

GARBA 177 PH

Precipitation hardenable (PH) metastable austenitic stainless steel for medium cyclic fatigue and elevated temperature.

GARBA 177 PH is a semi-austenitic precipitation-hardenable stainless steel with high relaxation resistance at elevated temperatures and excellent fatigue properties. This material has good formability and good form stability during the precipitation hardening heat treatment and a moderate level of corrosion resistance.

Chemical composition

Property	Value
C	0.09%
Si	0.70%
Mn	1.00%
P max.	0.040%
S max.	0.015%
Cr	16.00% - 18.00%
Al	0.70% - 1.50%
Ni	6.50% - 7.80%

Mechanical properties

For round wire

Diameter (mm)	Tolerance (mm)	Tensile strength (N/mm ²)	Tensile strength after heat treatment 480C 1h (N/mm ²)
0.30 - 0.65	±0.005		
0.66 - 1.01	±0.008		
1.02 - 2.26	±0.012		
2.27 - 4.01	±0.015		
4.02 - 6.26	±0.020		
6.27 - 8.00	±0.025		
0.30 - 0.40		1925 - 2213	2225 - 2525
0.41 - 0.50		1900 - 2185	2200 - 2500
0.51 - 0.65		1850 - 2127	2150 - 2450
0.66 - 0.80		1825 - 2099	2125 - 2425
0.81 - 1.00		1800 - 2070	2100 - 2400
1.01 - 1.25		1750 - 2012	2050 - 2350
1.26 - 1.50		1700 - 1955	2000 - 2300

Diameter (mm)	Tolerance (mm)	Tensile strength (N/mm ²)	Tensile strength after heat treatment 480C 1h (N/mm ²)
1.51 - 1.75		1650 - 1897	1950 - 2250
1.76 - 2.00		1600 - 1840	1900 - 2200
2.01 - 2.50		1550 - 1782	1850 - 2150
2.51 - 3.00		1500 - 1725	1800 - 2100
3.01 - 3.50		1450 - 1667	1750 - 2050
3.51 - 4.25		1400 - 1610	1700 - 2000
4.26 - 5.00		1350 - 1552	1650 - 1950
5.01 - 6.00		1300 - 1495	1550 - 1850
6.01 - 8.00		1250 - 1437	1500 - 1800

Surface conditions

Surface condition

Surface performance

AC-surface 0.30-8.00 mm Ø.

The AC-coating can be removed before heat treatment by using a 10-20% nitric acid pickle at room temperature.

Physical properties

Heat conductivity

Temperature °C	20	100	300
W/(m*°C)	15.0	15.5	19.0

Resistivity

Temperature °C	20	100	200	300
nΩm	900	950	1000	1050

Linear expansion

Pro °C	<30-100	30-200	30-300
x10 ⁻⁶	13.0	13.5	14.0

Specific heat capacity

Temperature °C	100	200
J/(kg °C)	480	520

Technical specification

Property	Value	
E modulus of elasticity	Abt. 190 kN/mm ² in drawn condition.	Abt. 200 kN/mm ² after heat treatment.
G modulus of shear	Abt. 73 kN/mm ² in drawn condition.	Abt. 78 kN/mm ² after heat treatment.

Steel grades and product standards

Nearest equivalent product standards	EN ISO 6931-1	ASTM A313	AMS 5678	BS 2056 301 S81	JIS G4314
Nearest equivalent steel grades	EN/DIN 1.4568	AISI/SAE 631	JIS SUS 631		

Recommendations

Heat treatment

Normal procedure for precipitation hardening is heat treatment at 480°C (896°F) for 1 hour and then air cooling. This should be done as soon as possible after spring coiling. The tensile strength of the wire before and after this treatment is given in the table in previous page.

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.

Relaxation and fatigue properties

In diagram 1 the fatigue properties of GARBA 177 PH is illustrated in a Goodman-diagram, based on a special test spring design.

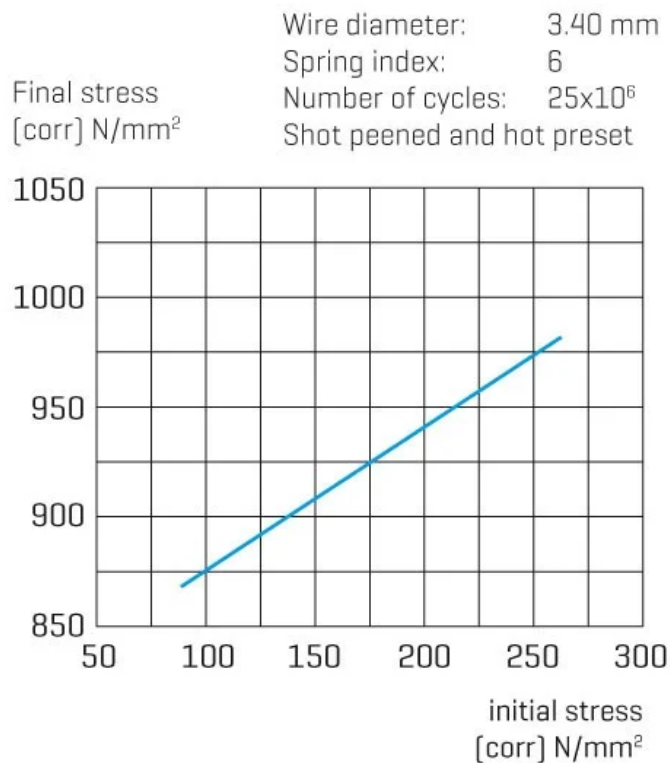


Diagram 2-3 show the relaxation properties (loss of load) of springs made from GARBA 177PH subjected to three different stress levels at different temperatures.

