128 to 1324 (115 to 135)	1324 to 1520 (135 to 155)
6.00	—	1079 to 1275 (110 to 130)	1275 to 1471 (130 to 150)
6.50		1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)
7.00			1422 to 1618 (145 to 165)
8.00	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
9.00	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
10.0	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
11.0	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
12.0	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)
13.0	1030 to 1226 (105 to 125)	1226 to 1422 (125 to 145)	1422 to 1618 (145 to 165)

Remark: For steel wire having a diameter of intermediate value, a value listed in a larger diameter division shall be used.

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- (3) The states of steel wire having a diameter under 6 mm incl. after the torsion test shall be as listed in Table 5.

Table 5

Item		Quality
Torsion No.	Wire dia. : 2.00 mm or less	20 times min.
	Wire dia. : Over 2.00 mm to 3.50 mm incl.	15 times min.
	Wire dia. : Over 3.50 mm to 6.00 mm incl.	10 times min.
State of broken section		Shall be normal to wire axis and shall be free from remarkable scratch and crack etc.
State of torsion		Remarkable vertical crack, scratch and local twisting shall not exist.

- (4) When the bending test is done on wire having a diameter of over 6 mm, a wire surface shall be free from harmful flaws and breakage.
- (5) When the winding test is done on wire having a diameter of under 6 mm incl., a wire surface shall be free from harmful flaws and breakage.

6. Test

6.1 Tensile Test

According to TSG2203G. However, the gripping distance shall be about 100 mm for a wire diameter of under 1.00 mm and about 200 mm for a wire diameter of over 1.00 mm incl. In the even when the specimen is broken at a gripping portion, the test shall be considered as invalid and another tensile test shall be done again on a newly sampled specimen.

6.2 Torsion Test

Both ends of the specimen shall be gripped firmly at a distance 100 times as large as the wire diameter. One end thereof shall be torsioned to break the wire while stretching the wire so as not to loose. Frequency of torsion, state of broken section, and torsion state in this instance shall be examined. The torsion frequency obtained when testing the wire at a gripping distance other than 100 times of wire diameter shall be increased in direct proportion to the gripping distance, so that this frequency is converted to the frequency for the gripping distance 100 times as large as the wire diameter.

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6.3 Bending Test

Specimen shall be bent at two spots in different directions by 90 degree along an arc having the same radius as the wire diameter. Then, states of wire surface shall be examined.

6.4 Winding Test

Specimen shall be wound twice or more around the core metal having the same diameter as the wire diameter, then the state of wire surface shall be examined.

6.5 Chemical Composition

The chemical composition shall be as specified by TSG1000G and TSG2902G.

6.6 General Quality

According to Section 13 of TSG3000G.

Applicable Standards

TSG1000G General Rule for Chemical Analysis of Steel Materials
 TSG2203G Tensile Test Method for Metallic Materials
 TSG2902G Method of Spark Test for Steels
 TSG3000G General Quality of Steels for Metallic Machine Structural Use
 TSG3530G Mild Steel Wire Rods and Hard Steel Wire Rods

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