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TITLE : PIANO WIRES

CLASS : C

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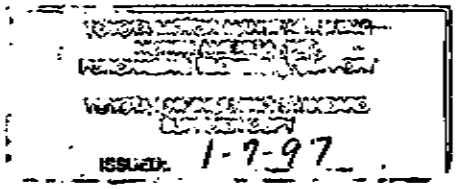

PIANO WIRES

1. Scope

This standard covers piano wires used in automobile parts and components.

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

2. Classification and Material Codes

The classification and material code of piano wires are given in Table 1.

Table 1

Classification	Material code	Comparable JIS (reference)	Application
Piano wire Class A	SWP-A		General springs
Piano wire Class V	SWP-V		Valve springs

3. Chemical Composition

The chemical composition of piano wires shall conform to Table 2.

Table 2

Material code	Chemical composition (%)					
	C	Si	Mn	P	S	Cu
SWP-A	0.75 to 0.85	0.12 to 0.32	0.30 to 0.90	0.025 max.	0.025 max.	0.20 max.
SWP-V						0.15 max.

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4. General Quality

(1) The wires shall have practically circular cross sections, and shall be smooth over surface free from detrimental flaws and other defects.

(2) The tensile strength of the wires shall conform to Table 3. However, the value will rise somewhat after forming and blueing treatment.

Table 3

Wire diameter (mm)	Tensile strength (MPa) {kgf/mm²}		Wire diameter (mm)	Tensile strength (MPa) {kgf/mm²}	
	Class A	Class V		Class A	Class V
0.08	2893 to 3187 {295 to 325}		1.00	2058 to 2256 {210 to 230}	
0.09	2844 to 3138 {290 to 320}		1.20	2010 to 2206 {205 to 225}	
0.10	2795 to 3089 {285 to 315}		1.40	1961 to 2158 {200 to 220}	
0.12	2746 to 3040 {280 to 310}		1.60	1912 to 2108 {195 to 215}	—
0.14	2697 to 2991 {275 to 305}		1.80	1863 to 2059 {190 to 210}	
0.16	2648 to 2942 {270 to 300}		2.00	1814 to 2010 {185 to 205}	1765 to 1912 {180 to 195}
0.18	2599 to 2893 {265 to 295}		2.30	1765 to 1961 {180 to 200}	1716 to 1863 {175 to 190}
0.20	2599 to 2844 {265 to 290}		2.60		
0.23	2550 to 2795 {260 to 285}		2.90	1716 to 1912 {175 to 195}	
0.26	2501 to 2746 {255 to 280}		3.20	1667 to 1863 {170 to 190}	1667 to 1814 {170 to 185}
0.29	2452 to 2697 {250 to 275}	—	3.50	1667 to 1814 {170 to 185}	
0.32	2403 to 2648 {245 to 270}		4.00		
0.35			4.50	1618 to 1765 {165 to 180}	1618 to 1765 {165 to 180}
0.40	2354 to 2599 {240 to 265}		5.00		
0.45	2305 to 2550 {235 to 260}		5.50	1569 to 1716 {160 to 175}	1569 to 1716 {160 to 175}
0.50			6.00	1520 to 1667 {155 to 170}	1520 to 1667 {155 to 170}
0.55	2256 to 2501 {230 to 255}		6.50		
0.60	2206 to 2452 {225 to 250}		7.00	1471 to 1618 {150 to 165}	—
0.65			8.00		
0.70	2158 to 2303 {220 to 245}		9.00	1422 to 1569 {145 to 160}	
0.80	2108 to 2354 {215 to 240}		10.00		
0.90	2108 to 2305 {215 to 235}				

Remark: For wires with an intermediate diameter, the tensile strength for the nearest thicker wire with the nearest diameter shall apply.

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(3) Wires 6 mm or less in diameter shall be subjected to a torsion test. The number of turns before failure, the resultant wire cross section and the condition of torsion shall conform to Table 4.

Table 4

No. of turns	Class A	Wire dia. : 2.6 mm max.	25 turns min.
		Wire dia. : Over 2.6 mm	20 turns min.
	Class V		25 turns min.
Resultant wire cross section			Flaws or cracks shall not be found. The surface should be in perpendicular to wire axis.
Condition of torsion			Torsion shall be uniform over entire length, without longitudinal cracks flaws or local torsion, and without conspicuous spiraling.

(4) Wires over 6 mm in diameter shall be subjected to a bending test. The wire shall not be torn or exhibit any detrimental flaws on the surface.

(5) Wires 1 mm or more in diameter shall be subjected to a flaw detection test. The flaw depth shall not exceed the values in Table 5.

Table 5

Unit: mm

Wire diameter	Flaw depth	
	Class A	Class V
2.00 max.	0.02 max.	0.01 max.
Over 2.00 to 3.00 incl.	0.03 max.	0.02 max.
Over 3.00 to 4.00 incl.	0.04 max.	
Over 4.00 to 5.00 incl.	0.05 max.	0.03 max.
Over 5.00 to 6.00 incl.	0.06 max.	
Over 6.00 to 8.00 incl.	0.07 max.	
Over 8.00	0.08 max.	

(6) When subjected to a decarburization check, class V wires shall not present a ferrite layer. In addition, the total depth of decarburization may exceed neither 1.5 % of the diameter nor 0.05 mm.

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5. Wire Diameter and Its Tolerance

(1) The standard wire diameter of piano wires shall conform to Table 6. The diameter ranges from 0.08 to 10.00 mm for class A, and from 2.00 to 6.00 mm for class V. The wire diameters shown in Table 6 are preferred: however, other sizes are acceptable when justified.

Table 6

Unit: mm

0.08	0.16	0.29	0.50	0.80	1.60	2.90	5.00	8.00
0.09	0.18	0.32	0.55	0.90	1.80	3.20	5.50	9.00
0.10	0.20	0.35	0.60	1.00	2.00	3.50	6.00	10.00
0.12	0.23	0.40	0.65	1.20	2.30	4.00		
0.14	0.26	0.45	0.70	1.40	2.60	4.50		

(2) Dimensional tolerances and out-of-round for piano wires shall conform to Table 7.

Table 7

Unit: mm

Wire diameter	Tolerance	Permissible eccentricity
0.18 max.	±0.005	
Over 0.18 to 0.45 incl.	±0.010	0.010 max.
Over 0.45 to 1.80 incl.	±0.015	0.015 max.
Over 1.80 to 3.20 incl.	±0.020	0.020 max.
Over 3.20 to 6.00 incl.	±0.030	0.030 max.
Over 6.00	±0.050	0.050 max.

6. Test Methods

6.1 Chemical Composition

According to TSG1000G and TSG2902G.

6.2 General Quality

According to the methods under Section 13 of TSG3000G.

6.3 Tensile Test

The tensile test shall be performed according to TSG2203G. The distance between clamps shall be about 100 mm for wire diameters under 1.00 mm and to about 200 mm for wire diameters 1.00 mm or more. When the specimen is broken at either clamping point, the test shall be invalidated and repeated with another specimen.

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6.4 Torsion Test

Both ends of the specimen shall be gripped firmly at a distance 100 times as a 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.

6.5 Bending Test

The specimen shall be bent at two points to an angle of 90° along a curvature whose radius is equal to the specimen diameter. The resultant wire surface shall be examined.

6.6 Flaw Detection Test

A wire with an appropriate length relieved of residual strain shall be boiled in an appropriate mixture of hydrochloric acid and water. The wire shall be inspected for flaws when it has reduced its diameter by about 1 % without pitting. Measure the flaw depth by grinding the wire until the flaw disappears and comparing the wire thickness before and after the grinding. This procedure, however, shall not apply to wire diameters under 1 mm.

6.7 Decarburization Test

The check shall be performed according to TSG2107G.

Applicable Standards

TSG1000G General Rule for Chemical Analysis of Steel Materials
TSG2107G Test Method for Decarburized Layer of Steels
TSG2203G Tensile Test Method for Metallic Materials
TSG2902G Method of Spark Test for Steels
TSG3000G General Quality of Steels for Machine Structural Use

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