

SWOSC-VHV

Oil tempered SiCrV-alloyed high tensile valve spring wire
Only manufactured in China

SWOSC-VHV is a Super Clean steel, especially intended for the manufacture of valve springs and other springs requiring high fatigue properties and good relaxation properties at moderately increased working temperatures.

The wire is manufactured in shaved condition in sizes from Ø 1.60 mm to 6.50 mm, or in egg or elliptical shape (corresponding to round cross section 2.50 mm to 6.50 mm). Other wire sizes on request.

CHEMICAL COMPOSITION

C (%)	Si (%)	Mn (%)	P max. (%)	S max. (%)	Cr (%)	V (%)
0.50 - 0.70	1.20 - 1.65	0.50 - 0.80	0.020	0.020	0.50 - 1.00	0.05 - 0.20

CLEANLINESS IN STEEL

The presence of non-metallic inclusions in the wire rod is inspected for every heat of SWOSC-VHV in accordance with the Suzuki Garphyttan method by the steel supplier.

Before release for production, Suzuki Garphyttan performs non-metallic inclusion inspection for every fifth heat. The criteria for supplier inspection and releasing inspection are the following;

For **wire** rod samples: Inclusion size max. 15 µm down to 1 mm below surface. Inspection area: 1 000 mm².

Inclusion size, surface	5-10 µm	>10-15 µm	>15 µm
Max. number of inclusions	50	7	0

For SWOSC-VHV, every heat is inspected including a SEM-EDS analysis of inclusions > 10µm to verify a Super Clean composition.

As stated by IVSWMA, International Valve Spring Wire Manufacturers Association, it is likely to find occasional inclusions in valve spring quality steel of a size larger than 30 µm.

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MECHANICAL PROPERTIES

- 1) Other wire sizes on request.
- 2) Ovality, i. e. the difference between the largest and smallest dimension of a cross section, is maximum half the tolerance range.
- 3) Conversion from tensile strength to hardness values can be calculated in standard ISO EN 18265. The tensile strength R_m within one coil does not vary more than 50 N/mm^2 .
- 4) Torsion test is carried out for assessing deformability. The fracture of the torsion test piece shall be smooth and perpendicular to the wire axis. The rupture shall show no longitudinal cracks.

FOR ROUND WIRE

Diameter (mm)	Tolerance (\pm mm)	Tensile Strength (N/mm^2)	Torsions ($l=300 \text{ mm}$, min. revs)	Reduct. of area (min. %)
1.60 - 2.00	0.020	2160 - 2260	5	45
2.01 - 2.50	0.020	2110 - 2210	5	45
2.51 - 3.20	0.020	2060 - 2160	5	45
3.21 - 4.00	0.025	2010 - 2110	4	45
4.01 - 5.00	0.025	1960 - 2060	3	45
5.01 - 5.60	0.030	1910 - 2010	3	40
5.61 - 6.00	0.035	1910 - 20100	3	40
6.01 - 6.50	0.035	1910 - 2010		35

YIELD POINT

The proof stress $R_{p0.2}$ is min. $0.9 \times$ tensile strength of the wire.

SURFACE CONDITIONS

SURFACE CONDITION

Surface condition – non-destructive testing

In the standard size range 2.00 - 6.00 mm the wire is tested continuously in Eddy Current equipment to a surface level of ≥ 40 microns. Other wire sizes on request.

Surface condition – end sample test

The wire is end sample tested by means of etch testing and binocular inspection as well as microscopical inspection of the material structure.

Max. permissible depth of partial surface decarburization and surface defects, $1\% \times$ wire diameter. In shaved condition; for diameters $\leq 2.00 \text{ mm}$ $10 \mu\text{m}$, for diameters $> 2.00 \text{ mm}$ $0.5\% \times d$.

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PHYSICAL PROPERTIES

E AND G MODULUS OF ELASTICITY

206 kN/mm²

E AND G MODULUS OF SHEAR

79.5 kN/mm²

STANDARDS

NEAREST EQUIVALENT STEEL GRADES

EN VDSiCrV

NEAREST EQUIVALENT STANDARDS

EN 10270-2

RECOMMENDATIONS

HEAT TREATMENT

As soon as possible after coiling, the springs should be stress relieved.

HOT PRESETTING

After shot peening, the springs should be hot preset or stress relieved. In order to reach optimum fatigue and relaxation properties, the springs must be preset at an appropriate stress.

SHOT PEENING

In order to obtain optimum fatigue properties, the process time should be adjusted to get a complete treatment. Size of shots should be adapted to wire dimension, pitch and shot peening equipment.

Shot peening of the inside of the spring coils is particularly critical.

SPRING CONDITIONS FOR TESTS

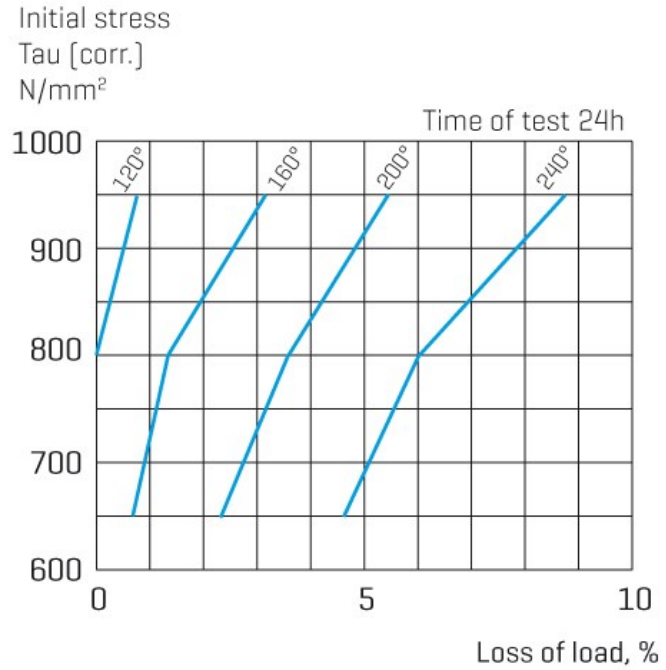
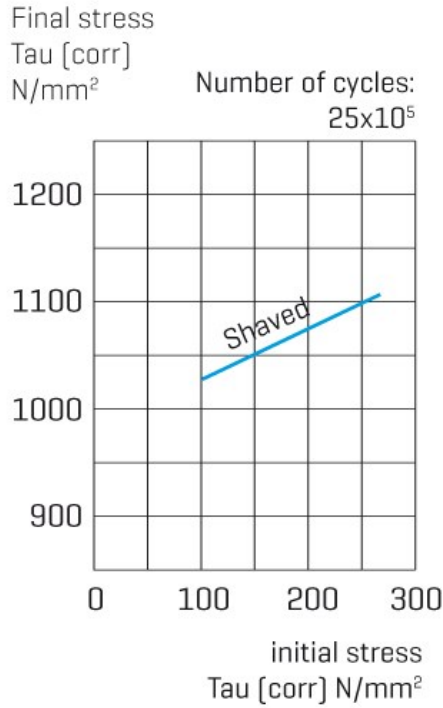
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Spring conditions for fatigue and relaxation tests (specially designed test spring) Diagram 1 and 2:	
Wire size	Ø 4.00 mm
Diameter external	28.00 mm
Spring length, l0	59.5 mm
N active	4.80
Spring index	6.0
Stress relieving	
Temperature	420 ±5°C (790 ±10 °F)
Time	30 minutes
Shot peening (double shot peening)	
1st treatment	Speed 56 m/sec. for 20 minutes, size of shots 0.8 mm
2nd treatment	Speed 30 m/sec. for 10 minutes, size of shots 0.8 mm
Hardness of Shot-peening grit (shot):	610-670 Hv
Aim for Almen arc-height	Min 0.45 mm
Hot presetting (theoretically set)	
	1300 N/mm ²
Temperature	200°C (max. 250°C)
Time	10 minutes

RELAXATION AND FATIGUE PROPERTIES

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In diagram 1 the fatigue properties of this grade are illustrated in a Goodman-diagram, based on a special test spring design.

Diagram 2 shows the relaxation properties (loss of load) of springs made from SWOSC-VHV wire subjected to static compression at different temperatures.