

# OTEVA 101 SC

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Oil tempered SiCrVMoW-alloyed ultra-high tensile clutch and transmission 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  $\varnothing$  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

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

## 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  $\mu$ m down to 1 mm below surface. Inspection area 1 000 mm<sup>2</sup>.

Inclusion size, surface	5-10	> 10-15	>15 $\mu$ m
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  $\mu$ m.

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## MECHANICAL PROPERTIES

### FOR ROUND WIRE

Diameter (mm)	Tolerance ( $\pm$ mm)	Tensile Strength (N/mm <sup>2</sup> )	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

## 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  $\geq 40$  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.

## STANDARDS

### NEAREST EQUIVALENT STANDARDS

EN 10270-2

## 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.

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## 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.

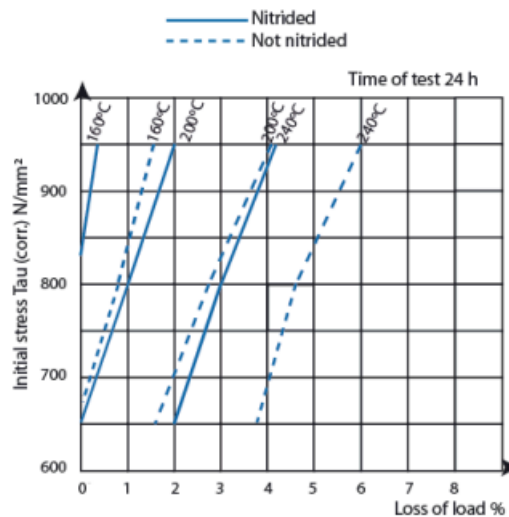
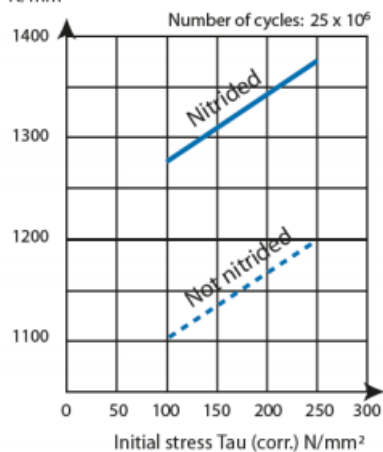
## SPRING CONDITIONS FOR TESTS

<b>Spring conditions for fatigue and relaxation tests (specially designed test spring) Diagram 1 and 2:</b>	
Wire diameter	Ø 3.85 mm
Diameter external	26.95
Spring length, l0	53.0
N active	4.15
Spring index	6.0
<b>Stress relieving</b>	
Temperature	450°C (790 ±10 °F)
Time	30 minutes
<b>Soft shot peened</b>	
Speed	20-30 m/s
Time	5 min
Shot size	0.8 mm
<b>Nitriding</b>	
Temperature	450-470°C
Time	5-20 hours
Aim for surface hardness	Min. 850 Hv

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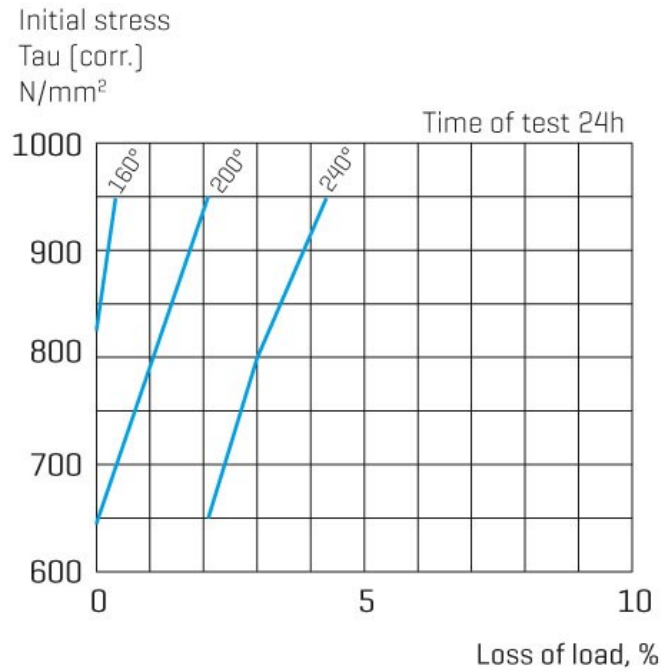
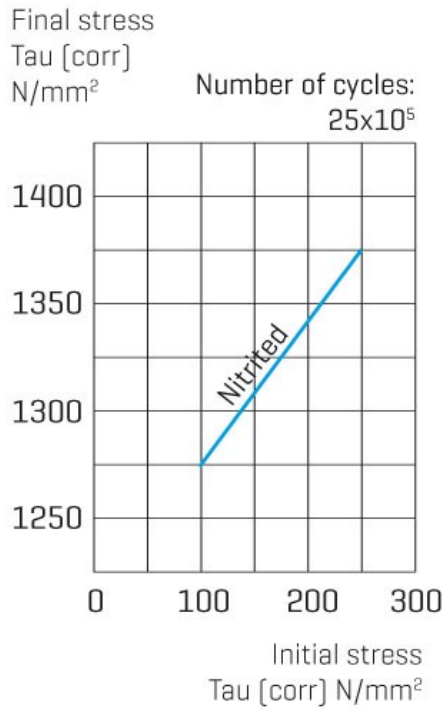
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Aim for core hardness	Min. 610 Hv
Compound (white) layer	Max. 1 $\mu$ m.
<b>Shot peening</b> (triple shot peening for nitrided springs)	
1st treatment	Pressure 0.3 MPa with RCW shoot size 0.6 mm (hardness 800 Hv) for 20 minutes.
2nd treatment	Pressure 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
<b>Hot presetting</b>	
(theoretically set)	1500 N/mm <sup>2</sup> (nitrided springs) 1300 N/mm <sup>2</sup> (not nitrided springs)
Temperature	200°C (max. 250°C)
Time	10 minutes

 Final stress Tau (corr.)  
N/mm<sup>2</sup>


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