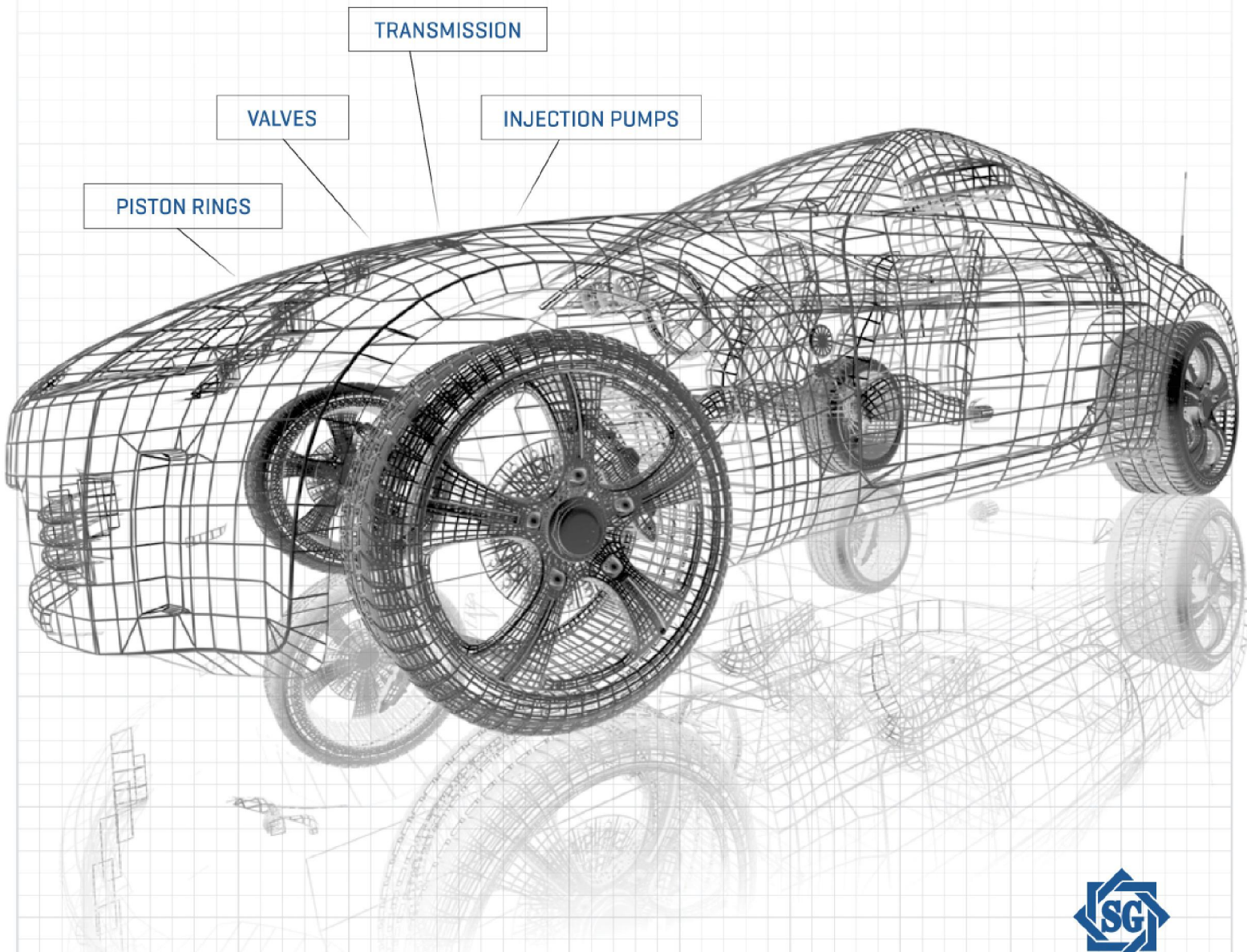


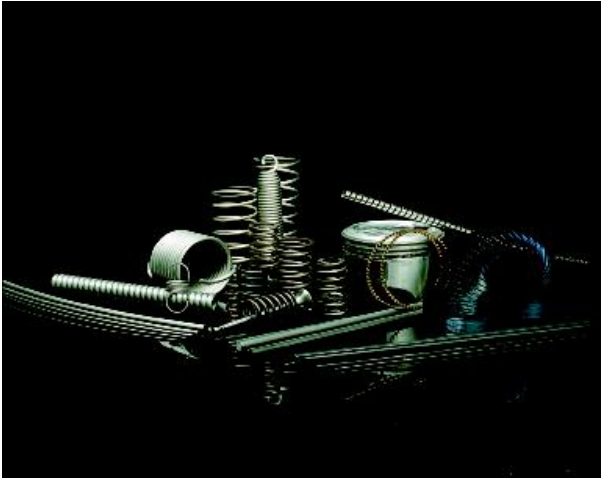
TECHNICAL PRODUCT INFORMATION

THE STRONGER.  
THE BETTER.



Suzuki Garphyttan

# Spring wire for applications with high performance demands



*The main focus is spring wire for combustion engines (valve and transmission springs, piston rings, compression rings, fuel injection springs) and other automotive applications.*

Suzuki Garphyttan has produced wire since 1906. Since 1927 the main product is oil tempered valve spring wire for the automotive industry. During the years others special wires such as stainless round wire, flat rolled and shaped wire in carbon, low alloyed and stainless material, have been added to the product program. We have acquired extensive knowledge and experience of steel grades, efficient manufacturing and quality control which is crucial to the properties of the finished product. Large resources are invested in research concerning improved properties of our products and improved manufacturing processes, enabling Suzuki Garphyttan to be world leader in the manufacturing of spring wire.

## **Coiling properties**

Defect free surfaces, narrow dimensional and tensile strength tolerances are important in achieving the best properties for spring coiling. Each wire is continuously controlled during the entire manufacturing – from wire rod to the finished product – according to a specific control plan.

## **Certified quality**

Suzuki Garphyttan has a Quality Management System certified according to the International Standard for Quality ISO TS 16949.

Our main wire rod suppliers also have Quality Management Systems certified by a third party according to ISO 9001 as a minimum and are also regularly audited by Suzuki Garphyttan.

## **Technical support**

We are prepared to assist you in utilizing modern materials for maximum performance. For us it is obvious and necessary to be at the front, to serve our customers, discussing problems and areas for development in existing as well as new products.

## **Environmental awareness**

Our goal is to manufacture high quality products without any negative effects on the environment. We are continuously improving our manufacturing processes to improve both internal and external environment. Before new investments are made, special consideration is given to environmental solutions.

We are certified according to ISO 14001.

For more information regarding different elements in our products we recommend the database IMDS "International Material Data System" where each element is named with a separate CAS-No. See the following Internet address: [www.mdsystem.com](http://www.mdsystem.com).



Stainless spring  
wire for high performance  
applications



**Suzuki Garphyttan**

# High fatigue and corrosion resistant wire

## **GARBA - Stainless spring wire**

A stainless wire which is used in springs demanding special properties such as corrosion and fatigue resistance and which are highly resistant to heat and wear. GARBA is available in several different steel grades with high tensile strength, fatigue strength and good coiling characteristics. The wire is normally delivered with an AC-surface coating to enhance the coiling properties. Some typical applications are springs for air compressors, anti-block brake systems, relays, cameras, injection pumps, common rail systems, marine and environmental use.

## **Specific fatigue demands on GARBA grades**

GARBA 177 PH has been developed for applications demanding extra strength performance. GARBA 177 PH has the following advantages: Higher fatigue strength than ordinary 18/8-steel after precipitation hardening, high level of corrosion resistance, heat resistant at >250-350°C, excellent spring characteristics, elasticity comparable to high grade music wire and good dimensional stability after spring coiling as well as after precipitation hardening.

GARBA 177 Supreme® is an electro slag refined version, ESR, of GARBA 177 PH for superior fatigue resistance.

The ESR process gives a material with lower level of inclusions compared to a material not processed with ESR and in addition a better segregation level.

Material properties achieved by ESR in combination with shaved surface and precipitation hardening result in superior fatigue resistance.

GARBA 177 Supreme® is commonly used in injection pumps and common rail systems.

## **GARBAFLEX flat wire**

We can offer flat wire in the grades below from high quality round wire which is cold rolled in our modern, high capacity rolling mill.

Before rolling the wire is cold drawn and heat treated to ensure correct dimension, structure and hardness. This process is done using equipment and methods, which have made Suzuki Garphyttan one of the world's leading manufacturers of spring wire.

Typical applications for stainless flat wire are expander for 3 part piston oil scraper rings, retaining rings and wave springs.



## **GARBAFLEX shaped wire**

We can offer profiled wire products in the grades below. Shaped wire is manufactured from high quality round wire which is die drawn or profile rolled to finished form in our modern rolling mill. Shaped wire is available in an annealed or cold rolled finish. Typical applications for shaped wire are retaining rings, springs and medical applications.

# High fatigue and corrosion resistant wire

## Chemical composition, approximate values %

Our steel grades	C	Si	Mn	P max.	S max.	Cr	Ni	Mo	Al	Cu
GARBA 177 Supreme®	0.09	0.50	0.50	0.025	0.015	17.00	7.00	–	1.00	–
GARBA 177 Premium	0.09	0.50	0.50	0.025	0.015	17.00	7.00	–	1.00	–
GARBA 177 PH	0.09	0.50	0.50	0.025	0.015	17.00	7.00	–	1.00	–
GARBA 178 Mo	0.10	1.10	1.30	0.040	0.015	17.00	8.00	0.70	–	–
GARBA 1812Mo	0.04	0.50	1.00	0.040	0.015	17.50	12.00	2.50	–	–
GARBA 188	0.08	0.50	1.00	0.045	0.015	18.00	9.00	–	–	–
GARBA 188L	0.04	0.40	1.50	0.045	0.015	18.50	8.25	–	–	–
GARBAFLEX 11R51	0.08	1.50	1.80	0.025	0.010	17.00	7.50	0.70	–	–
GARBAFLEX 174Mn	0.07	0.50	5.90	0.045	0.020	17.00	5.00	–	–	–
GARBAFLEX 177PH	0.09	0.50	0.50	0.025	0.015	17.00	7.00	–	1.00	–
GARBAFLEX 188	0.08	0.50	1.00	0.045	0.015	18.00	9.00	–	–	–
GARBAFLEX 188L	0.04	0.40	1.50	0.045	0.015	18.50	8.25	–	–	–

## Nearest equivalent steel grades

## Nearest equivalent standards

Our steel grades	EN	AISI/SAE	JIS	EN	ASTM	ISO	AMS	BS	JIS
GARBA 177 Supreme®	1.4568	631	SUS 631	10270-3	A313	–	5678	–	G4314
GARBA 177 Premium	1.4568	631	SUS 631	10270-3	A313	–	–	–	G4314
GARBA 177 PH	1.4568	631	SUS 631	10270-3	A313	–	–	2056 301 S81	G4314
GARBA 178 Mo	1.4310	302	–	10270-3	A313	–	–	2056 302 S26	–
GARBA 1812Mo	1.4401	316	SUS 316	10270-3	A313	–	–	2056 316 S42	G4314
GARBA 188	1.4310	302	SUS 302	10270-3	A313	–	5688	2056 302 S26	G4314
GARBA 188L	1.4301	304	SUS 304	–	A313	–	–	2056 304 S15	G4314
GARBAFLEX 11R51	1.4310	302	SUS 302	10270-3	A313/A313M	6931-1	–	–	–
GARBAFLEX 174Mn	1.4371	201	SUS 201	–	–	–	–	–	G4309
GARBAFLEX 177PH	1.4568	631	SUS 631	–	A313	–	–	–	G4314
GARBAFLEX 188	1.4310	302	SUS 302	–	A313	–	5688 F	2056 302 S25	G4314
GARBAFLEX 188L	1.4301	304	SUS 304	–	A313	–	–	2056 304 S15	G4314

# Delivery forms

## Stainless steel spring wire

Our stainless grades can be delivered in coils as per below:

Wire size mm	Coil weight kg, approx.	Coil diameter mm, mean
0.51 – 0.80	20 – 70	300/400
0.81 – 1.10	50 – 80	400
1.11 – 1.50	80 – 150	400/600
1.51 – 3.50	100 – 250	600/750
3.51 –	200	600/750



### Carriers – Eddy Current tested wire

Wire size	2.50– 5.60 mm
Weight	800 kg

### Compact coils

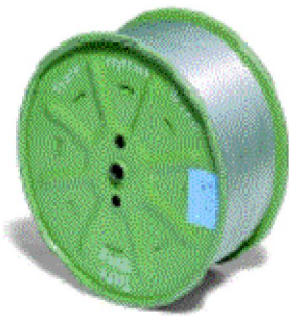
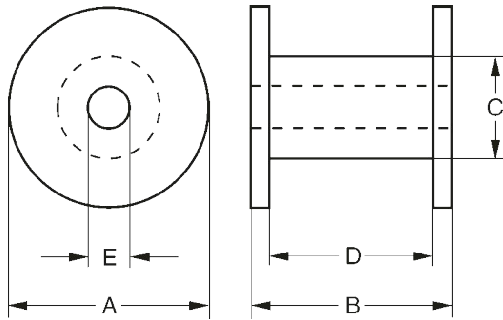
With or without paper core

Size range:	1.50 - 7.00 mm	
	Z2 (1.50-2.40 mm)	Z3 (2.00-7.00 mm)
Inner diameter:	355 mm	500 mm
Weight:	450 kg	450-900 kg



# Delivery forms

## Stainless steel spring wire



### Metal spools

Wire Ø mm	Size, mm					Weight
	A	B	C	D	E	kg
0.40	695	314	400	279	33	approx. 125
0.41 – 2.00	695	314	400	279	33	approx. 125-250
1.50 – 3.00	770	445	400	400	33	max. 500



### Wooden spools

Wire size 0.50 – 3.00 mm.

Size, mm	Size, mm					Weight
	A	B	C	D	E	kg
750	290	495	242	32		approx. 250

### Plastic reels DIN 8559

Wire size: 0.25 – 1.10 mm

Wire size, mm	Type	Reel size, mm					Weight kg
		A	B	C	D	E	
0.25 – 0.35	SH 460	460	105	319	91	305	approx. 20
0.36 – 1.10	SH 460	460	105	319	91	305	approx. 40



# Delivery forms

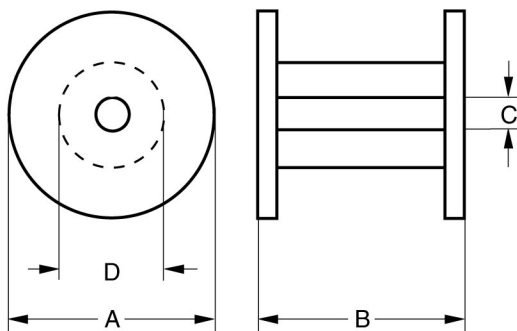
## Flat and shaped Stainless Steel

Wooden spool, 250 kg



### Wooden spools

Type	Size, mm				Weight
	A	B	C	D	kg approx.
SP 60	510	235	350	410	60
SP 125	610	225	350	410	125
SP 250	765	235	350	505	250





# GARBA 177 Supreme®

Precipitation hardenable stainless spring wire. Shaved and EC-tested \*].  
For applications demanding superior fatigue properties

GARBA 177 Supreme® is a semi-austenitic precipitation-hardenable stainless steel, processed by ESR (Electro Slag Refining), which reduces the risk of harmful inclusions. The ESR process together with a shaved surface improves the fatigue resistance as compared to GARBA 177PH.

## Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	Cr %	Ni %	Al %
0.09	0.50	0.50	17.00	7.00	1.00

## Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Tensile strength (N/mm <sup>2</sup> ) Drawn condition		Heat treated 480°C, 1 h Min.-Max.
		Min.	Max.	
0.30 – 0.41	0.005	1885	2165	2205-2525
>0.41 – 0.65	0.005	1860	2130	2180-2490
>0.65 – 0.81	0.008	1810	2070	2130-2430
>0.81 – 1.01	0.008	1810	2060	2130-2420
>1.01 – 1.61	0.012	1780	2030	2100-2390
>1.61 – 2.26	0.012	1720	1960	2040-2310
>2.26 – 3.20	0.015	1670	1910	1990-2260
>3.20 – 4.01	0.015	1610	1850	1910-2180
>4.01 – 4.51	0.020	1570	1800	1900-2160
>4.51 – 5.60	0.020	1540	1770	1860-2120
		1500	1710	1820-2060
		1400	1600	1660-1940
		1350	1550	1620-1920
		1310	1500	1580-1800
		1300	1495	1550-1790

<sup>1)</sup> Narrower tolerances on request.

\*] For further details regarding dimensions comprised by EC-testing, please refer to table presented in section "Shaved and Eddy Current tested"

## AC-coating

The wire is normally supplied with AC-coating suitable for automatic spring coiling. AC-coating can be removed before heat treatment by using a 10-20% nitric acid pickle at room temperature.

## E and G modulus

Modulus of elasticity, E: Abt. 190 GPa in drawn condition.  
Abt. 200 GPa after heat treatment  
Modulus of shear, G: Abt. 73 GPa in drawn condition.  
Abt. 78 GPa after heat treatment.

Density: 7.90 kg/dm<sup>3</sup>.

## Specific heat capacity

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

## 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 <sup>-6</sup>	13.0	13.5	14.0

## Delivery forms

See separate sheet.

## Surface performance

AC-surface 0.30–5.60 mm Ø.

## Nearest equivalent steel grades

EN 1.4568, AISI/SAE 631 and JIS SUS 631.

## Nearest equivalent standards

EN 10270-3, ASTM A313, AMS 5678 and JIS G4314.

# GARBA 177 Supreme®

For applications demanding superior fatigue properties

## 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 Supreme® is illustrated in a Goodman-diagram, based on a special test spring design. Diagrams 2-3 show the relaxation properties (loss of load) of springs made from GARBA 177 Supreme® subjected to three different stress levels at different temperatures.

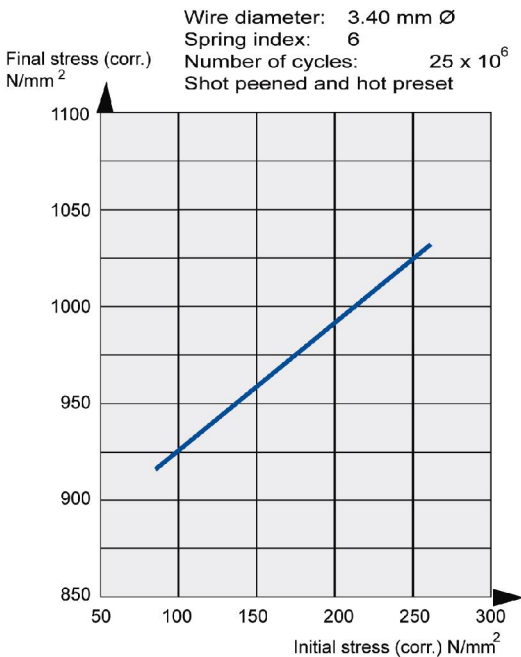


Diagram 1 (Goodman) - Fatigue properties

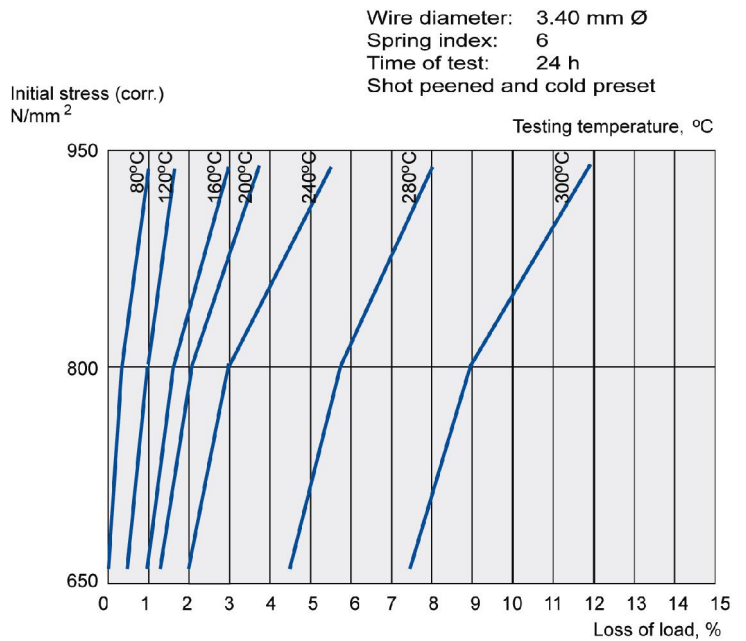


Diagram 2 - Relaxation properties, cold preset

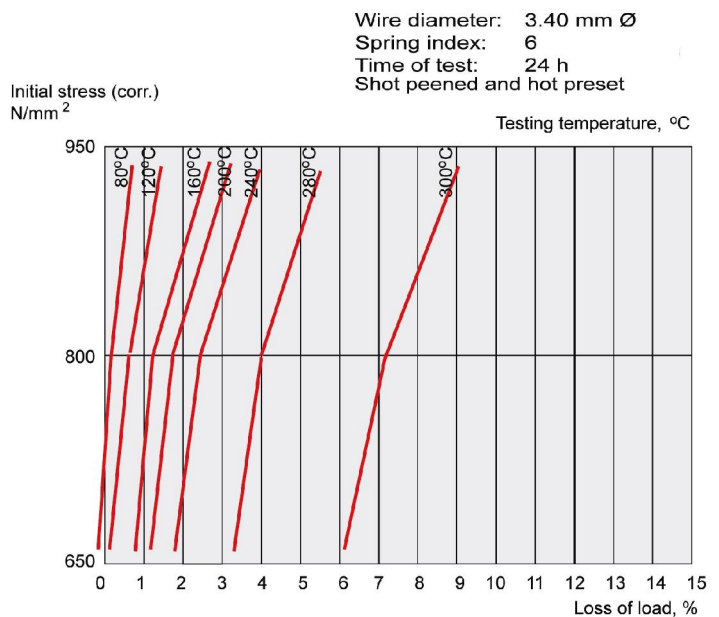


Diagram 3 - Relaxation properties, hot preset



# GARBA 177 Supreme®

## Shaved and Eddy Current tested

*Suzuki Garphyttan uses the most advanced Eddy Current testing equipment available on the market. Experience from many years of surface testing in efficient continuous testing lines is a guarantee for high quality spring wire.*

Eddy Current testing is carried out on material with high demands on surface quality.

EC-testing is performed with both rotating (R) and stationary (D) probe test equipment.

<b>Steel grade</b>	<b>Dimension, mm</b>	<b>ESR</b>	<b>Shaved</b>	<b>Unshaved</b>	<b>RD40</b>
GARBA 177 Supreme®	0.30 – 1.99	X	X	–	–
GARBA 177 Supreme®	2.00 – 5.60	X	X	–	X

# GARBA 177 Supreme®

## Electro slag refining (ESR) process

For applications demanding superior fatigue properties

### Electro Slag Refining (ESR) process

ESR process, see figure 1.

The ESR process gives a material with lower level of inclusions compared to a material not processed with ESR and in addition also a better segregation level.

Material properties achieved by ESR in combination with shaved wire surface and precipitation hardening result in superior fatigue resistance.

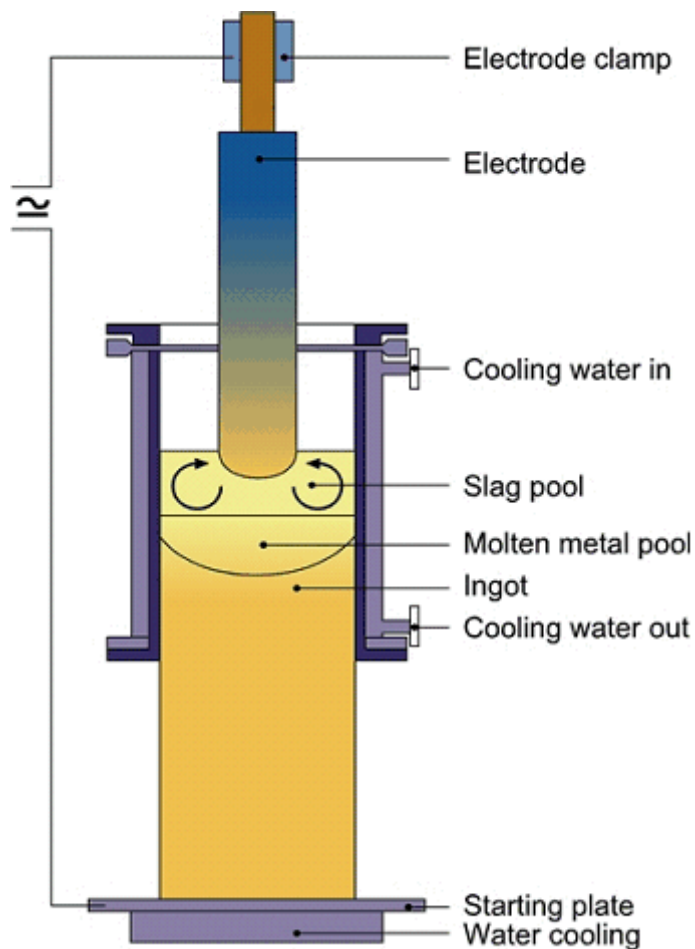


Figure 1.

# GARBA 177 Premium

Precipitation hardenable stainless spring wire. Shaved and EC-tested \*)  
For applications demanding high fatigue properties

GARBA 177 Premium 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. The shaved surface improves the fatigue resistance as compared to GARBA 177PH.

## Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	Cr %	Ni %	Al %
0.09	0.50	0.50	17.00	7.00	1.00

## Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Tensile strength (N/mm <sup>2</sup> )		Heat treated 480°C, 1 h Min.
		Size mm	Drawn condition Min. Max.	
0.30 – 0.41	0.005	0.30 – 0.40	1885 2165	2205-2525
>0.41 – 0.65	0.005	>0.40 – 0.50	1860 2130	2180-2490
>0.65 – 0.81	0.008	>0.50 – 0.65	1810 2070	2130-2430
>0.81 – 1.01	0.008	>0.65 – 0.80	1810 2060	2130-2420
>1.01 – 1.61	0.012	>0.80 – 1.00	1780 2030	2100-2390
>1.61 – 2.26	0.012	>1.00 – 1.25	1720 1960	2040-2310
>2.26 – 3.20	0.015	>1.25 – 1.50	1670 1910	1990-2260
>3.20 – 4.01	0.015	>1.50 – 1.75	1610 1850	1910-2180
>4.01 – 4.51	0.020	>1.75 – 2.00	1570 1800	1900-2160
>4.51 – 5.60	0.020	>2.00 – 2.50	1540 1770	1860-2120
		>2.50 – 3.00	1500 1710	1820-2060
		>3.00 – 3.50	1400 1600	1660-1940
		>3.50 – 4.25	1350 1550	1620-1920
		>4.25 – 5.00	1310 1500	1580-1800
		>5.00 – 5.60	1300 1495	1550-1790

<sup>1)</sup> Narrower tolerances on request.

\*) For further details regarding dimensions comprised by EC-testing, please refer to table presented in section "Shaved/Unshaved and Eddy Current tested"

### AC coating

The wire is normally supplied with AC-coating suitable for automatic spring coiling. AC-coating can be removed before heat treatment by using a 10-20% nitric acid pickle at room temperature.

### E and G modulus

Modulus of elasticity, E: Abt. 190 GPa in drawn condition.  
Abt. 200 GPa after heat treatment.

Modulus of shear, G: Abt. 73 GPa in drawn condition.  
Abt. 78 GPa after heat treatment.

Density: 7.90 kg/dm<sup>3</sup>.

### Specific heat capacity

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

### 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 <sup>-6</sup>	13.0	13.5	14.0

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.30–5.60 mm Ø

### Nearest equivalent steel grades

EN 1.4568, AISI/SAE 631, BS 2056 301 S81 and JIS SUS 631.

### Nearest equivalent standards

EN 10270-3, ASTM A313 and JIS G4314.

## GARBA 177 Premium

### Shaved and Eddy Current tested

*Suzuki Garphyttan uses the most advanced Eddy Current testing equipment available on the market. Experience from many years of surface testing in efficient continuous testing lines is a guarantee for high quality spring wire.*

Eddy Current testing is carried out on material with high demands on surface quality.

EC-testing is performed with both rotating (R) and stationary (D) probe test equipment.

<b>Steel grade</b>	<b>Dimension, mm</b>	<b>Shaved</b>	<b>Unshaved</b>	<b>RD40</b>
GARBA 177 Premium	0.30 – 6.00	X	-	-
GARBA 177 Premium	2,00 – 5.60	X	-	X

# GARBA 177 PH

Precipitation hardenable stainless spring wire.

For applications demanding medium fatigue properties.

GARBA 177PH 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, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	Cr %	Ni %	Al %
0.09	0.50	0.50	17.00	7.00	1.00

## Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance ± mm	Tensile strength (N/mm <sup>2</sup> )		Heat treated 480°C, 1 h Min.
		Drawn condition Min.	Max.	
0.30 – 0.41	0.005	1925	2213	2225
>0.41 – 0.65	0.005	1900	2185	2200
>0.65 – 0.81	0.008	1850	2127	2150
>0.81 – 1.01	0.008	1825	2099	2125
>1.01 – 1.61	0.012	1800	2070	2100
>1.61 – 2.26	0.012	1750	2012	2050
>2.26 – 3.20	0.015	1700	1955	2000
>3.20 – 4.01	0.015	1650	1897	1950
>4.01 – 4.51	0.020	1600	1840	1900
>4.51 – 6.01	0.020	1550	1782	1850
>6.01 – 6.26	0.020	1500	1725	1800
>6.26 – 7.01	0.025	1450	1667	1750
>7.01 – 8.00	0.025	1400	1610	1700
		1350	1552	1650
		1300	1495	1550
		1250	1437	1500
		1250	1437	1500

### AC coating

The wire is normally supplied with AC-coating suitable for automatic spring coiling. AC-coating can be removed before heat treatment by using a 10-20% nitric acid pickle at room temperature.

### E and G modulus

Modulus of elasticity, E: Abt. 190 GPa in drawn condition.  
Abt. 200 GPa after heat treatment.

Modulus of shear, G: Abt. 73 GPa in drawn condition.  
Abt. 78 GPa after heat treatment.

Density: 7.90 kg/dm<sup>3</sup>.

### Specific heat capacity

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

### 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 <sup>-6</sup>	13.0	13.5	14.0

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.30–8.00 mm Ø.

### Nearest equivalent steel grades

EN 1.4568, AISI/SAE 631, BS 2056 301 S81 and JIS SUS 631.

### Nearest equivalent standards

EN 10270-3, ASTM A313 and JIS G4314.

# GARBA 177 PH

## For applications demanding medium fatigue properties

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

Wire diameter: 3.40 mm Ø  
 Spring index: 6  
 Time of test: 24 h  
 Shot peened and cold preset

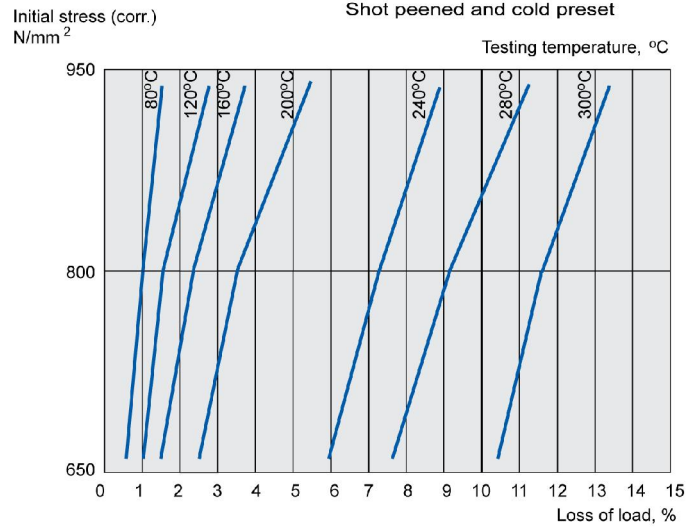


Diagram 2 - Relaxation properties, cold preset

Wire diameter: 3.40 mm Ø  
 Spring index: 6  
 Time of test: 24 h  
 Shot peened and hot preset

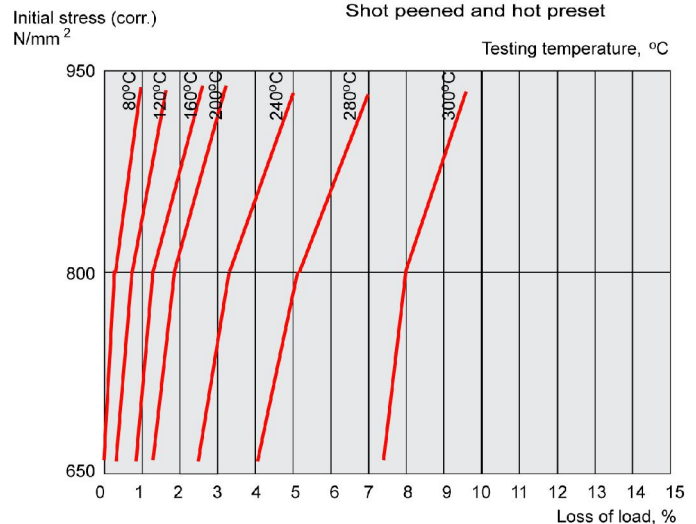


Diagram 3 - Relaxation properties, hot preset

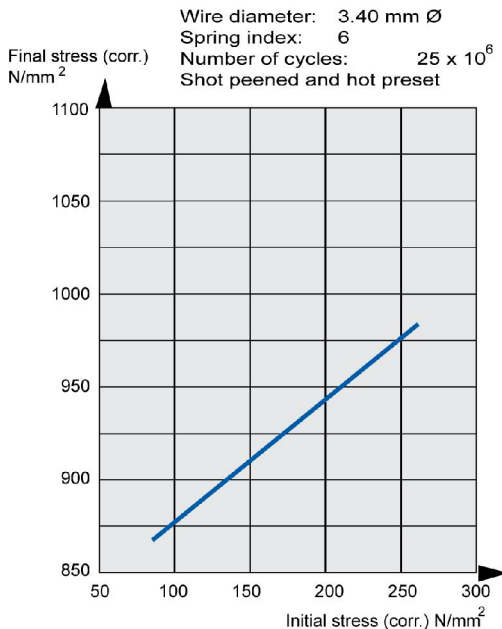


Diagram 1 (Goodman) - Fatigue properties





# GARBA 178Mo

## Stainless spring wire. Similar to EN 1.4310 with increased tensile strength

GARBA 178Mo is a general-purpose austenitic stainless steel that is used for springs and other components requiring good fatigue resistance and good resistance against atmospheric corrosion. Addition of molybdenum increases the tensile strength as compared to GARBA 188 and also increases the resistance against localised and general corrosion.

### Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	Cr %	Ni %	Mo %
0.10	1.10	1.30	17.00	8.00	0.70

### Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Size mm	Tensile strength (N/mm <sup>2</sup> )	
			Min.	Max.
0.30 – 0.41	0.008	0.30 – 0.40	2250	2590
>0.41 – 0.65	0.008	>0.40 – 0.50	2200	2530
>0.65 – 0.81	0.010	>0.50 – 0.65	2150	2470
>0.81 – 1.01	0.010	>0.65 – 0.80	2100	2420
>1.01 – 1.61	0.015	>0.80 – 1.00	2050	2360
>1.61 – 2.26	0.015	>1.00 – 1.25	2000	2300
>2.26 – 3.20	0.020	>1.25 – 1.50	1950	2240
>3.20 – 4.01	0.020	>1.50 – 1.75	1900	2190
>4.01 – 4.51	0.025	>1.75 – 2.00	1850	2130
>4.51 – 6.01	0.025	>2.00 – 2.50	1750	2010
>6.01 – 6.26	0.025	>2.50 – 3.00	1700	1960
>6.26 – 7.01	0.030	>3.00 – 3.50	1650	1900
>7.01 – 8.00	0.030	>3.50 – 4.25	1600	1840
		>4.25 – 5.00	1550	1780
		>5.00 – 6.00	1500	1730
		>6.00 – 7.00	1450	1670
		>7.00 – 8.00	1400	1610

<sup>1)</sup> Narrower tolerances on request.

### E and G modulus

Modulus of elasticity, E: Abt. 180 GPa in drawn condition  
Abt. 185 GPa after heat treatment

Modulus of shear, G: Abt. 70 GPa in drawn condition  
Abt. 73 GPa after heat treatment

Density: 7.90 kg/dm<sup>3</sup>

### Specific heat capacity

Temperature °C	20	100	200	400
J/(kg* °C)	440	480	520	560

### Heat conductivity

Temperature °C	20	100	200	400
W/(m* °C)	15.0	16.0	18.0	20.0

### Resistivity

Temperature °C	20	100	200	400
nΩm	900	950	1000	1050

### Linear expansion

Pro °C	30–100	30–200	30–400
x10 –6	17.0	17.5	18.5

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.30–8.00 mm Ø.

### Nearest equivalent steel grades

EN 1.4310 and AISI/SAE 302.

### Nearest equivalent standards

EN 10270-3, BS 2056 302 S26 and ASTM A313.

### Heat treatment

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

Recommended temperature for compression springs or tension springs without initial tension is approx. 420 °C for 0.5 - 4 hours.

# GARBA 1812Mo

## Stainless spring wire. Mo-alloyed, good corrosive resistance

GARBA 1812Mo is an austenitic stainless steel, which as compared to GARBA 178Mo offers a higher resistance against intergranular corrosion due to lower carbon content. The higher content of molybdenum also increases the resistance against general corrosion.

### Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	Cr %	Ni %	Mo %
0.04	0.50	1.00	17.50	12.00	2.50

### Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Tensile strength (N/mm <sup>2</sup> )	
		Min.	Max.
0.25 – 0.26	0.005	1700	1960
>0.26 – 0.41	0.008	1675	1930
>0.41 – 0.65	0.008	1650	1900
>0.65 – 0.81	0.010	1625	1870
>0.81 – 1.01	0.010	1600	1840
>1.01 – 1.61	0.015	1575	1810
>1.61 – 2.26	0.015	1550	1780
>2.26 – 3.20	0.020	1500	1730
>3.20 – 4.01	0.020	1450	1670
>4.01 – 4.51	0.025	1400	1610
>4.51 – 6.01	0.025	1350	1550
>6.01 – 6.26	0.025	1300	1500
>6.26 – 7.01	0.030	1250	1440
>7.01 – 8.00	0.030	1225	1410
		1200	1380
		1150	1320
		1125	1290
		1075	1240

<sup>1)</sup> Narrower tolerances on request.

### E and G modulus

Modulus of elasticity, E: Abt. 175 GPa in drawn condition  
Abt. 180 GPa after heat treatment

Modulus of shear, G: Abt. 68 GPa in drawn condition  
Abt. 71 GPa after heat treatment

Density: 8.00 kg/dm<sup>3</sup>

### Specific heat capacity

Temperature °C	20	100	200	400
J/(kg*°C)	440	480	520	560

### Heat conductivity

Temperature °C	20	100	200	400
W/(m*°C)	13.5	14.5	15.5	18.5

### Resistivity

Temperature °C	20	100	200	400
nΩm	750	800	850	1000

### Linear expansion

Pro °C	30-100	30-200	30-400
x10 <sup>-6</sup>	16.5	17.0	18.0

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.25–8.00 mm Ø.

### Nearest equivalent steel grades

EN 1.4401, AISI/SAE 316 and JIS SUS 631.

### Nearest equivalent standards

EN 10270-3, ASTM A313, BS 2056 316 S42 and JIS G4314.

### Heat treatment

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

Recommended temperature for compression springs or tension springs without initial tension is approx. 420 °C for 0.5 - 4 hours.



# GARBA 188

## Stainless spring wire

GARBA 188 is a general-purpose austenitic stainless steel, which is used for springs and other components requiring good fatigue resistance. The formability is excellent and the corrosion resistance is good against atmospheric corrosion.

### Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	P max. %	S max. %	Cr %	Ni %
0.08	0.50	1.00	0.045	0.015	18.00	9.00

### Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Tensile strength (N/mm <sup>2</sup> )	
		Min.	Max.
0.30 – 0.41	0.008	2150	2470
>0.41 – 0.65	0.008	2100	2420
>0.65 – 0.81	0.010	2050	2360
>0.81 – 1.01	0.010	2000	2300
>1.01 – 1.61	0.015	1950	2240
>1.61 – 2.26	0.015	1900	2190
>2.26 – 3.20	0.020	1850	2130
>3.20 – 4.01	0.020	1800	2070
>4.01 – 4.51	0.025	1750	2010
>4.51 – 6.01	0.025	1700	1960
>6.01 – 6.26	0.025	1650	1900
>6.26 – 7.01	0.030	1600	1840
>7.01 – 8.00	0.030	1550	1780
		1500	1730
		1450	1670
		1400	1610
		1350	1550
		1300	1500

<sup>1)</sup> Narrower tolerances on request.

### E and G modulus

Modulus of elasticity, E: Abt. 180 GPa in drawn condition  
Abt. 185 GPa after heat treatment

Modulus of shear, G: Abt. 70 GPa in drawn condition  
Abt. 73 GPa after heat treatment

Density: 7.90 kg/dm<sup>3</sup>

### Specific heat capacity

Temperature °C	20	100	200	400
J/(kg* °C)	440	480	520	560

### Heat conductivity

Temperature °C	20	100	200	400
W/(m* °C)	15.0	15.5	17.5	20.0

### Resistivity

Temperature °C	20	100	200	300
nΩm	700	750	800	950

### Linear expansion

Pro °C	30-100	30-200	30-300
x10 <sup>-6</sup>	17.0	17.5	18.5

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.25–8.00 mm Ø.

### Nearest equivalent steel grades

EN 1.4310, AISI/SAE 302 and JIS SUS 302.

### Nearest equivalent standards

EN 10270-3, ASTM A313, AMS 5688, BS 2056 302 S26 and JIS G4314.

### Heat treatment

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

Recommended temperature for compression springs or tension springs without initial tension is approx. 350°C for 0.5 - 3 hours.



# GARBA 188L

## Stainless spring wire

GARBA 188 is a general-purpose austenitic stainless steel, which is used for springs and other components requiring good fatigue resistance. GARBA 188L has a higher formability as compared to GARBA 188 due to its lower carbon content.

### Chemical composition, approximate values % (values within the standard EN 10270-3)

C %	Si %	Mn %	P max. %	S max. %	Cr %	Ni %
0.04	0.40	1.50	0.045	0.015	18.50	8.25

### Physical properties (values within the standard EN 10270-3)

Size mm	Tolerance <sup>1)</sup> ± mm	Tensile strength (N/mm <sup>2</sup> )	
		Min.	Max.
0.25 – 0.40	0.005	1785	2000
>0.40 – 0.50	0.005	1700	1910
>0.50 – 0.70	0.008	1700	1910
>0.70 – 0.83	0.009	1650	1830
>0.83 – 1.00	0.010	1650	1830
>1.00 – 1.50	0.011	1530	1740
>1.50 – 1.60	0.011	1445	1650
>1.60 – 2.00	0.014	1445	1650
>2.00 – 2.50	0.014	1360	1570
>2.50 – 2.80	0.018	1360	1570
>2.80 – 4.00	0.018	1275	1490
>4.00 – 6.00	0.022	1190	1400
>6.00 – 6.30	0.022	1105	1320
>6.30 – 8.00	0.028	1105	1320

<sup>1)</sup> Narrower tolerances on request.

### E and G modulus

Modulus of elasticity, E: Abt. 180 GPa in drawn condition

Abt. 185 GPa after heat treatment

Modulus of shear, G: Abt. 70 GPa in drawn condition

Abt. 73 GPa after heat treatment

Density: 7.90 kg/dm<sup>3</sup>

### Specific heat capacity

Temperature °C	20	100	200	400
J/(kg* °C)	440	480	520	560

### Heat conductivity

Temperature °C	20	100	200	400
W/(m* °C)	15.0	15.5	17.5	20.0

### Resistivity

Temperature °C	20	100	200	300
nΩm	700	750	800	950

### Linear expansion

Pro °C	30-100	30-200	30-300
x10 <sup>-6</sup>	17.0	17.5	18.5

### Delivery forms

See separate sheet.

### Surface performance

AC-surface 0.25–8.00 mm Ø.

### Nearest equivalent steel grades

EN 1.4301, AISI/SAE 304 and JIS SUS 304.

### Nearest equivalent standards

ASTM A313, BS 2056 302 S15 and JIS G4314.

### Heat treatment

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

Recommended temperature for compression springs or tension springs without initial tension is approx. 350°C for 0.5 - 3 hours.

# GARBAFLEX 11R51

## Flat and shaped wire

GARBAFLEX 11R51 is an austenitic stainless steel wire alloyed with molybdenum, supplied in the cold rolled or annealed condition.

### Chemical Composition, approximate values in %

C %	Si %	Mn %	P max %	S max %	Cr %	Ni %	Mo %
0.08	1.5	1.8	0.025	0.010	17	7.5	0.7

### Size tolerances for flat wire

Width mm	Tolerance ± mm
1.00 – 5.00	0.05
> 5.00 – 8.00	0.07
> 8.00 – 10.00	0.10
Thickness mm	
0.30 – 0.80	0.015
> 0.80 – 1.00	0.019
> 1.00 – 1.60	0.025

### Tolerances for shaped wire

Size mm	Tolerance ± mm
– 1.50	0.02
> 1.50 – 3.00	0.03
> 3.00 – 5.00	0.04
> 5.00 – 7.00	0.05
> 7.00 –	0.06

### Tensile strength

As cold rolled max. 2400 N/mm<sup>2</sup>  
As annealed max. 850 N/mm<sup>2</sup>

### Elongation

As annealed min. 40%

### Microstructure

Austenite

### Surface

Bright.  
Surface defects max. 1% of thickness.

### Execution

Rolled on 2 sides (flat)  
Rolled on 4 sides (shaped)

### Camber

Max. 3 mm measured on 1 m length.

### Coil set

Max. 20 mm measured on 1 m length.

### Delivery form

On wooden spools, max. 250 kg.

### Nearest equivalent steel grades

EN 1.4310, AISI/SAE 302 and JIS SUS 302

### Nearest equivalent standards

ASTM A313/A313M, EN 10270-3, ISO 6931-1

For further technical support, please contact Suzuki Garphyttan.

# GARBAFLEX 174Mn

## Flat and shaped wire

GARBAFLEX 174Mn is an austenitic stainless wire, supplied in the cold rolled or annealed condition.

### Chemical Composition, approximate values in %

C %	Si %	Mn %	P max %	S max %	Cr %	Ni %
0.07	0.50	5.90	0.045	0.020	17.00	5.00

### Size tolerances for flat wire

Width mm	Tolerance ± mm
2.00 – 5.00	0.05
> 5.00 – 8.00	0.07
> 8.00 – 10.00	0.10
Thickness mm	
0.30 – 0.80	0.015
> 0.80 – 1.00	0.019
> 1.00 – 1.60	0.025

### Tolerances for shaped wire

Size mm	Tolerance ± mm
– 1.50	0.02
> 1.50 – 3.00	0.03
> 3.00 – 5.00	0.04
> 5.00 – 7.00	0.05
> 7.00 –	0.06

### Tensile strength

As cold rolled max. 1900 N/mm<sup>2</sup>.  
As annealed max. 950 N/mm<sup>2</sup>.

### Yield strength

As annealed 300-450 N/mm<sup>2</sup>.

### Elongation

As annealed min. 40%.

### Microstructure

Austenite.

### Surface

Bright.  
Surface defects max. 1% of thickness.

### Execution

Rolled on 2 sides (flat).  
Rolled on 4 sides (shaped).

### Camber

Max. 5 mm measured on 1 m length.

### Coil set

Max. 20 mm measured on 1 m length.

### Delivery form

On wooden spools. Max. 250 kg.

### Nearest equivalent steel grades

EN 1.4371, AISI/SAE 201 and JIS SUS 201.

For further technical support, please contact Suzuki Garphyttan.

# GARBAFLEX 177PH

## Flat and shaped wire

GARBAFLEX 177PH is a precipitation hardenable stainless wire for flat and shaped wire applications in corrosive atmosphere and elevated working temperature.

### Chemical Composition, approximate values in %

C %	Si %	Mn %	Cr %	Ni %	Al %
0.09	0.50	0.50	17.00	7.00	1.00

### Size tolerances for flat wire

Width mm	Tolerance ± mm
1.00 – 5.00	0.05
> 5.00 – 8.00	0.07
> 8.00 – 10.00	0.10
Thickness mm	Tolerance ± mm
0.30 – 0.80	0.013
> 0.80 – 1.00	0.019
> 1.00 – 1.60	0.025
> 1.60 – 2.30	0.050

### Tolerances for shaped wire

Size mm	Tolerance ± mm
– 1.50	0.02
> 1.50 – 3.00	0.03
> 3.00 – 5.00	0.04
> 5.00 – 7.00	0.05
> 7.00 –	0.06

### Mechanical properties

On request.

### Specific heat capacity

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

### 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 <sup>-6</sup>	13.0	13.5	14.0

### Heat treatment

For best spring properties the springs are heat treated at a temperature of 480 °C (896 °F) for 1 hour and then air cooled. The tensile strength of the wire before and after this treatment is given in the table for steel grade GARBA 177PH.

### Surface

Bright.

Surface defects max. 1% of thickness.

### Execution

Rolled on 2 sides (flat).

Rolled on 4 sides (shaped).

### Nearest equivalent steel grades

EN 1.4568, AISI/SAE 631 and JIS SUS 631.

For further technical support, please contact Suzuki Garphyttan.

# GARBAFLEX 188

## Flat and shaped wire

GARBAFLEX 188 is an austenitic stainless wire, supplied in the cold rolled or annealed condition.

### Chemical Composition, approximate values in %

C %	Si %	Mn %	P max %	S max %	Cr %	Ni %
0.08	0.50	1.00	0.045	0.015	18.00	9.00

### Size tolerances for flat wire

Width mm	Tolerance ± mm
2.00 – 5.00	0.05
> 5.00 – 8.00	0.07
> 8.00 – 10.00	0.10
Thickness mm	
0.20 – 0.80	0.015
> 0.80 – 1.00	0.019
> 1.00 – 1.60	0.025

### Tolerances for shaped wire

Size mm	Tolerance ± mm
– 1.50	0.02
> 1.50 – 3.00	0.03
> 3.00 – 5.00	0.04
> 5.00 – 7.00	0.05
> 7.00 –	0.06

### Tensile strength

As cold rolled max. 1850 N/mm<sup>2</sup>.  
As annealed max. 850 N/mm<sup>2</sup>.

### Elongation

Min. 40%.

### Microstructure

Austenite.

### Surface

Bright.  
Surface defects max. 1% of thickness.

### Execution

Rolled on 2 sides (flat).  
Rolled on 4 sides (shaped).

### Camber

Max. 5 mm measured on 1 m length.

### Coil set

Max. 20 mm measured on 1 m length.

### Delivery form

On wooden spools. Max. 250 kg.

### Nearest equivalent steel grades

EN 1.4310, AISI/SAE 302 and JIS SUS 302.

### Nearest equivalent standards

ASTM A313, AMS 5688 F, BS 2056 302 S25 and JIS G4314.

For further technical support, please contact Suzuki Garphyttan.



# GARBAFLEX 188L

## Flat and shaped wire

GARBAFLEX 188L is an austenitic stainless wire, supplied in the cold rolled or annealed condition.

### Chemical Composition, approximate values in %

C %	Si %	Mn %	P max %	S max %	Cr %	Ni %
0.04	0.40	1.50	0.045	0.015	18.50	8.25

### Size tolerances for flat wire

Width mm	Tolerance ± mm
2.00 – 5.00	0.05
> 5.00 – 8.00	0.07
> 8.00 – 10.00	0.10
Thickness mm	
0.20 – 0.80	0.015
> 0.80 – 1.00	0.019
> 1.00 – 1.60	0.025

### Tolerances for shaped wire

Size mm	Tolerance ± mm
– 1.50	0.02
> 1.50 – 3.00	0.03
> 3.00 – 5.00	0.04
> 5.00 – 7.00	0.05
> 7.00 –	0.06

### Tensile strength

As cold rolled max. 1850 N/mm<sup>2</sup>.

As annealed max. 850 N/mm<sup>2</sup>.

### Elongation

Min. 40%.

### Microstructure

Austenite.

### Surface

Bright.

Surface defects max. 1% of thickness.

### Execution

Rolled on 2 sides (flat).

Rolled on 4 sides (shaped).

### Camber

Max. 5 mm measured on 1 m length.

### Coil set

Max. 20 mm measured on 1 m length.

### Delivery form

On wooden spools. Max. 250 kg.

### Nearest equivalent steel grades

EN 1.4301, AISI/SAE 304 and JIS SUS 304.

### Nearest equivalent standards

ASTM A313, BS 2056 302 S15 and JIS G4314.

For further technical support, please contact Suzuki Garphyttan.

# Addresses

## Production Sites

### Sweden

Suzuki Garphyttan AB  
(Bruksvägen 3)  
SE-719 80 Garphyttan  
Sweden  
Tel +46 (0)19 295 100  
Fax +46 (0)19 295 101  
Email [info.se@sg-wire.com](mailto:info.se@sg-wire.com)  
[www.suzuki-garphyttan.com](http://www.suzuki-garphyttan.com)

### USA

Suzuki Garphyttan Corp.  
4404 Nimitz Parkway  
South Bend, IN 46628  
USA  
Tel +1 574 232 8800  
Fax +1 574 232 2565  
Email [info.us@sg-wire.com](mailto:info.us@sg-wire.com)

### China

Suzuki Garphyttan Wire (Suzhou) Co. Ltd.  
Building B, No 6 Longpu Road  
SIP, Suzhou 215126  
P.R. China  
Tel +86 512 8885 5361  
Fax +86 512 8885 5366  
Email [info.cn@sg-wire.com](mailto:info.cn@sg-wire.com)

### Mexico

Suzuki Garphyttan, S.A. de C.V.  
Av. Santa Fe No. 3  
Parque Industrial Opción  
Carretera Federal No. 57 (Qro – SLP) Km 57.8  
San José Iturbide, Guanajuato, C.P. 37980  
Mexico  
Tel +52 (442) 153 5560 / +1 630 981 1212  
Email [info.mx@sg-wire.com](mailto:info.mx@sg-wire.com)

## Sales Offices

### Sweden

Suzuki Garphyttan AB  
(Bruksvägen 3)  
SE-719 80 Garphyttan  
Sweden  
Tel +46 (0)19 295 100  
Fax +46 (0)19 295 101  
Email [info.se@sg-wire.com](mailto:info.se@sg-wire.com)  
[www.suzuki-garphyttan.com](http://www.suzuki-garphyttan.com)

### China

Suzuki Garphyttan Wire (Suzhou) Co. Ltd.  
Building B, No 6 Longpu Road  
SIP, Suzhou 215126  
P.R. China  
Tel +86 512 8885 5361  
Fax +86 512 8885 5366  
Email [info.cn@sg-wire.com](mailto:info.cn@sg-wire.com)

### Germany

Suzuki Garphyttan GmbH  
Postfach 102541  
DE-40016 Düsseldorf  
Germany  
Tel +49 (0)211/92304-0  
Fax +49 (0)211/92304-40  
Email [info.se@sg-wire.com](mailto:info.se@sg-wire.com)  
[www.suzuki-garphyttan.de](http://www.suzuki-garphyttan.de)

### USA

Suzuki Garphyttan Corp.  
4404 Nimitz Parkway  
South Bend, IN 46628  
USA  
Tel +1 574 232 8800  
Fax +1 574 232 2565  
Email [info.us@sg-wire.com](mailto:info.us@sg-wire.com)

### Mexico

Suzuki Garphyttan, S.A. de C.V.  
Av. Santa Fe No. 3  
Parque Industrial Opción  
Carretera Federal No. 57 (Qro – SLP) Km 57.8  
San José Iturbide, Guanajuato, C.P. 37980  
Mexico  
Tel +52 (442) 153 5560 / +1 630 981 1212  
Email [info.mx@sg-wire.com](mailto:info.mx@sg-wire.com)

## Sales Representatives/Distributors/Re-sellers

### Brazil

UBRASTEEL TRADING LTDA  
Rua Vieira de Morais, 420 - conj 92 - Campo Belo  
BR - CEP 04617-000 - Sao Paulo - SP  
Brazil  
Tel +55 11 5536 9540  
Fax +55 11 5093 1131  
Email [info@ubrasteel.com.br](mailto:info@ubrasteel.com.br), [vendas@ubrasteel.com.br](mailto:vendas@ubrasteel.com.br),  
[ole.bergh@ubrasteel.com.br](mailto:ole.bergh@ubrasteel.com.br)

### Great Britain

STRIDE SUPPLIES LTD  
Unit 7, Lakeside Industrial Estate  
Broad Ground Road  
GB-B98 8YP Redditch, Worcs.  
England  
Tel +44 01527 500170  
Fax +44 01527 505652  
Email [info@stride-supplies.co.uk](mailto:info@stride-supplies.co.uk)

### Korea

JOIL STEEL Co  
#919, AceHitechcity2  
Seonyu-ro 13-gil 25  
Yeongdeungpo-gu  
Seoul  
Korea  
Tel +82-2-761-2028  
Fax +82-2-761-2029  
Email [joilsteel@kita.net](mailto:joilsteel@kita.net)

