pengg usha martin

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# Powering **Possibilities** with

## Passion. Precision. Perfection.

**Best In Class High Quality Oil Hardened and Tempered Steel Wires**

Introduction:

# PENGG USHA MARTIN

## THE LAST WORD IN HIGH QUALITY OIL HARDENED AND TEMPERED STEEL WIRES.

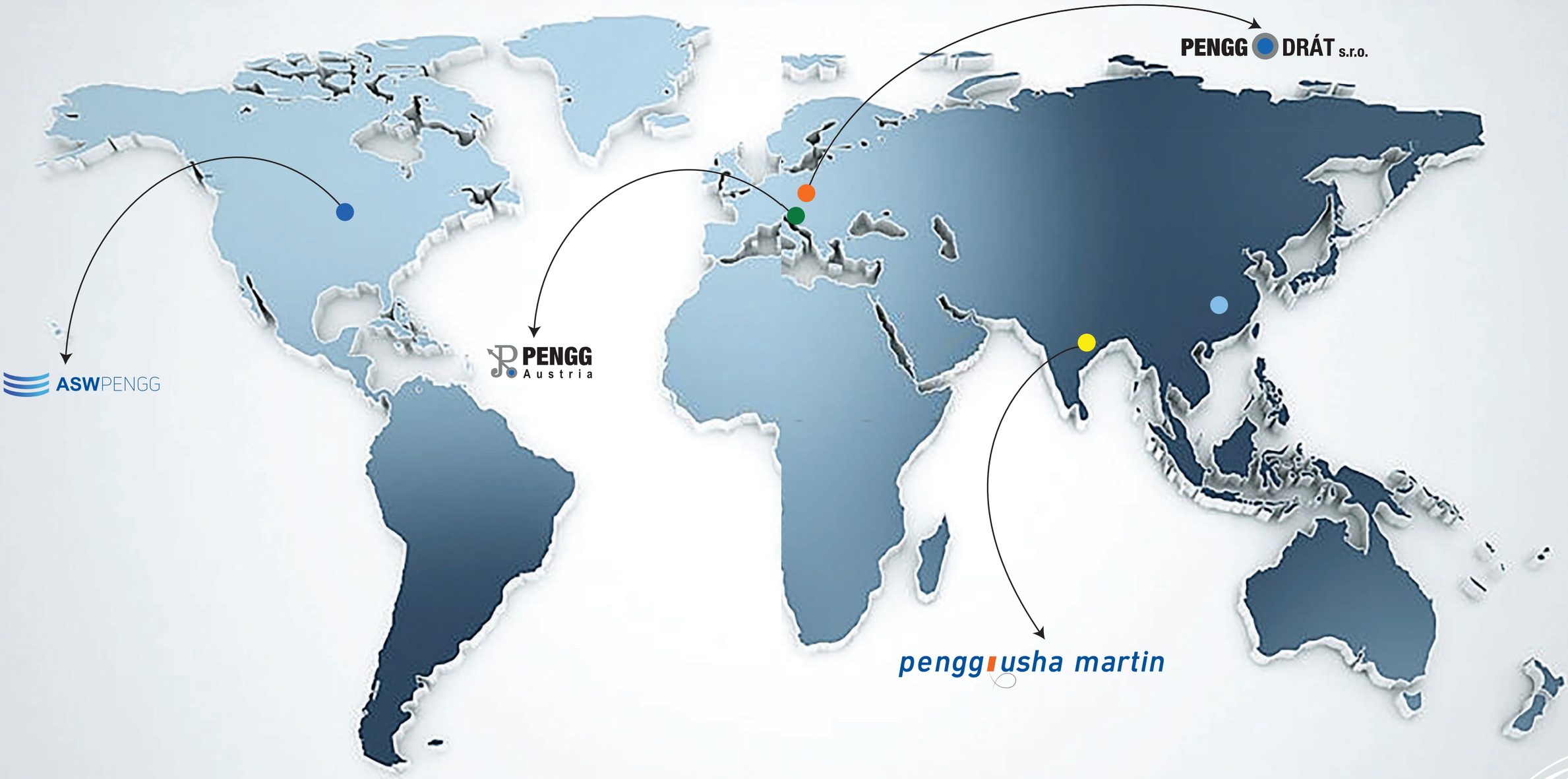
Pengg Usha Martin has successfully adopted and incorporated the vast experience and considerable expertise of its parent companies, Joh Pengg and Usha Martin and hence delivering excellence to customers every step of the way.


A company specialized in the manufacture of wire for use in a variety of products and applications, Pengg Usha Martin has achieved international recognition within the fields of automobile and mechanical engineering.

What sets us apart? The highest degree of dimensional accuracy, precision in mechanical properties, a thorough knowledge of the metallurgical processes involved, a close working relationship with our customers and focused attention to their requirements.

These qualities represent at the same time, our motto and our standards. The foundation of these standards has been laid with the help of our collaborator Joh Pengg, Austria who have many years of metal working experience, originating in the mid-13th century and continued to the present day by their skill and technical competence.

# OUR PRESENCE

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Product Offering

# OIL TEMPERED WIRES

The continuous oil-tempering process optimizes wire properties and results in a stress-relieved, homogenous wire structure with no deformation texture. Our customers appreciate the durability of these wires, their excellent fatigue life, the reliability when subjected to elevated operating temperatures and high resistance against relaxation.

Application examples:

Engine valve springs, clutch springs, springs for fuel injection systems, damper springs, etc.




## CERTIFIED QUALITY MANAGEMENT SYSTEMS

Our wires undergo tough quality tests, including eddy testing to ensure that only the best products of the highest quality reach our customers.

Our quality management system has been designed and are managed in accordance with IATF 16949/ISO 9001


## ENVIRONMENT IN FOCUS

We are committed to protect the environment. Our environment management system is managed in accordance with ISO 14001:2015.

The focus of our active environmental management involves the following aspects:

i) Continual improvement of our processes, products and systems for better environmental performance.

ii) Attention to environmental aspects during process development and facility planning.

iii) Providing training in order to avoid accidents and malfunctions.

iv) Continual reduction of pollution by most suitable, economically justifiable technology.

v) Compliance with legal framework and other environmental requirements.

## MANUFACTURING PROCESSES

While the manufacturing involves a lot of technical expertise, an overview of some of the key processes is given below.

### SHAVING

For products satisfying the most demanding specifications. A thick layer of 300 micron of wire rod is shaved off to reduce surface defects, remove decarburization and eliminate harmful effects of the wire rod manufacturing process.

### PATENTING

A particularly fine-grained microstructure with excellent cold working properties is achieved. In addition, this process ensures extremely uniform wire properties and allows higher tensile end products.

### WIRE DRAWING

We use state-of-the-art technology to ensure that the wire conforms to the required dimensions. We believe in the importance of torsion-free and low- friction wire guides and thorough cooling in the drawing process

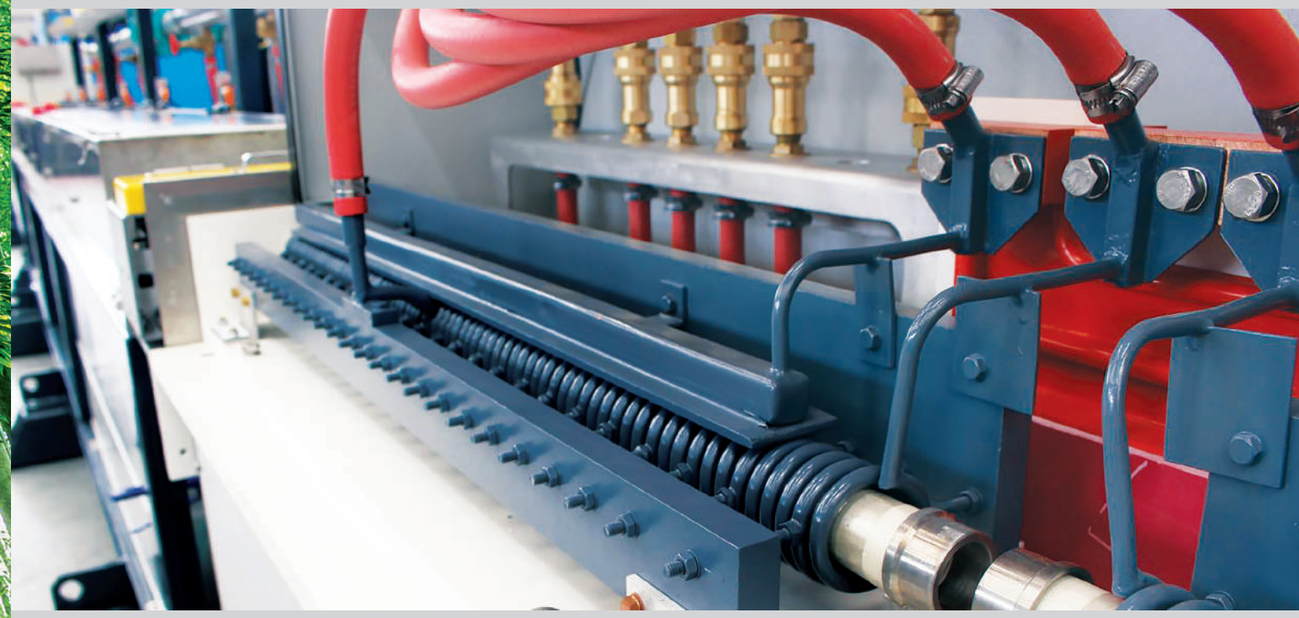
### OIL HARDENING & TEMPERING

A continuous process to optimize wire properties, it is carried out by quenching the wire to martensite in oil, followed by tempering in a lead bath. These results in a stress-relieved, homogenous structure with no deformation texture. Our customers appreciate the durability of these wires, their excellent fatigue life, reliability when subjected to elevated operating temperatures and high resistance against relaxation.

### EDDY TESTING

Spring wire for the highest dynamic stresses is checked for surface flaws using electromagnetic in-line testing. This system catches the defects and colors the surface defects of more than 40 microns depth using two independent probes. Additional sensors give further information regarding the quality of the wire.

This enables the non-destructive quality inspection and testing of the entire length of wire. When combined with our strict finished goods inspection, this system guarantees that you receive highest quality products suitable for further processing.



# PENTHOR FROM PENGG USHA MARTIN

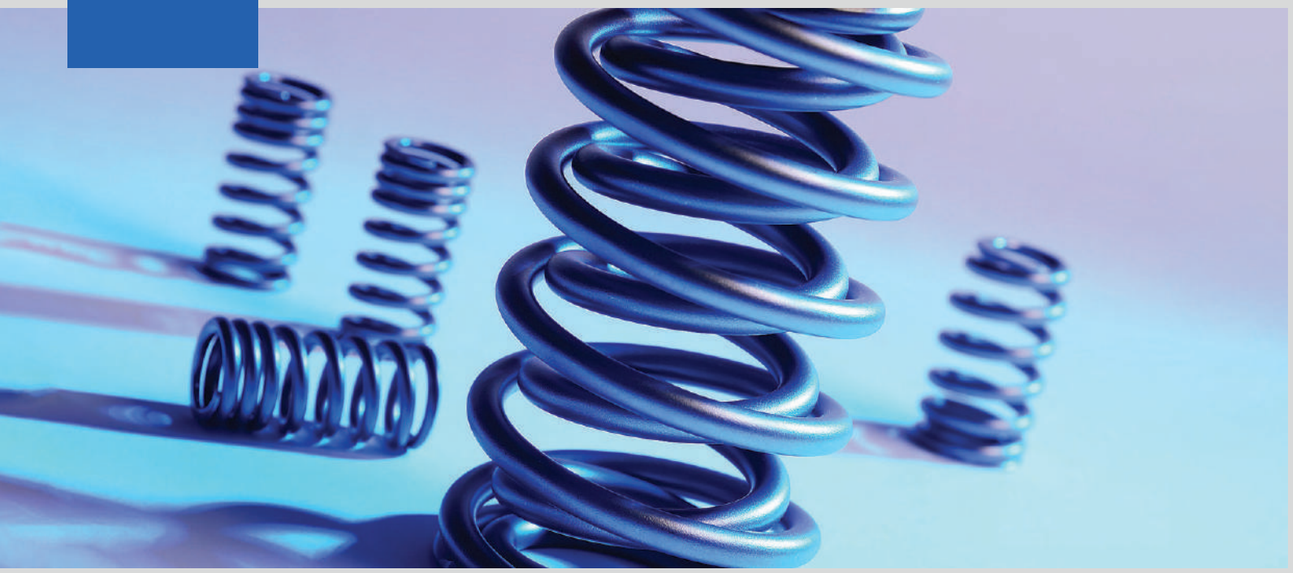
## A COMPLETE RANGE OF SPECIALIZED OIL HARDENED & TEMPERED STEEL WIRES FOR SPRING MANUFACTURING

| PRODUCT | DESCRIPTION | SIMILAR GRADES | APPLICATION |
|---|---|---|---|
| Penthor 1064 | Oil tempered SiCrV+Ni alloyed valve spring wire from shaved wire rod, with dia ≥ 2.50mm 40 µm-continuous surface inspected. | NA | For high dynamic stresses e.g. valve springs. |
| Penthor 964 | Oil tempered SiCrV alloyed valve spring wire from shaved wire rod, with dia ≥ 2.50mm 40 µm-continuous surface inspected. | • VDSiCrV according to EN 10270-2 : 2011<br>• ASTM A877/877M Grade B<br>• SWOSC-VHV | For high dynamic stresses e.g. valve springs. |
| Penthor 943 | Oil tempered SiCrV alloyed spring wire with dia ≥ 2.5mm 60 µm-continuous surface inspected. | • TDSiCrV according to EN 10270-2 : 2011<br>• ASTM A1000 Grade D | For moderate dynamic stresses e.g. clutch springs |
| Penthor 911 HT | Oil tempered SiCrV alloyed spring wire with dia ≥ 2.5mm 60 µm-continuous surface inspected. | NA | For moderate dynamic stresses e.g. trunk springs |
| Penthor 911 | Oil tempered SiCrV alloyed spring wire. | • FDSiCrV according to EN 10270-2 : 2011 | For statically stressed springs e.g. suspension springs |
| Penthor 864 | Oil tempered SiCr alloyed valve spring wire from shaved wire rod with diameters ≥ 2.5 mm 40 µm-continuous surface inspected. | • VDSiCr according to EN 10270-2 : 2011<br>• ASTM A877/877M Grade A<br>• JIS G3561 SWOSC-V<br>• VDSiCr according to IS 4454 Part 2 | For high dynamic stresses e.g. valve springs |
| Penthor 844S | Oil tempered SiCr alloyed spring wire spring wire from shaved wire with diameters ≥ 2.5 mm 40 µm-continuous surface inspected. | • TDSiCr according to EN 10270-2 : 2011<br>• ASTM A1000 Grade A<br>• JIS G3560 SWOSC-B<br>• TDSiCr according to IS 4454 Part 2 | For dynamic stresses |
| Penthor 842/843 | Oil tempered SiCr alloyed spring wire with diameters ≥ 2.5 mm 60 µm-continuous surface inspected. | • TDSiCr according to EN 10270-2 : 2011<br>• ASTM A1000 Grade A<br>• JIS G3560 SWOSC-B<br>• TDSiCr according to IS 4454 Part 2 | For moderate dynamic stresses e.g. clutch springs |
| Penthor 811 | Oil tempered SiCr alloyed spring wire. | • FDSiCr according to EN 10270-2 : 2011<br>• ASTM A401/A401M<br>• JIS G3560 SWOSC-B<br>• FDSiCr according to IS 4454 Part 2 | For statically stressed springs e.g. suspension springs |
| Penthor 111 | Oil tempered unalloyed spring wire. | • FDC according to EN 10270-2 : 2011<br>• ASTM A229/A229M<br>• JIS G3560 SWO-A<br>• FDC according to IS 4454 Part 2 | For statically stressed springs e.g. garage springs, car seat springs. |

We also manufacture multiarc/oval shaped wires across all grades. (Pls refer shaped wire page)

# PENTHOR 1064

OIL TEMPERED SILICON/CHROMIUM/ VANADIUM + NICKEL ALLOYED VALVE SPRING WIRE FROM SHAVED WIRE ROD



## EXTERNAL STANDARD:
NA

## FURTHER SIMILAR STANDARDS:
NA

## APPLICATIONS:
Especially suitable for coil springs subjected to high dynamic stresses requiring good fatigue resistance (eg valve springs), as well as for springs which require high tensile strength and excellent relaxation properties at moderately elevated working temperatures (up to approx. 250 °C).

## RANGE OF DIAMETERS:
1.30 to 7.00 mm Ø

## CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % | V % | Ni % |
|---|---|---|---|---|---|---|---|---|
| 0.50-0.70 | 1.80-2.20 | 0.30-1.00 | 0.020 | 0.020 | 0.06 | 0.85-1.05 | 0.05-0.25 | 0.20-0.40 |

## RAW MATERIAL:
Wire rod made of Si-killed steel according to in-house specifications.

The wire rod is shaved to eliminate surface defects such as seams, cracks and decarburization.

## CLEANLINESS ACC. TO MAX. T-METHOD:
Number of non- metallic inclusions in the surface area detected on end samples of the wire rod.

| Size of indusions | 5-10 | >10-15 | >15[1)] | µm |
|---|---|---|---|---|
| Max.number/1000mm² | 50 | 7 | 0 | |

1) As stated by IVSWMA* it is likely to find occasional inclusions in valve spring quality steel of a size large than 15 um IVSWMA: International Valve Spring Wire Manufacturers Association

## MECHANICAL PROPERTIES: PENTHOR 1064

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS min. Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2280 to 2380 | - | 5 | MAX 0.5 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2230 to 2360 | | | | |
| >1.60 to 2.00 | | 2230 to 2330 | | | | |
| >2.00 to 2.50 | | 2180 to 2280 | | | | |
| >2.50 to 2.70 | | 2130 to 2230 | 45 | | | |
| >2.70 to 3.00 | | 2130 to 2230 | | | | |
| >3.00 to 3.20 | | 2130 to 2230 | | | | |
| >3.20 to 3.50 | ±0.025 | 2080 to 2180 | | 4 | | |
| >3.50 to 4.00 | | 2080 to 2180 | | | | |
| >4.00 to 4.20 | | 2030 to 2130 | 40 | | | |
| >4.20 to 4.50 | | 2030 to 2130 | | | | |
| >4.50 to 4.70 | | 2030 to 2130 | | 3 | | |
| >4.70 to 5.00 | | 2030 to 2130 | | | | |
| >5.00 to 5.60 | ±0.030 | 1980 to 2080 | | | | |
| >5.60 to 6.00 | ±0.035 | 1980 to 2080 | | | | |
| >6.00 to 7.00 | ±0.040 | 1960 to 2060 | 35 | - | | |

- Range of tensile strength within one coil max. 60 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

## SURFACE INSPECTION:
Wires with diameters from 2.5 to 6.5 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects.

Testing of wires <2.5 mm can be agreed upon separately.

Defect ≥40µm are recorded and marked.

## HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

After shot peening, the springs must be stress relieved at approx. 240°C for 30 minutes.

## SHOT PEENING:
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 964

## OIL TEMPERED SILICON/CHROMIUM/ VANADIUM ALLOYED VALVE SPRING WIRE FROM SHAVED WIRE ROD

**EXTERNAL STANDARD:**
The material confirms to VDSiCrV according to EN 10270 – 2: 2011

**FURTHER SIMILAR STANDARDS:**
ASTM A877/877M Grade B and SWOSC-VHV

**APPLICATIONS:**
Especially suitable for coil springs subjected to high dynamic stresses requiring good fatigue resistance (e.g. valve springs), as well as for springs which require high tensile strength and excellent relaxation properties at moderately elevated working temperatures (up to approx. 250° C)

**RANGE OF DIAMETERS:**
1.30 to 10.00mm Ø

**CHEMICAL COMPOSITION (HEAT ANALYSIS):**

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % | V % |
|---|---|---|---|---|---|---|---|
| 0.50-0.70 | 1.20-1.65 | 0.40-0.90 | 0.020 | 0.020 | 0.060 | 0.50-1.00 | 0.10-0.25 |

**RAW MATERIAL:**
Wire rod made of Si-killed steel according to in-house specifications.

The wire rod is shaved to eliminate surface defects such as seams, cracks and decarburization.

**CLEANLINESS ACC. TO MAX. T-METHOD:**
Number of non- metallic inclusions in the surface area detected on end samples of the wire rod.

| Size of indusions | 5-10 | >10-15 | >15[1)] | µm |
|---|---|---|---|---|
| Max.number/1000mm² | 50 | 7 | 0 | |

1) As stated by IVSWMA* it is likely to find occasional inclusions in valve spring quality steel of a size large than 15 um IVSWMA: International Valve Spring Wire Manufacturers Association

## MECHANICAL PROPERTIES: PENTHOR 964

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPA | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2230 to 2360 | 50 | 5 | MAX 0.50 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2210 to 2360 | | | | |
| >1.60 to 2.00 | ±0.025 | 2160 to 2310 | | 4 | | |
| >2.00 to 2.50 | | 2100 to 2250 | | | | |
| >2.50 to 2.70 | | 2060 to 2210 | | | | |
| >2.70 to 3.00 | ±0.030 | 2060 to 2210 | 45 | | | |
| >3.00 to 3.20 | | 2060 to 2210 | | | | |
| >3.20 to 3.50 | | 2010 to 2160 | | | | |
| >3.50 to 4.00 | | 2010 to 2160 | | | | |
| >4.00 to 4.20 | ±0.035 | 1960 to 2110 | | 3 | | |
| >4.20 to 4.50 | | 1960 to 2110 | | | | |
| >4.50 to 4.70 | | 1960 to 2110 | | | | |
| >4.70 to 5.00 | | 1960 to 2110 | 40 | | | |
| >5.00 to 5.60 | | 1910 to 2060 | | | | |
| >5.60 to 6.00 | ±0.040 | 1910 to 2060 | 35 | | | |
| >6.00 to 6.50 | | 1910 to 2060 | | | | |
| >6.50 to 7.00 | | 1860 to 2010 | | | | |
| >7.00 to 8.00 | ±0.045 | 1860 to 2010 | | 2 | | |
| >8.00 to 9.00 | | 1810 to 1960 | | | | |
| >9.00 to 10.00 | ±0.050 | 1810 to 1960 | | | | |

- Range of tensile strength within one coil max. 50 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

**SURFACE INSPECTION:**
Wires with diameters from 2.5 to 6.5 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects. Testing of wires <2.50 mm can be agreed upon separately.

Defects ≥ 40 µm are recorded and marked.

**HEAT TREATMENT:**
After coiling, the springs should be stress relieved as soon as possible at 380°–425°C, with a holding time of 30 minutes at temperature.

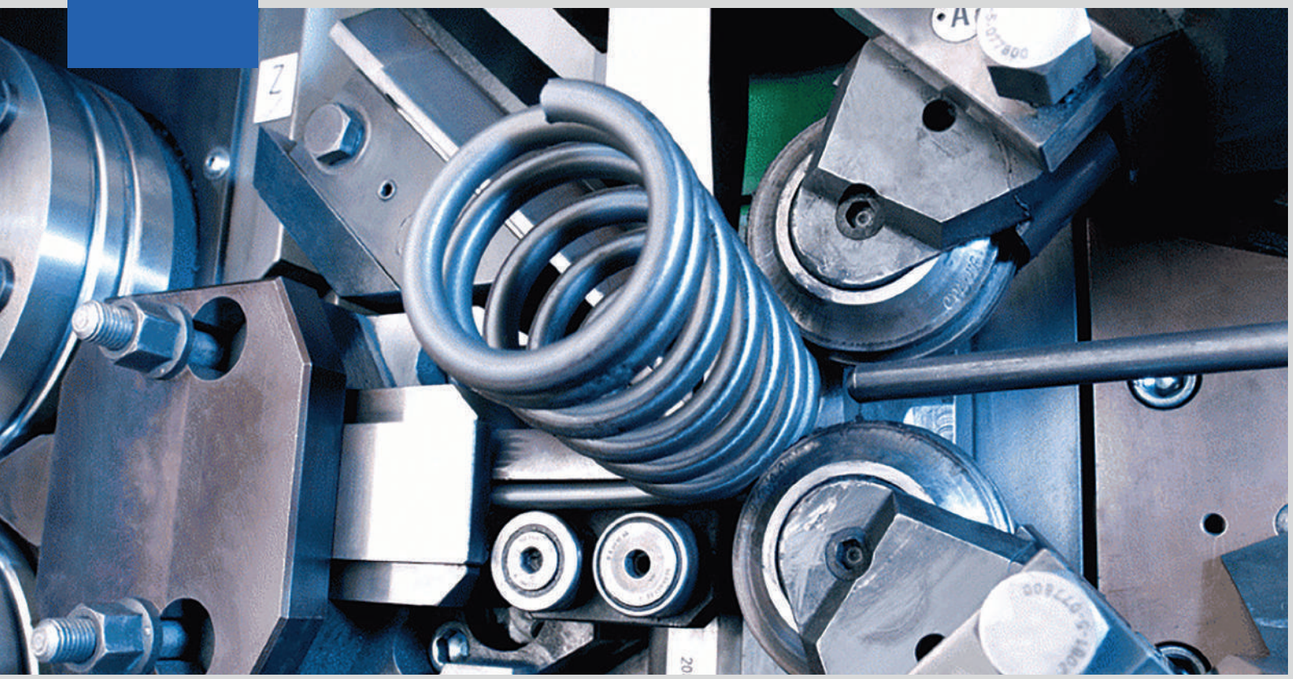
After shot peening, the springs must be stress relieved at approx. 240°C for 30 minutes.

**SHOT PEENING:**
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 943

## OIL TEMPERED SILICON/CHROMIUM/ VANADIUM ALLOYED SPRING WIRE



**EXTERNAL STANDARD:**
The material confirms to TDSiCrV according to EN 10270 – 2: 2011.

**FURTHER SIMILAR STANDARDS:**
ASTM A-1000 Grade D

**APPLICATIONS:**
For coil springs subjected to moderate dynamic stresses, such as clutch springs or springs requiring similar moderate fatigue resistance as well as high tensile strength and excellent relaxation properties at elevated temperatures (up to approx. 250°C).

**RANGE OF DIAMETERS:**
1.30 to 10.00 mm Ø

**CHEMICAL COMPOSITION (HEAT ANALYSIS):**

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % | V % |
|---|---|---|---|---|---|---|---|
| 0.50-0.70 | 1.20-1.65 | 0.40-0.90 | 0.020 | 0.020 | 0.10 | 0.50-1.00 | 0.10-0.25 |

**RAW MATERIAL:**
Wire rod according to in-house specifications.

**CLEANLINESS ACC. TO DIN 50602, INCLUSIONS CHART 1:**
Max. size 2 for all types of inclusions.

**MECHANICAL PROPERTIES: PENTHOR 943**

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS min. Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2230 to 2360 | 50 | 5 | MAX 1.30 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2210 to 2360 | | | | |
| >1.60 to 2.00 | ±0.025 | 2160 to 2310 | | 4 | | |
| >2.00 to 2.50 | | 2100 to 2250 | | | | |
| >2.50 to 2.70 | | 2060 to 2210 | | | | |
| >2.70 to 3.00 | ±0.030 | 2060 to 2210 | 45 | | | |
| >3.00 to 3.20 | | 2060 to 2210 | | | | |
| >3.20 to 3.50 | | 2010 to 2160 | | | | |
| >3.50 to 4.00 | | 2010 to 2160 | | | | |
| >4.00 to 4.20 | ±0.035 | 1960 to 2110 | | 3 | | |
| >4.20 to 4.50 | | 1960 to 2110 | | | | |
| >4.50 to 4.70 | | 1960 to 2110 | | | | |
| >4.70 to 5.00 | | 1960 to 2110 | | | | |
| >5.00 to 5.60 | | 1910 to 2060 | | | | |
| >5.60 to 6.00 | ±0.040 | 1910 to 2060 | 40 | | | |
| >6.00 to 6.50 | | 1910 to 2060 | | | | |
| >6.50 to 7.00 | | 1860 to 2010 | | | | |
| >7.00 to 8.00 | ±0.045 | 1860 to 2010 | 35 | – | | |
| >8.00 to 9.00 | | 1810 to 1960 | | | | |
| >9.00 to 10.00 | ±0.050 | 1810 to 1960 | | | | |

- Range of tensile strength within one coil max. 60 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

**SURFACE INSPECTION:**
Wires with diameters from 2.5 to 6.5 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects.

Testing of wires <2.5 mm can be agreed upon separately.

Defect ≥60µm are recorded and marked.

**HEAT TREATMENT:**
After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

After shot peening, the springs must be stress relieved at approx. 240°C for 30 minutes.

**SHOT PEENING:**
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 911HT

## OIL TEMPERED SILICON/CHROMIUM/ VANADIUM ALLOYED SPRING WIRE

### EXTERNAL STANDARD:
NA

### FURTHER SIMILAR STANDARDS:
NA

### APPLICATIONS:
For coil springs subjected to moderate dynamic stresses, such as clutch springs or springs requiring similar moderate fatigue resistance as well as high tensile strength and excellent relaxation properties at elevated temperatures (up to approx. 250°C).

### RANGE OF DIAMETERS:
1.30 to 7.00 mm Ø

### CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % | V % |
|---|---|---|---|---|---|---|---|
| 0.50-0.70 | 1.20-1.65 | 0.40-0.90 | 0.020 | 0.020 | 0.10 | 0.50-1.00 | 0.10-0.25 |

### RAW MATERIAL:
Wire rod according to in-house specifications.

### CLEANLINESS ACC. TO DIN 50602, INCLUSIONS CHART 1:
Max. size 2 for all types of inclusions.

### MECHANICAL PROPERTIES: PENTHOR 911HT

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | TORSION (MIN.) nos | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2330 to 2430 | 45 | 4 | MAX 1.30 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2330 to 2430 | | | | |
| >1.60 to 2.00 | ±0.025 | 2260 to 2360 | | | | |
| >2.00 to 2.50 | | 2260 to 2360 | 40 | | | |
| >2.50 to 2.70 | | 2240 to 2340 | | | | |
| >2.70 to 3.00 | ±0.030 | 2240 to 2340 | | | | |
| >3.00 to 3.20 | | 2240 to 2340 | | | | |
| >3.20 to 3.50 | | 2240 to 2340 | | 3 | | |
| >3.50 to 4.00 | | 2220 to 2320 | | | | |
| >4.00 to 4.20 | ±0.035 | 2220 to 2320 | 38 | | | |
| >4.20 to 4.50 | | 2220 to 2320 | | | | |
| >4.50 to 4.70 | | 2200 to 2300 | | | | |
| >4.70 to 5.00 | | 2200 to 2300 | | | | |
| >5.00 to 5.60 | | 2200 to 2300 | | | | |
| >5.60 to 6.00 | ±0.040 | 2180 to 2280 | | NA | | |
| >6.00 to 6.50 | | 2180 to 2280 | | | | |
| >6.50 to 7.00 | | 2180 to 2280 | | | | |

- Range of tensile strength within one coil max. 60 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

### SURFACE INSPECTION:
Wires with diameters from 2.5 to 6.5 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects.

Testing of wires <2.5 mm can be agreed upon separately.

Defect ≥60µm are recorded and marked.

### HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

After shot peening, the springs must be stress relieved at approx. 240°C for 30 minutes.

### SHOT PEENING:
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 911

## OIL TEMPERED SILICON/ CHROMIUM/VANADIUM ALLOYED SPRING WIRE

### EXTERNAL STANDARD:
The material confirms to FDSiCrV according to EN 10270-2:2011

### APPLICATIONS:
For statically stressed springs or springs working in the finite life range, requiring strength at elevated temperatures (up to approx. 250°C).

### RANGE OF DIAMETERS:
1.30 to 10.00 mm Ø

### CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % | V % |
|---|---|---|---|---|---|---|---|
| 0.50-0.70 | 1.20-1.65 | 0.40-0.90 | 0.030 | 0.025 | 0.12 | 0.50-1.00 | 0.10-0.25 |

### RAW MATERIAL:
Wire rod according to in-house specifications.

### MECHANICAL PROPERTIES: PENTHOR 911

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2280 to 2410 | 45 | MAX 1.50 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2260 to 2410 | | | |
| >1.60 to 2.00 | ±0.025 | 2210 to 2360 | | | |
| >2.00 to 2.50 | | 2160 to 2310 | | | |
| >2.50 to 2.70 | | 2110 to 2260 | | | |
| >2.70 to 3.00 | ±0.030 | 2110 to 2260 | | | |
| >3.00 to 3.20 | | 2110 to 2260 | | | |
| >3.20 to 3.50 | | 2110 to 2260 | 42 | | |
| >3.50 to 4.00 | | 2060 to 2210 | | | |
| >4.00 to 4.20 | ±0.035 | 2060 to 2210 | 40 | | |
| >4.20 to 4.50 | | 2060 to 2210 | | | |
| >4.50 to 4.70 | | 2010 to 2160 | | | |
| >4.70 to 5.00 | | 2010 to 2160 | | | |
| >5.00 to 5.60 | ±0.040 | 2010 to 2160 | 38 | | |
| >5.60 to 6.00 | | 1960 to 2110 | | | |
| >6.00 to 7.00 | | 1960 to 2110 | 35 | | |
| >7.00 to 8.00 | ±0.045 | 1910 to 2050 | | | |
| >8.00 to 8.50 | | 1890 to 2030 | 32 | | |
| >8.50 to 10.00 | ±0.050 | 1870 to 2010 | | | |

- Range of tensile strength within one coil max. 70 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

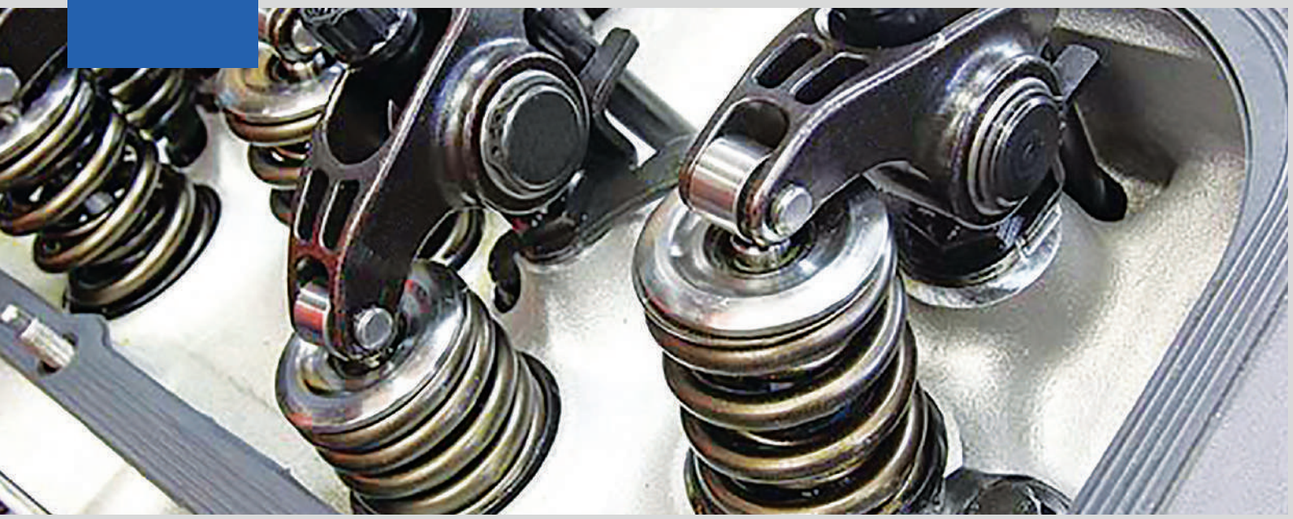
1) End samples

### HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 864

OIL TEMPERED SILICON/CHROMIUM ALLOYED VALVE SPRING WIRE FROM SHAVED WIRE ROD.



## EXTERNAL STANDARD:

The material confirms to VDSiCr according to EN 10270 – 2: 2011 & IS 4454 Part 2:2001

## FURTHER SIMILAR STANDARDS:

ASTM A877/877M Grade A JIS G3561 SWOSC - V

## APPLICATIONS:

Especially suitable for coil springs subjected to high dynamic stresses requiring good fatigue resistance (eg. valve springs), as well as for springs which require high tensile strength and excellent relaxation proper- ties at moderately elevated working temperatures (up to approx. 250°C).

## RANGE OF DIAMETERS:

1.30 to 10.00mm Ø

## CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % |
|---|---|---|---|---|---|---|
| 0.50-0.60 | 1.20-1.60 | 0.50-0.90 | 0.025 | 0.020 | 0.06 | 0.50-0.80 |

## RAW MATERIAL:

Wire rod made of Si-killed steel according to in-house specifications.

The wire rod is shaved to eliminate surface defects such as seams, cracks and decarburization.

## CLEANLINESS ACC. TO MAX. T-METHOD:

Number of non-metallic inclusions in the surface area detected on end samples of the wire rod

| Size of indusions | 5-10 | >10-15 | >15[1)] | µm |
|---|---|---|---|---|
| Max.number/1000mm² | 50 | 7 | 0 | |

1) As stated by IVSWMA* it is likely to find occasional inclusions in valve spring quality steel of a size large than 15µm * IVSWMA: International Valve Spring Wire Manufacturers Association.

## MECHANICAL PROPERTIES: PENTHOR 864

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS min. Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2080 to 2210 | 50 | 5 | MAX 0.5 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2060 to 2210 | | | | |
| >1.60 to 2.00 | ±0.025 | 2010 to 2160 | | 4 | | |
| >2.00 to 2.50 | | 1960 to 2060 | | | | |
| >2.50 to 2.70 | | 1910 to 2010 | | | | |
| >2.70 to 3.00 | ±0.030 | 1910 to 2010 | 45 | | | |
| >3.00 to 3.20 | | 1910 to 2010 | | | | |
| >3.20 to 3.50 | | 1910 to 2010 | | | | |
| >3.50 to 4.00 | | 1860 to 1960 | | | | |
| >4.00 to 4.20 | ±0.035 | 1860 to 1960 | | 3 | | |
| >4.20 to 4.50 | | 1860 to 1960 | | | | |
| >4.50 to 4.70 | | 1810 to 1910 | | | | |
| >4.70 to 5.00 | | 1810 to 1910 | | | | |
| >5.00 to 5.60 | | 1810 to 1910 | | | | |
| >5.60 to 6.00 | ±0.040 | 1760 to 1860 | 40 | - | | |
| >6.00 to 6.50 | | 1760 to 1860 | | | | |
| >6.50 to 7.00 | | 1710 to 1810 | | | | |
| >7.00 to 8.00 | ±0.045 | 1710 to 1810 | | | | |
| >8.00 to 9.00 | | 1670 to 1770 | | | | |
| >9.00 to 10.00 | ±0.050 | 1670 to 1770 | 35 | | | |

- Range of tensile strength within one coil max. 50 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

## SURFACE INSPECTION:

Wires with diameters from 2.5 to 6.5 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects. Testing of wires <2.50 mm can be agreed upon separately.

Defects ≥ 40 µm are recorded and marked.

## HEAT TREATMENT:

After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

After shot peening, the springs must be stress relieved at approx. 240°C for 30 minutes.

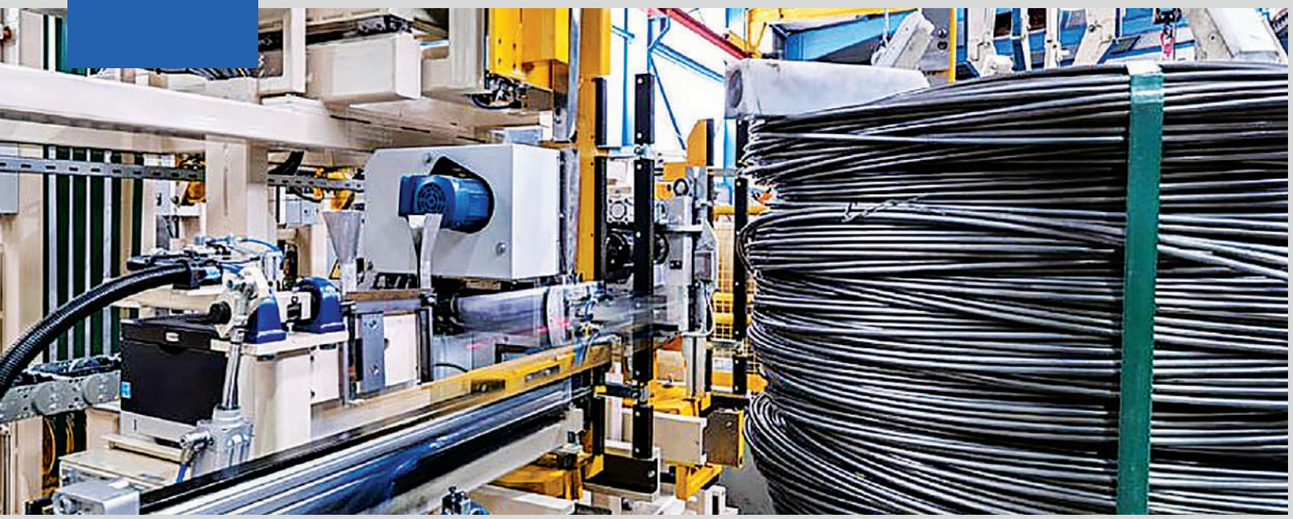
## SHOT PEENING:

The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 844S

## OIL TEMPERED SILICON/CHROMIUM ALLOYED SPRING WIRE FROM SHAVED WIRE ROD



**EXTERNAL STANDARD:**
The material confirms with TDSiCr according to EN 10270-2: 2011 & IS 4454 Part2:2001

**FURTHER SIMILAR STANDARDS:**
ASTM A-1000 Grade A, JIS 3560 SWOSC-B

**APPLICATIONS:**
For coil springs subjected to dynamic stresses requiring excellent relaxation properties at elevated temperatures(up to approx. 250°C).

**RANGE OF DIAMETERS:**
1.30 to 10.00mm Ø

**CHEMICAL COMPOSITION (HEAT ANALYSIS):**

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % |
|---|---|---|---|---|---|---|
| 0.50-0.60 | 1.20-1.60 | 0.50-0.90 | 0.025 | 0.020 | 0.08 | 0.50-0.80 |

**RAW MATERIAL:**
Wire rod according to in-house specifications.
The wire rod is shaved to eliminate surface defects such as seams, cracks and decarburization.

**CLEANLINESS ACC. TO DIN 50602, INCLUSIONS CHART 1:**
Max. size 2 for all types of inclusions.

**MECHANICAL PROPERTIES: PENTHOR 844S**

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS min. Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40<br>>1.40 to 1.60 | ±0.020 | 2080 to 2210<br>2060 to 2210 | 50 | 5 | MAX 0.50 %<br>OF<br>THE WIRE DIAMETER | |
| >1.60 to 2.00<br>>2.00 to 2.50<br>>2.50 to 2.70 | ±0.025 | 2010 to 2160<br>1960 to 2060<br>1910 to 2010 | | 4 | | |
| >2.70 to 3.00<br>>3.00 to 3.20<br>>3.20 to 3.50<br>>3.50 to 4.00 | ±0.030 | 1910 to 2010<br>1910 to 2010<br>1910 to 2010<br>1860 to 1960 | 45 | | | |
| >4.00 to 4.20<br>>4.20 to 4.50<br>>4.50 to 4.70<br>>4.70 to 5.00<br>>5.00 to 5.60 | ±0.035 | 1860 to 1960<br>1860 to 1960<br>1810 to 1910<br>1810 to 1910<br>1810 to 1910 | | 3 | | |
| >5.60 to 6.00<br>>6.00 to 6.50<br>>6.50 to 7.00 | ±0.040 | 1760 to 1860<br>1760 to 1860<br>1710 to 1810 | 40 | | | |
| >7.00 to 8.00<br>>8.00 to 9.00 | ±0.045 | 1710 to 1810<br>1670 to 1770 | | - | | |
| >9.00 to 10.00 | ±0.050 | 1670 to 1770 | 35 | | | |

- Range of tensile strength within one coil max. 50 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

**SURFACE INSPECTION:**
Wires with diameters from 2.50 to 6.50 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects.

Testing of wires <2.50 mm can be agreed upon separately.

Defect >40um are recorded and marked.

**HEAT TREATMENT:**
After coiling, the springs should be stress relieved as soon as possible at 380°– 425°C, with a holding time of 30 minutes at temperature.

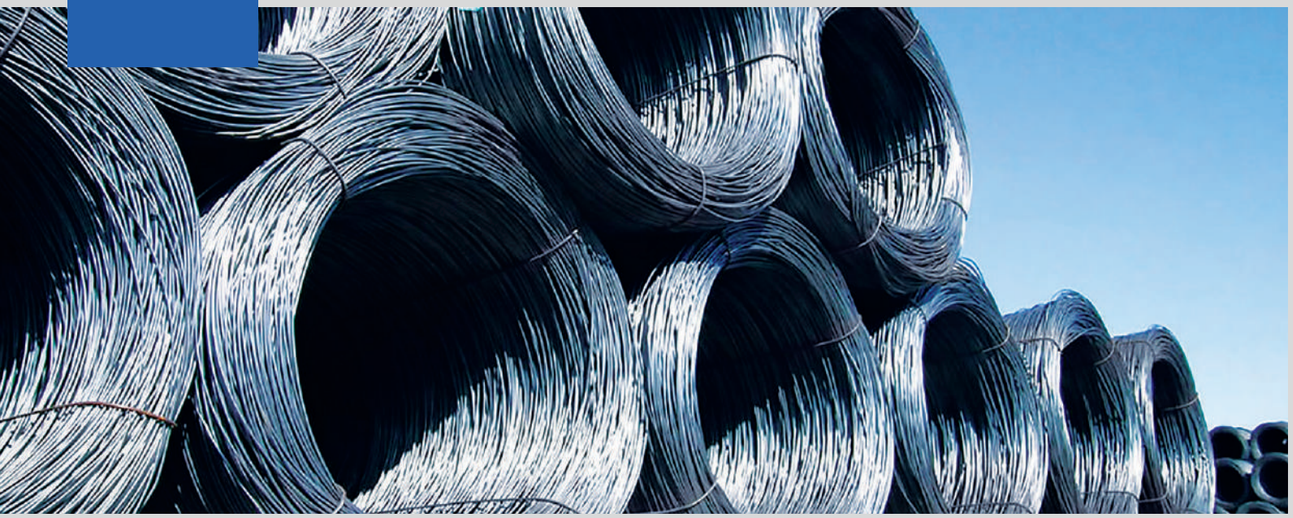
After shot peening, the springs must be stress relieved at approx. 240° C for 30 minutes.

**SHOT PEENING:**
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 843/842

## OIL TEMPERED SILICON/CHROMIUM ALLOYED SPRING WIRE



### EXTERNAL STANDARD:
The material confirms with TDSiCr according to
EN 10270- 2: 2011 & IS 4454 Part 2:2001

### FURTHER SIMILAR STANDARDS:
ASTM A-1000 Grade A, JIS 3560 SWOSC-B

### APPLICATIONS:
For coil springs subjected to moderate dynamic stresses such as clutch springs or springs requiring similar moder- ate fatigue resistance as well as high tensile strength and excellent relaxation properties at elevated temperatures (up to approx. 250°C).

### RANGE OF DIAMETERS:
1.30 to 10.00mm Ø

### CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % |
|---|---|---|---|---|---|---|
| 0.50-0.60 | 1.20-1.60 | 0.50-0.90 | 0.025 | 0.020 | 0.10 | 0.50-0.80 |

### RAW MATERIAL:
Wire rod according to in-house specifications.

### CLEANLINESS ACC. TO DIN 50602, INCLUSIONS CHART 1:
Max. size 2 for all types of inclusions.

### MECHANICAL PROPERTIES: PENTHOR 843/842

| WIRE DIAMETER mm | TOLERANCE mm | ULTIMATE TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | MINIMUM NO. OF TORSIONS min. Nos. | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 2080 to 2210 | 50 | 5 | MAX 1.3 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 2060 to 2210 | | | | |
| >1.60 to 2.00 | ±0.025 | 2010 to 2160 | | 4 | | |
| >2.00 to 2.50 | | 1960 to 2060 | | | | |
| >2.50 to 2.70 | | 1910 to 2010 | | | | |
| >2.70 to 3.00 | ±0.030 | 1910 to 2010 | 45 | | | |
| >3.00 to 3.20 | | 1910 to 2010 | | | | |
| >3.20 to 3.50 | | 1910 to 2010 | | | | |
| >3.50 to 4.00 | | 1860 to 1960 | | | | |
| >4.00 to 4.20 | ±0.035 | 1860 to 1960 | | | | |
| >4.20 to 4.50 | | 1860 to 1960 | | | | |
| >4.50 to 4.70 | | 1810 to 1910 | | | | |
| >4.70 to 5.00 | | 1810 to 1910 | | | | |
| >5.00 to 5.60 | | 1810 to 1910 | | 3 | | |
| >5.60 to 6.00 | ±0.040 | 1760 to 1860 | 40 | | | |
| >6.00 to 6.50 | | 1760 to 1860 | | | | |
| >6.50 to 7.00 | | 1710 to 1810 | | | | |
| >7.00 to 8.00 | ±0.045 | 1710 to 1810 | | - | | |
| >8.00 to 9.00 | | 1670 to 1770 | | | | |
| >9.00 to 10.00 | ±0.050 | 1670 to 1770 | 35 | | | |

- Range of tensile strength within one coil max. 60 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1
- Penthor 842 grade comes without eddy current testing

1) End samples

### SURFACE INSPECTION:
Wires with diameters from 2.5 to 6.50 mm are eddy current surface inspected after oil hardening and tempering using a combination of two methods to detect both transverse and longitudinal defects. Testing of wires <2.50 mm can be agreed upon separately.

Defect ≥60um are recorded and marked. Penthor 842 wire are not subjected to inline surface inspection.

### HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible at 380° – 425°C, with a holding time of 30 minutes at temperature.

After shot peening, the springs must be stress relieved at approx 240°C for 30 minutes.

### SHOT PEENING:
The shot size and blast time must be chosen to ensure complete coverage of the inside of the springs. Particular attention should be paid to the above in case of springs with small index and pitch.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 811

## OIL TEMPERED SILICON/CHROMIUM ALLOYED SPRING WIRE

### EXTERNAL STANDARD:
The material confirms with FDSiCr according to EN 10270-2: 2011 & IS 4454 part 2:2001.

### FURTHER SIMILAR STANDARDS:
ASTM A401/A401M JIS 3560 SWOSC- B

### APPLICATIONS:
For statically stressed springs or springs working in the finite life range, requiring strength at elevated temperatures up to approx. 250°C.

### RANGE OF DIAMETERS:
1.30 to 12.50mm Ø

### CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % | Cr % |
|---|---|---|---|---|---|---|
| 0.50-0.60 | 1.20-1.60 | 0.50-0.90 | 0.030 | 0.025 | 0.12 | 0.50-0.80 |

### RAW MATERIAL:
Wire rod according to in-house specifications.

### MECHANICAL PROPERTIES: PENTHOR 811

| WIRE DIAMETER mm | TOLERANCE mm | TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|
| 1.30 to 1.40<br>>1.40 to 1.60 | ±0.020 | 2070 to 2250<br>2040 to 2220 | 45 | MAX 1.5 %<br>OF<br>THE WIRE DIAMETER | |
| >1.60 to 2.00<br>>2.00 to 2.50<br>>2.50 to 2.70 | ±0.025 | 2000 to 2180<br>1970 to 2140<br>1950 to 2120 | | | |
| >2.70 to 3.00<br>>3.00 to 3.20<br>>3.20 to 3.50<br>>3.50 to 4.00 | ±0.030 | 1930 to 2100<br>1910 to 2080<br>1900 to 2060<br>1870 to 2030 | 42 | | |
| >4.00 to 4.20<br>>4.20 to 4.50<br>>4.50 to 4.70<br>>4.70 to 5.00<br>>5.00 to 5.60 | ±0.035 | 1860 to 2020<br>1850 to 2000<br>1840 to 1990<br>1830 to1980<br>1800 to1950 | 40 | | |
| >5.60 to 6.00<br>>6.00 to 6.50<br>>6.50 to 7.00 | ±0.040 | 1780 to 1930<br>1760 to 1910<br>1740 to 1890 | 38 | | |
| >7.00 to 8.00<br>>8.00 to 8.50 | ±0.045 | 1710 to 1860<br>1700 to 1850 | 35 | | |
| >8.50 to 10.00 | ±0.050 | 1660 to 1810<br>1620 to 1770 | 32 | | |
| >10.00 to 12.00 | ±0.070 | | | | |
| >12.00 to 12.50 | ±0.080 | 1580 to 1730 | 30 | | |

- Range of tensile strength within one coil max. 70 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

### HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible.

**Please inquire for special tolerances, tensile, sections, etc.**

# PENTHOR 111

OIL TEMPERED UNALLOYED SPRING WIRE

## EXTERNAL STANDARD:
The material confirms with FDC acc. to EN 10270-2: 2011.

## FURTHER SIMILAR STANDARDS:
ASTM A229/A229M JIS G3560 SWO - A

## APPLICATIONS:
For statically stressed springs and springs working in the finite life range

## RANGE OF DIAMETERS:
1.30 to 12.50mm Ø

## CHEMICAL COMPOSITION (HEAT ANALYSIS):

| C % | Si % | Mn % | P Max % | S Max % | Cu Max % |
|---|---|---|---|---|---|
| 0.60-0.75 | 0.15-0.35 | 0.50-1.20 | 0.030 | 0.025 | 0.120 |

## RAW MATERIAL:
Wire rod according to in-house specifications.

## MECHANICAL PROPERTIES: PENTHOR 111

| WIRE DIAMETER mm | TOLERANCE mm | TENSILE STRENGTH MPa | MINIMUM REDUCTION AREA % | PERMISSIBLE DEPTH OF SURF. DEFECTS 1) % | PERMISSIBLE PART DECARBURIZATION DEPTH 1) % |
|---|---|---|---|---|---|
| 1.30 to 1.40 | ±0.020 | 1810 to 1970 | 45 | MAX 1.0 % OF THE WIRE DIAMETER | |
| >1.40 to 1.60 | | 1760 to 1940 | | | |
| >1.60 to 2.00 | ±0.025 | 1720 to 1890 | | | |
| >2.00 to 2.50 | | 1670 to 1820 | | | |
| >2.50 to 2.70 | | 1640 to 1790 | | | |
| >2.70 to 3.00 | ±0.030 | 1620 to 1770 | | | |
| >3.00 to 3.20 | | 1600 to 1750 | | | |
| >3.20 to 3.50 | | 1580 to 1730 | 42 | | |
| >3.50 to 4.00 | | 1550 to 1700 | | | |
| >4.00 to 4.20 | ±0.035 | 1540 to 1690 | 40 | | |
| >4.20 to 4.50 | | 1520 to 1670 | | | |
| >4.50 to 4.70 | | 1510 to 1660 | | | |
| >4.70 to 5.00 | | 1500 to1650 | | | |
| >5.00 to 5.60 | | 1470 to1620 | | | |
| >5.60 to 6.00 | ±0.040 | 1460 to 1610 | 38 | | |
| >6.00 to 6.50 | | 1440 to 1590 | | | |
| >6.50 to 7.00 | | 1430 to 1580 | 35 | | |
| >7.00 to 8.00 | ±0.045 | 1400 to 1550 | | | |
| >8.00 to 8.50 | | 1380 to 1530 | | | |
| >8.50 to 10.00 | ±0.050 | 1360 to 1510 | 32 | | |
| >10.00 to 12.00 | ±0.070 | 1320 to 1470 | | | |
| >12.00 to 12.50 | ±0.080 | 1280 to 1430 | 30 | | |

- Range of tensile strength within one coil max. 70 MPa
- Ovality: Difference between the largest and smallest diameter of a cross section does not exceed 50% of the diameter tolerance.
- Yield point (0.2%limit) at least 90% of the tensile strength
- Modulus of elasticity E= 206.000 MPa (Standard)
- Shear Modulus G = 79.500 MPa (Standard)
- Torsion tests are carried out according to EN 10218-1

1) End samples

## HEAT TREATMENT:
After coiling, the springs should be stress relieved as soon as possible.

**Please inquire for special tolerances, tensile, sections, etc.**

# SHAPED WIRE

**APPLICABLE SPECIFICATION:**
Material according to EN 10270 - 2 as well as other international standards and customers specifications.

**TYPES OF MATERIAL:**
Oil-tempered wires across all grades served by Pengg Group.

**RAW MATERIAL:**
wire rod according to in-house specifications

**MECHANICAL PROPERTIES:**
Tensile and hardness according to customer requirements

**SHAPES:**
square, rectangular, flat, oval, two side flat.
special shapes on request according to customer requirements.

**APPLICATIONS:**
Engine valve, Automotive transmission electrical connector parts, Automotive door hinges, conveyer screws, piston rings, and other engineering applications.

# DIMENSIONAL RANGE AND TOLERANCES:

**SHAPED WIRE:**
Min. size: 1.50 *1.50 mm
corner configuration min. 0.30 mm

**TOLERANCES**

| SIZE | TOLERANCES |
|---|---|
| >1.50 mm - 3.00 mm | +/-0.020 mm |
| >3.00 mm - 5.00 mm | +/-0.030 mm |
| >5.00 mm - 6.00 mm | +/- 0.040mm |

Other dimensions and tolerances on special request

**FLAT WIRE:**
Thickness: min 1.40 mm
w/t max. 3

**TOLERANCES**

| NOMINAL WIDTH | TOLERANCES | THICKNESS | TOLERANCES |
|---|---|---|---|
| 1.50 mm - 3.00 mm | +/-0.050 mm | 1.00 mm - 2.00 mm | +/-0.015 mm |
| 3.00 mm - 5.00 mm | +/-0.070 mm | 2.00 mm - 4.00 mm | +/-0.020 mm |

Other dimensions and tolerances on special request

# DELIVERY FORMS

TYPE 1
CATCH-WEIGHT COILS

| WIRE DIAMETER | COIL DIAMETER (MM) | | MAXIMUM COIL WEIGHT KG |
|---|---|---|---|
| | INSIDE | OUTSIDE | |
| 1.30-2.50 | 800 | 1100 | 550 |
| 2.51-6.99 | 1100 | 1400 | 1000 |
| 7.00-10.00 | 1400 | 1700 | 1000 |
| 10.01-12.50 | 1800 | 2100 | 1200 |

TYPE 2
CARRIERS

| WIRE DIAMETER | COIL DIAMETER (MM) | | MAXIMUM WEIGHT/ CARRIER KG | MAXIMUM CARRIER HEIGHT MM |
|---|---|---|---|---|
| | INSIDE | OUTSIDE | | |
| 1.30-2.50 | 800 | 1100 | 2500 | 1500 |
| 2.51-6.99 | 1100 | 1400 | 2500 | 1000 |
| 7.00-10.00 | 1400 | 1700 | 2500 | 1200 |

TYPE 3
WOODEN BOX AND PALLET

Material: Carrier made of steel tubes

Packaging: For packaging, the materials used are only those which can be recycled 100% such as paper or LPDE (low density polyethylene)

# SAFETY; HANDLING AND STORAGE INFORMATION

- Oil hardened and tempered wires are very high tensile wires Due to straight cast and very high springiness these wire have tendency to get opened very swiftly with a very high force while cutting the steel/plastic straps used for binding the coils which may result in accident. Hence during cutting the steel straps used for binding these coils ensure that, (i) Few rings in the coil are bound together with cable tie (ii) While cutting cable ties, free end is tied with former or pay off arm carefully to avoid accidents.

- Be attentive while running the coils of oil hardened and tempered wires, since more springiness action of these wires may result in fatal accidents. If possible, use safety ring on the top of the coil or a cross bar.

- While cutting the steel strap of oil hardened and tempered wires, please ensure that wire is not damaged mechanically. Any mechanical damage may result in the problem of breakage during subsequent coiling operation.

- During the usage of oil hardened and tempered wires; if a certain portion of coil is left after coiling the required number of springs, then in that case, apply rust preventive oil to the left over portion of the coil, pack the leftover coil properly and then shift the same to storage area after proper identification.

- If the wires are received in wet condition at the time of receipt, please intimate us immediately for further actions.

- Handle the wires carefully to avoid mechanical damage. Mechanical damage on wire surface may result in the problem of breakage during coiling operation.

- Please store these wires in proper conducive storage conditions, preferably in a horizontal manner on dry wooden planks. During storage of these wires, please ensure that wires do not come in contact with water and moisture to avoid the problem of rust.

- To protect the wires from atmospheric influences and hence to avoid the problem of rust; ensure that wires are stored in proper packed condition.

- If the wires are not stored properly in proper storage conditions and wire get rusted due to poor storage conditions; Pengg Usha will not be liable for such cases.

- Ensure that oil hardened and tempered wires are used within six months after the receipt.

- The springs coiled from defective portion of eddy tested wires which is painted with yellow / white paint have to be discarded. Ensure that such springs are not mixed with OK springs.

- Avoid metal to metal and metal to concrete floor contact during storage: handling and usage of these wires.