OTEVA 101 SC

Oil tempered SiCrVMoW-alloyed ultra-high tensile valve spring wire for surface nitriding.

OTEVA® 101 SC is a Super Clean steel, especially intended for the manufacture of clutch and transmission springs and other springs requiring high fatigue properties and good relaxation properties at increased working temperatures.

Manufactured as standard in shaved condition in sizes from Ø 2.00 mm to 5.00 mm or in egg or elliptical shape corresponding to round cross section 2.50 mm to 5.00 mm. Other wire sizes on request.

Chemical composition

Element	Weight %
C	0.50% - 0.70%
Si	2.10% - 2.40%
Mn	0.30% - 0.70%
P max.	0.020%
S max.	0.030%
Cr	1.10% - 1.40%
V	0.05% - 0.25%
Mo	0.05% - 0.25%
W	0.05% - 0.25%

Data last verified: 2023-04-13

Cleanliness in steel

The presence of non-metallic inclusions in the wire rod is inspected for every heat 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 mm^2.

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

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.

Mechanical properties

For round wire

Diameter (mm)	Tolerance (mm)	Tensile Strength (N/mm^2)	Torsions (l=300 mm, min. revs)	Reduct. of area (min. %)
2.00 - 2.50	±0.020	2100 - 2200	2	40
2.51 - 3.20	±0.020	2100 - 2200	2	40
3.21 - 4.00	±0.025	2100 - 2200	2	40
4.01 - 5.00	±0.025	2100 - 2200	2	40

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Surface conditions

Surface condition

Surface condition – non-destructive testing
In the standard size range 2.00 - 5.00 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, 0.5% x wire diameter. No complete decarburization allowed.

Technical specification

Property	Value
E modulus of elasticity	206 kN/mm^2
G modulus of shear	79.5 kN/mm^2

Steel grades and product standards

Nearest equivalent product standards	EN 10270-2

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Recommendations

Heat treatment

As soon as possible after coiling, the springs should be stress relieved. Depending on nitriding temperature used later in the spring manufacturing process, this temperature may be decreased.

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.

Soft shot peening

Before the nitriding process a soft shot peening process shall be applied in order to remove the oxide layer on the spring wire surface.

Nitriding

Springs of OTEVA® 101 SC must be nitrided to obtain optimum fatigue and relaxation properties. Our recommendation is gas nitriding.

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.

For nitrided springs with an extremely hard surface zone, it is important to use a shot peening media with high hardness.

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

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Spring conditions for tests

Spring conditions for fatigue and relaxation tests (specially designed test spring) Diagram 1 and 2:

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Wire diameter	Ø 3.85 mm
Diameter external	26.95
Spring length, l0	53.0
N active	4.15
Spring index	6.0
Stress relieving	
Temperature	450°C (790 ±10 °F)
Time	30 minutes
Soft shot peened	
Speed	20-30 m/s
Time	5 min
Shot size	0.8 mm
Nitriding	Gas nitriding
Temperature	450-470°C
Time	5-20 hours
Aim for surface hardness	Min. 850 Hv
Aim for core hardness	Min. 610 Hv

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Compound (white) layer	Max. 1 µm.
Shot peening (triple shot peening for nitrided springs)	
1st treatment	Pressure 0.3 MPa with RCW shoot size 0.6 mm (hardness 800 Hv) for 20 minutes.
2nd treatment	Pressure 0.3 MPa with RCW shoot size 0.25 mm (hardness 800 Hv) for 10 minutes.
3rd treatment	Pressure 0.2 MPa with fine shoot size (hardness 700 HV) for 10 minutes.
Aim for Almen arc-height	0.55 – 0.60 mm
Hot presetting	1500 N/mm2 (nitrided springs)
(theoretically set)	1300 N/mm2 (not nitrided springs)
Temperature	200°C (max. 250°C)
Time	10 minutes

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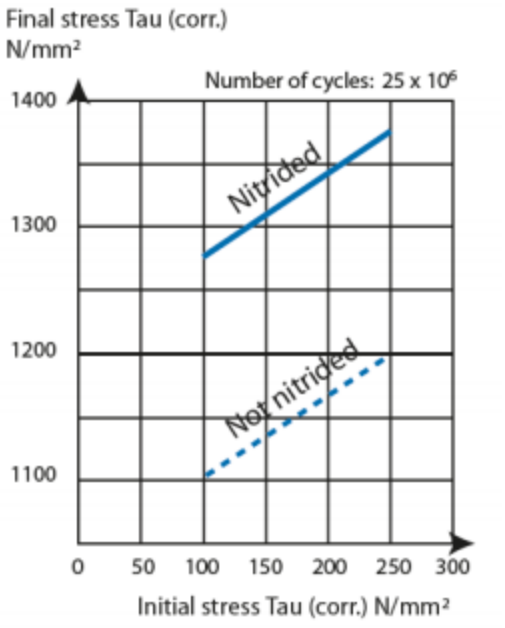

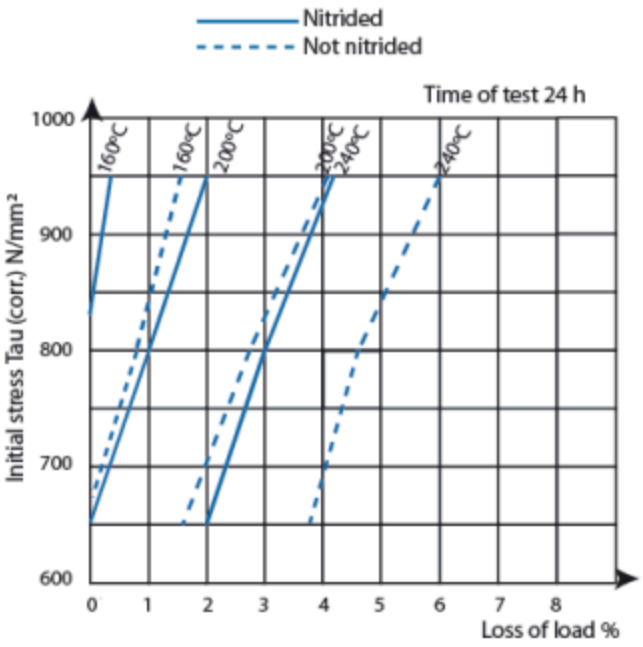

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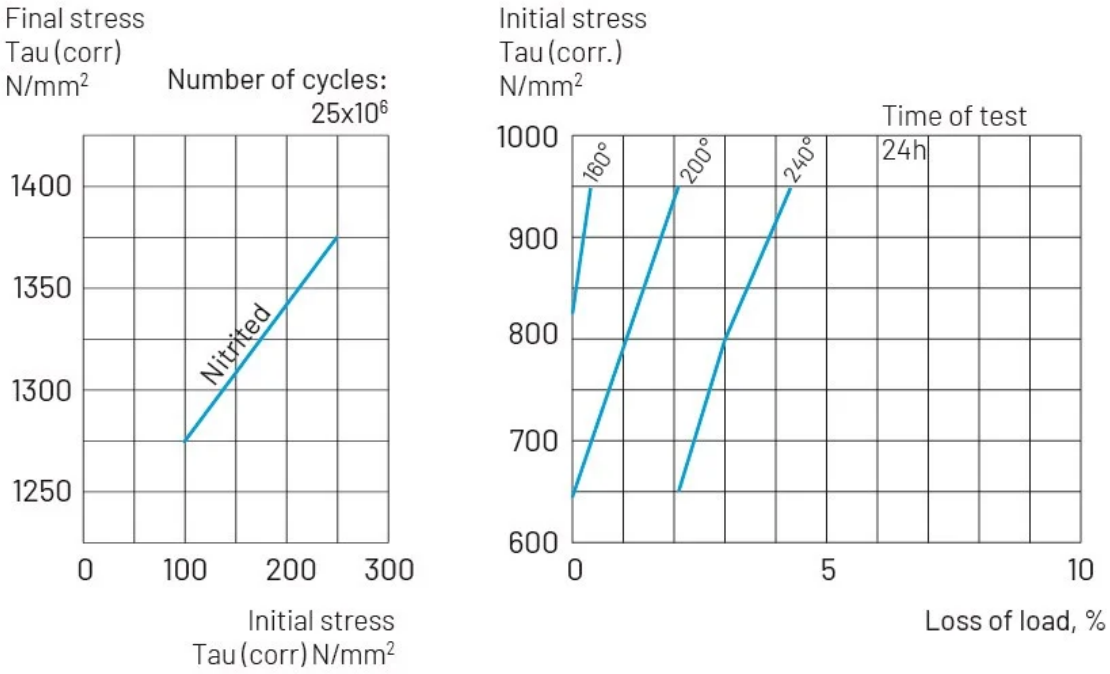
Relaxation and fatigue properties



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 nitrided springs made from OTEVA® 101 SC wire subjected to static compression at different temperatures, nitrided/not nitrided.

Additional

Additional information

Decarburisation
No total decarburisation. Partial decarburisation (no continuous zones) max. 1.2% of a corresponding round wire dimension.

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