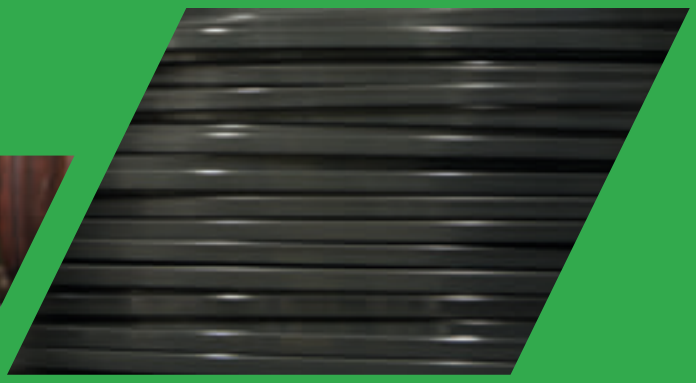


FAR

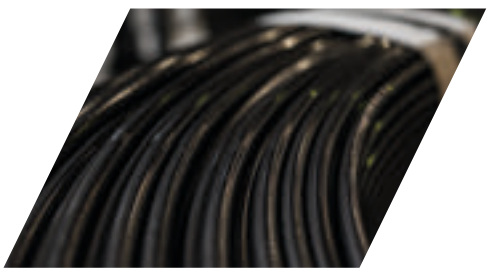
TEMPERED STEEL WIRE

TEMPERED STEEL WIRE









FAR S.p.A. produces exclusively high resistance tempered steel wire for the automotive industry, aerospace industry and anywhere elastic components in critical conditions and strong mechanical stresses are requested.
The company has 12.000 m^2 covered by production buildings. The site is located in the north-east of Italy, 90 Km from Venice in the heart of Dolomite National Park, in Villapaiera of Feltre (BL).

The production, according to the dedicated norm (DIN, EN, SAE, ASTM, JIS, BS), covers the range from 3,00 mm up to 18,50 mm and can offer shaved wire and shaped wire as well, giving to the customer the complete possible choice in this market. Thanks to the high standards applied to the process and the technologically advanced machinery, FAR is a reliable supplier for the best springs manufacturers in the world.

FAR has ISO 9001 and IATF 16949 qualifications, several automotive quality and process audits and positive active homologations for the automotive sector. But more than this, we strongly believe that our history and our reputation is the primary warranty for the customer.

PRODUCT RANGE

Standard:
according to the norm

High tensile (HR):
1850-1950 MPa (where exceed the norm)

Very high tensile (KR):
1950-2050 MPa (where exceed the norm)

Round Tempered Spring Wire

Reference standard
EN 10270-2 or equivalent

Chemical Composition	Main Application	Steel purity grade	Diameter range (mm)	Standard Surface condition	Tensile Strength (*)	NDT (Eddy Current)	EN 10270/2 or nearest equivalent class	Note
Carbon Steels	Static Moderately dynamic	Standard	3.00 – 18.50	Unshaved	Standard	Upon request on 100% wire length	FD SiCr	Shaving upon request
Chrome Silicon Steels	Static	Standard	3.00 – 18.50	Unshaved	Standard	Upon request on 100% wire length	FD SiCr	Shaving upon request
	Moderately dynamic		5.60 - 17.00		High		FD SiCr HR/KR	
			3.50 – 16.00		Very high			
	Moderately dynamic		3.00 - 18.50		Standard		TD SiCr	
	Dynamic		3.00 - 18.50			100 % wire length	VD SiCr	
	High dynamic	Super Clean	3.00 - 10.00	Shaved	Standard	100 % wire length	VD SiCr SC	
Chrome Silicon Vanadium Steels	Static	Standard	3.00 – 18.50	Unshaved	Standard	Upon request on 100% wire length	FD SiCrV	Shaving upon request
	Moderately dynamic		5.60 - 17.00		High		FD SiCrV HR/KR	
			3.50 – 16.00		Very high			
	Moderately dynamic		3.00 - 18.50		Standard		TD SiCrV	
	Dynamic		3.00 - 18.50			100 % wire length	VD SiCrV	
	High dynamic	Super Clean	3.00 - 10.00	Shaved	Standard	100 % wire length	VD SiCr SC	

Cleanliness in steel, non-metallic inclusions

According to ISO 4967 and ASTME 45-A
Heavy Max=1,5/Thin Max=2

Reference standard and nearest equivalent standards

The main reference standard is EN10270-2 in FD,TD,VD class for different grades.

Near standards are ASTM A in 229, 401, 1000 and 877 class - B.S. in 2803 685A55 in HS,ND,HD – JIS G 3568,3561 – SIS 142090-05

Shaped Spring Wire

F.A.R. produces shaped wire: square, rectangular, oval, trapezoidal, polygonal and according to customer's design. Wires can be tempered or hard drawn to equivalent EN10270-1 class tensile strength.

Material: Carbon or micro alloyed steels
(see tables for round wire)

Tensile strength: according to Customer request or reference to the nearest equivalent round wire.

Tempered Flats - Natural edges

Flat tempered and untempered products with natural edges can be produced in several steel grades, design and tolerances must be agreed before order confirmation.

Material: Carbon or micro alloyed steels
(see tables for round wire)

Tensile strength: according to Customer request or reference to the nearest equivalent round wire.

STANDARD PACKAGING

Unless different requirements, the wire will be supplied in coils, the wire form a continuous length without welding.

Proper protection against abrasion will be put under the strips, when applicable and requested by the customer plastic strips are used, and the free ends protected with plastic caps.

Upon agreement different wrapping paper can be applied.

Each coil is labelled to ensure perfect identification and traceability.

The wire, on request, will be supplied in carriers containing one or multiple coils each.

In the following table standard dimensions for selected common diameter/coil weight, available also different dimensions and weight.

Round Tempered Spring Wire

Wire Diameter (mm)	Approximate coil weight (kg)	Traditional line Coil dimension		Coil Height (mm)	Induction line Coil dimension		Coil Height (mm)
		Inside diameter (mm)	Outside diameter (mm)		Inside diameter (mm)	Outside diameter (mm)	
3.00 – 4.99	500	900	1300	220	----	----	----
	1000	900	1500	330	----	----	----
5.00 – 7.59	500	1200	1500	220	----	----	----
	1000	1200	1700	250	----	----	----
7.60 – 8.99	500	1700	2000	200	----	----	----
	1000	1700	2100	250	1700	1900	300
	2000	1700	2100	280	1700	2070	300
9.00 – 10.99	1000	1700	2100	250	1700	1900	300
	2000	1700	2100	280	1700	2000	300
11.00 – 12.99	----	1000*	----	----	1700	1900	300
	----	2000*-3000*	----	----	1700	2070	300
13.00 – 18.50	----	2000*-3000*	----	----	1700	2070	300

(*) According to wirerod coil weight

Shaped Tempered and Untempered Spring Wire

Coils
see table for round equivalent diameter

Spools
Internal diameter: 600 mm
External diameter: 850 mm (depending on weight coil)
Height: 300 mm

Surface Finish

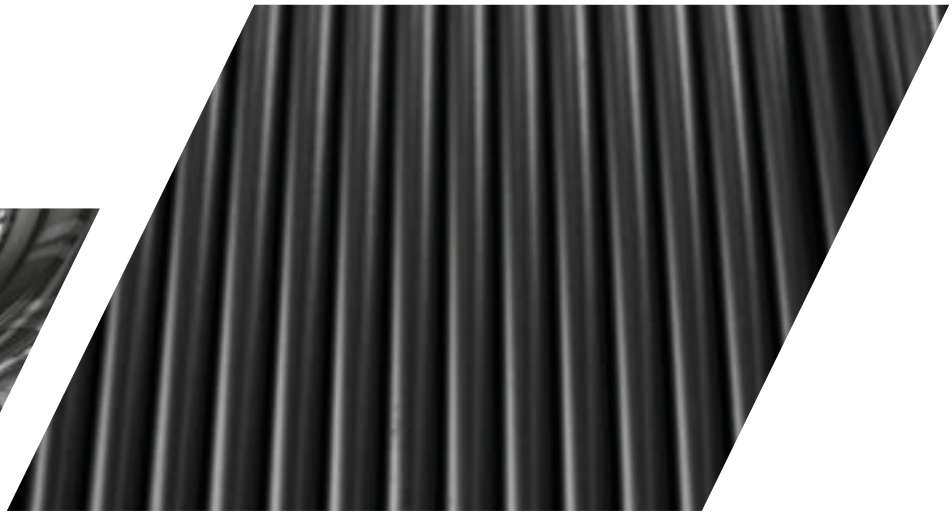
Unless otherwise specified, the wire shall be delivered in slightly oiled conditions to protect against corrosion.

Tempered and Untempered Flats - Natural edges

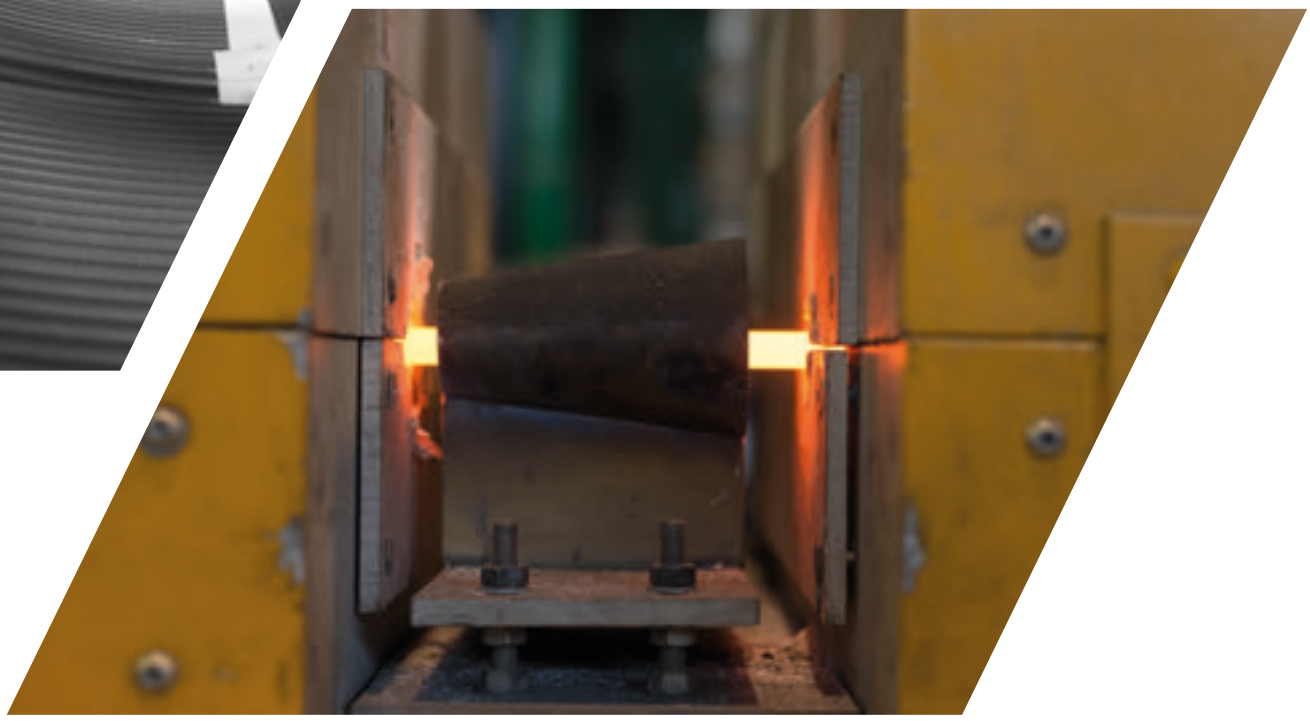
Coils
see table for round equivalent diameter

Spools
Internal diameter: 600 mm
External diameter: 850 mm (depending on weight coil)
Height: 300 mm

Some product shape could require different packaging, to be agreed.









FDC, TDC, VDC

Application

FD C is alloyed tempered spring wire intended for the production of springs and other mechanical particulars for normal applications, exposed to static stresses.

General Note

For different grades in Carbon Steel: **EN10270-2 TD C** and **VD C** ask our technical department for specific requests.

Chemical Composition (reference values)

	C	Si	Mn	P	S	Cu	Cr
% by mass	0.60 – 0.75	0.10 – 0.35	0.50 – 1.20	Max 0.03	Max 0.025	Max 0.12	(*)

(*) May be added for proper through hardening

Mechanical properties

- Tensile Strength can comply the norm request, furthermore higher tensile can be obtained on customer's request and technical staff approval.
- Both at norm and at higher tensile a minimum value of reduction in area after fracture is guaranteed at 40%.
- The range of the tensile strength within a coil/reel shall not exceed 70 Mpa.
- Other mechanical properties and dimensional carachteristics according to the reference norm or customer requirements.
- Yield point Rp02 = min 90% Rm.
- Elastic Modulus: E= 206 GPa (Indicative value).
- Shear Modulus: G= 79,5 GPa (Indicative value).

N.D.T.

Upon request and agreement additional Eddy Current Test (Non Destructive Test) can be performed on 100% length of the wire and defect areas will be permanently marked. Results will be reported in the inspection documents.

Wire inspection and inspection documents

Tests and inspections is performed according to EN 10270-2 – the results and relative limits are reported in inspection documents according to EN 10240 3.1 B.

Surface decarburization and surface defect

Max possible depth of partial decarburization and surface defects: 1.0% of wire diameter - no complete decarburization allowed.

Surface defects will be inspected as specified in EN 10270-2 – 7.4.5.

Spring heat treatment

As soon as possible after coiling, the springs should be stress relieved. As indicative parameter we recommend at T=420 ± 5°C Time 30 min (Indicative values).

Spring shot peening

In order to obtain optimal fatigue properties, the process time should be adjusted to get a complete treatment. The size of shots should be adapted to the wire dimension, pitch and shot peening equipment. Shot peening of the inner part of the spring coils is particularly critical.

Spring presetting and stress relieving

After shot peening, in order to reach optimal fatigue and relaxation properties the springs must be preset at an appropriate stress. For stress relieving we recommend T=250 ± 10°C for 30 min (Indicative values).

FD SiCr, TD SiCr, VD SiCr

Application

SiCr grade's classes is alloyed tempered spring wire intended for the production of springs and other mechanical particulars for normal applications, every class has a proper application:

FD SiCr: static or moderate fatigue stresses;

FD SiCr HR/KR: static or moderate fatigue stresses, applied for that parts requiring higher loads and contained weight;

TD SiCr: medium and moderately high fatigue stresses as required for some clutch springs or transmission springs;

VD SiCr: high fatigue stresses as required for valve springs or with similar requirements;

VD SiCr SC (SuperClean): high fatigue stresses as required for some valve springs or with similar requirements in the superclean steel quality, even if "superclean" is not a standardized term it is commonly used for steel grades with extra-low content on non-metallic inclusions;

Chemical Composition (reference values) % by mass

	C	Si	Mn	P	S	Cu	Cr
FD, FD HR/KR	0.50 – 0.60	1.20 – 1.60	0.50 – 0.90	Max 0.03	Max 0.025	Max 0.12	0.50 – 0.80
TD	0.50 – 0.60	1.20 – 1.60	0.50 – 0.90	Max 0.025	Max 0.020	Max 0.10	0.50 – 0.80
VD, VD SC	0.50 – 0.60	1.20 – 1.60	0.50 – 0.90	Max 0.025	Max 0.020	Max 0.06	0.50 – 0.80

Only for VD SiCr SC quality:

The presence of non-metallic inclusions in the wire rod is inspected in accordance with Maximum Thickness Method Criteria (Max T Method). This special evaluation is done before drawing, for every heat destined to VD SC wire production.

The criteria for releasing wire rod material for "superclean" grade is the respect of the following parameters as minimum:

Sampling Frequency	Every Heat - 6 coil/heat
Inspected area of the polished specimen	1000 mm^2 - In the external zone max deep of 1,00mm from the surface

Inclusion size (µm)	5 ÷ 10	10 ÷ 15	> 15
Number of inclusions	≤ 50	≤ 7	0

Mechanical properties

- Tensile Strength can comply the norm request, furthermore higher tensile can be obtained on customer's request and technical staff approval.
- Both at norm and at higher tensile the minimum value of reduction in area after fracture is guaranteed as specified in EN 10270-2 for the nearest grade.
- The range of the tensile strength within a coil/reel shall not exceed 70 MPa for FD and FD HR/KR, 60 MPa for TD and 50 MPa for VD and VD SC.
- Other mechanical properties and dimensional tolerances according to the reference norm or customer requirements.
- Yield point Rp02 = min 90% Rm.
- Elastic Modulus: E= 206 GPa (Indicative value).
- Shear Modulus: G= 79,5 GPa (Indicative value).

SURFACE QUALITY

Surface decarburization and surface defect

Max possible depth of partial decarburization and surface defects:

FD, FD HR/KR - 1.5% of wire diameter
no complete decarburization allowed.

TD - 1.3% of wire diameter
no complete decarburization allowed.

VD, VD SC - 1.0% of wire diameter – no complete decarburization allowed.

Surface defects will be inspected as specified in EN 10270-2 – 7.4.5.

N.D.T.

For the grades TD, and VD and FD upon agreement, Eddy Current Test (Non Destructive Test) is performed on 100% length of the final wire after heat treatment and defect areas will be permanently marked. The NDT is performed with static and rotating probe. Results will be reported in the inspection documents.

The maximum depth of surface defect shall satisfy the values listed in the following table:

Nominal diameter (mm)		Max depth of surface defect (µm)
Min.	Max	
3.00	4.99	TD-60; VD-40; VD SC-40;
5.00	5.99	TD-60; VD-50; VD SC-50;
6.00	8.00	TD-0,01*d; VD-60; VD SC-60;
For other diameters values have to be agreed		

Surface Shaving “S”

Surface Shaving can be performed from final Ø 3,00 and Ø 12,50 mm, in VD SiCrV SC quality the shaving process is normally performed till 10,00mm if not differently agreed, for all other qualities and diameters the process must be requsted.

Wire inspection and inspection documents

Tests and inspections shall be performed according to EN 10270-2 - and the results and relative limits reported in inspection documents according to EN 10240 3.1 B.

Spring heat treatment

As soon as possible after coiling, the springs should be stress relieved. As indicative parameter we recommend at T=420 ± 5°C Time 30 min (Indicative values).

Spring shot peening

In order to obtain optimal fatigue properties, the process time should be adjusted to get a complete treatment. The size of shots should be adapted to the wire dimension, pitch and shot peening equipment. Shot peening of the inner part of the spring coils is particularly critical.

Spring presetting and stress relieving

After shot peening, in order to reach optimal fatigue and relaxation properties the springs must be preset at an appropriate stress. For stress relieving we recommend T=250 ± 10°C for 30 min (Indicative values).

FD SiCrV, TD SiCrV, VD SiCrV

Application

SiCrV grade's classes are alloyed tempered spring wire intended for the production of springs and other mechanical particulars with good relaxing properties at moderately increased working temperatures, every class has a proper application:

FD SiCrV: static or moderate fatigue stresses;

TD SiCrV: medium and moderate high fatigue stresses as required for some clutch springs or transmission springs;

VD SiCrV: high fatigue stresses as required for valve springs or with similar requirements;

VD SiCrV SC (SuperClean): high fatigue stresses as required for some valve springs or with similar requirements in the superclean steel quality even if "superclean" is not a standardized term it is commonly used for steel grades with extra-low content on non-metallic inclusions;

Chemical Composition (reference values) % by mass

	C	Si	Mn	P	S	Cu	Cr	V
FD	0.50 – 0.70	1.20 – 1.65	0.40 – 0.90	Max 0.03	Max 0.025	Max 0.12	0.50 – 1.00	0.10 – 0.25
TD	0.50 – 0.70	1.20 – 1.65	0.40 – 0.90	Max 0.025	Max 0.020	Max 0.10	0.50 – 1.00	0.10 – 0.25
VD, VD SC	0.50 – 0.70	1.20 – 1.65	0.40 – 0.90	Max 0.025	Max 0.020	Max 0.06	0.50 – 1.00	0.10 – 0.25

Only for VD SiCrV SC quality:

The presence of non-metallic inclusions in the wire rod is inspected in accordance with Maximum Thickness Method Criteria (Max T Method). This special evaluation is done before drawing, for every heat destined to VD SC wire production.

The criteria for releasing wire rod material for for "superclean" grade is the respect the following parameters as minimum:

Sampling Frequency	Every Heat - 6 coil/heat
Inspected area of the polished specimen	1000 mm^2 - In the external zone max deep of 1,00mm from the surface

Inclusion size (µm)	5 ÷ 10	10 ÷ 15	> 15
Number of inclusions	≤ 50	≤ 7	0

Mechanical properties

- Tensile Strength must comply the norm request, furthermore higher tensile can be obtained on customer's request and technical staff approval.
- Both at norm and at higher tensile a minimum value of reduction in area after fracture is guaranteed as specified in EN 10270-2 for the nearest grade.
- The range of the tensile strength within a coil/reel shall not exceed 70 MPa for FD 60 MPa for TD and 50 MPa for VD and VD SC.
- Other mechanical properties and dimensional tolerances according to the reference norm or customer requirements.
- Yield point Rp02 = min 90% Rm.
- Elastic Modulus: E= 206 GPa (Indicative value).
- Shear Modulus: G= 79,5 GPa (Indicative value).

SURFACE QUALITY

Surface decarburization and surface defect

Max possible depth of partial decarburization and surface defects:

FD - 1.5% of wire diameter - no complete decarburization allowed.

TD - 1.3% of wire diameter - no complete decarburization allowed.

VD, VD SC - 1.0% of wire diameter - no complete decarburization allowed.

Surface defects will be inspected as specified in EN 10270-2 - 7.4.5.

N.D.T.

For the grades TD, and VD and FD upon agreement, Eddy Current Test (Non Destructive Test) is performed on 100% length of the final wire after heat treatment and defect areas will be permanently marked. The NDT is performed with static and rotating probe. Results will be reported in the inspection documents.

The maximum depth of surface defect shall satisfy the values listed in the following table:

Nominal diameter (mm)		Max depth of surface defect (µm)
Min.	Max	
3.00	4.99	TD-60; VD-40; VD SC-40;
5.00	5.99	TD-60; VD-50; VD SC-50;
6.00	8.00	TD-0,01*d; VD-60; VD SC-60;
For other diameters values have to be agreed		

Surface Shaving “S”

Surface Shaving can be performed from final Ø 3,00 and Ø 12,50 mm, in VD SiCrV SC quality the shaving process is normally performed till 10,00mm if not differently agreed, for all other qualities and diameters the process must be requsted.

Wire Inspection and inspection documents

Tests and inspections shall be performed according to EN 10270-2 - and the results and relative limits reported in inspection documents according to EN 10240 3.1 B.

Spring heat treatment

As soon as possible after coiling, the springs should be stress relieved. As indicative parameter we recommend at T=420 ± 5°C Time 30 min (Indicative values).

Spring shot peening

In order to obtain optimal fatigue properties, the process time should be adjusted to get a complete treatment. The size of shots should be adapted to the wire dimension, pitch and shot peening equipment. Shot peening of the inner part of the spring coils is particularly critical.

Spring presetting and stress relieving

After shot peening, in order to reach optimal fatigue and relaxation properties, the springs must be preset at an appropriate stress. For stress relieving we recommend T=250 ± 10°C for 30 min (Indicative values).

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