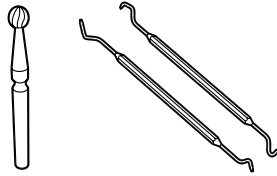


Zapp 2205SH-SW Medical Datasheet

Wire



Zapp is certified according to ISO 9001



Zapp 2205SH-SW

is a duplex (austenitic/ferritic) stainless steel with super high tensile strength.

The grade is characterized by:

- Very good corrosion resistance
- High resistance to stress corrosion cracking in chloride bearing environments
- High resistance to stress corrosion cracking in environments containing hydrogen sulphide
- High resistance to general corrosion, pitting, and crevice corrosion
- High resistance to erosion corrosion and corrosion fatigue
- Extremely high tensile strength in 'as delivered' condition
- Very good relaxation resistance
- Physical properties that offer design advantages

Service temperature: -100 to 300 °C (-150 to 570 °F)

Chemical composition (nominal) %

| C | Si | Mn | P | S | Cr | Ni | Mo | N |
|---------|-------|-------|---------|---------|------|-----|-----|------|
| ≤ 0.030 | ≤ 0.5 | ≤ 0.9 | ≤ 0.030 | ≤ 0.015 | 22.0 | 5.0 | 3.2 | 0.18 |

Forms of supply

| Surface finish | Dimension mm | in. |
|----------------|-------------------------|-----------------------------|
| Coated | 0.4 - 3.0 ¹⁾ | 0.016 - 0.118 ¹⁾ |
| Bright | 0.20 - 0.80 | 0.008 - 0.031 |
| Polished | 0.4 - 1.0 | 0.016 - 0.039 |
| Degreased | 0.4 - 3.0 ¹⁾ | 0.016 - 0.118 ¹⁾ |

¹⁾ Dimensions > 1 mm on request only

Standards

- UNS: S32205/S31803
- EN Number: 1.4462
- EN Name: X2CrNiMoN22-5-3
- W.No.: 1.4462

Applications

Zapp 2205SH-SW can be used for dental instruments.

Delivery Forms

Wire is delivered in lots and forms according to customers' requirements:

- On various types of spools with wire weights up to 500 kg (1,100 lb)
- In straightened lengths 0.45 to 4 m (1.5 to 13 ft)

Mechanical properties

At 20 °C (68 °F)

Tensile strength, R_m , and proof strength, $R_{p0.2}$ ¹⁾, MPa (ksi) in the 'as delivered' condition

| Wire diameter | Nominal, R_m | Nominal $R_{p0.2}$ | | | |
|---------------|-----------------|--------------------|-----|-----------|----------|
| | | mm | in. | ± 100 MPa | ± 15 ksi |
| 0.20 - 0.70 | 0.0079 - 0.028 | 2,550 | 370 | 2,050 | 297 |
| > 0.70 - 0.80 | > 0.028 - 0.031 | 2,400 | 348 | 2,000 | 290 |
| > 0.80 - 1.00 | > 0.031 - 0.039 | 2,300 | 334 | 1,950 | 283 |
| > 1.00 - 1.50 | > 0.039 - 0.059 | 2,250 | 326 | 1,915 | 278 |
| > 1.50 - 2.00 | > 0.059 - 0.079 | 2,150 | 312 | 1,800 | 261 |
| > 2.00 - 2.50 | > 0.079 - 0.098 | 2,050 | 297 | 1,745 | 253 |
| > 2.50 - 3.00 | > 0.098 - 0.118 | 2,000 | 290 | 1,700 | 247 |

¹⁾ $R_{p0.2}$ corresponds to 0.2 % offset yield strength.

²⁾ Dimensions >1 mm on request only

Tensile strength can be increased by 200 MPa (29 ksi) up to 450 MPa (65 ksi) by tempering depending on tensile and tempering conditions. Please ask us for more information of heat treatment. The tensile strength variation between spools/coils within the same production lot is ± 50 MPa (7 ksi) maximum. Yield strength in the tempered condition is approx. 90 % of the tempered tensile strength. Tensile strength values are guaranteed and are measured directly after production. During storage, both the tensile strength and yield strength will increase somewhat due to ageing. Depending on the storage conditions, the tensile strength can increase by 0 – 80 MPa (0 – 12 ksi).

The tensile strength and yield strength will decrease by 3 – 4 % per 100 °C (210 °F) increase in service temperature.

Straightened lengths

Straightening will reduce the tensile strength by approx. 7 %.

Fatigue strength

The diagrams below are based on tempered and pre-stressed cylindrical helical springs with a wire surface free from tooling damage.

AISI 316

At elevated temperatures, the fatigue strength decreases at

- 100 °C (210 °F): by about 5 %
- 200 °C (390 °F): by about 10 %

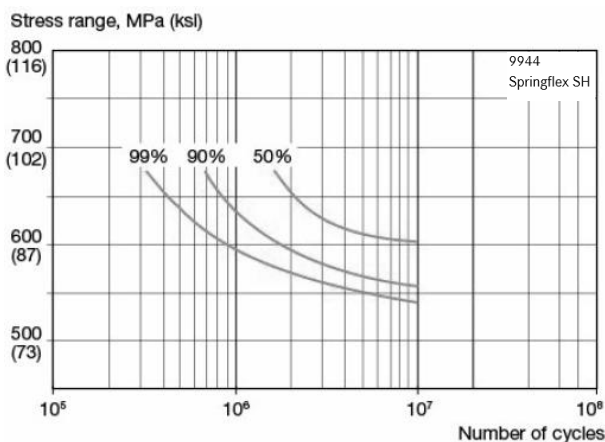


Figure 1. Wöhler diagram, mean stress 450 MPa (65 ksi). The curves are valid for springs coiled from wire 1.00 mm (0.039 in.) in diameter and represents 50 %, 90 % and 99 % certainty against failure.

Stress range = double the stress amplitude.

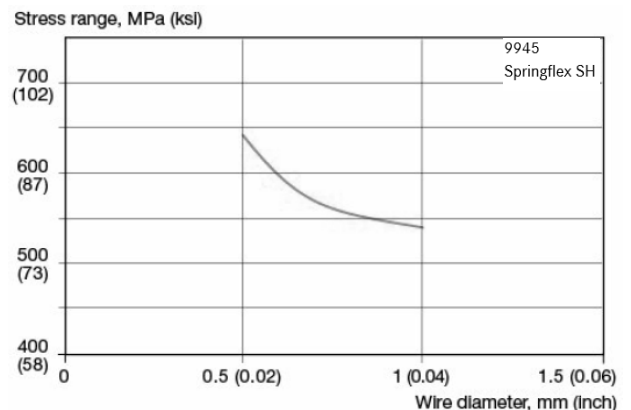


Figure 2. Stress range for different wire diameters, mean stress 450 MPa (65 ksi). Stress range at $10^{7.5}$ load cycles as a function of the wire diameter and 90 % certainty against failure.

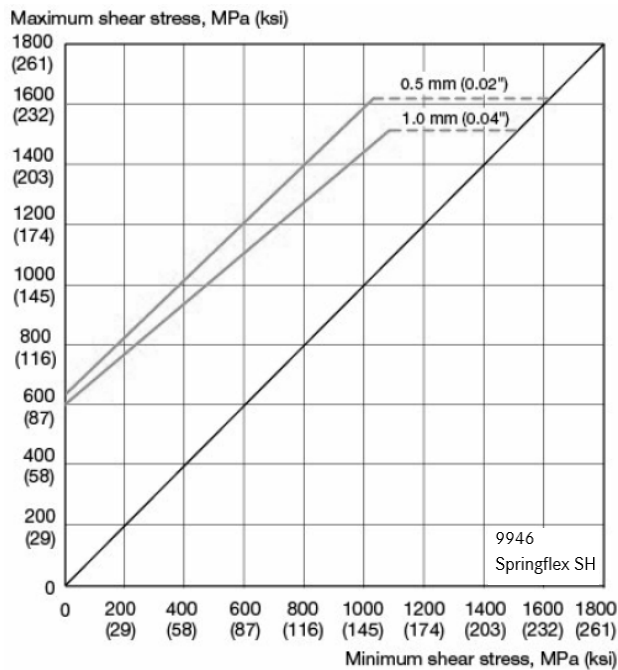


Figure 3. Modified Goodman diagram for different wire diameters. The curves are valid for $10^{7 ⁷}$ load cycles and represent 90 % certainty against failure.

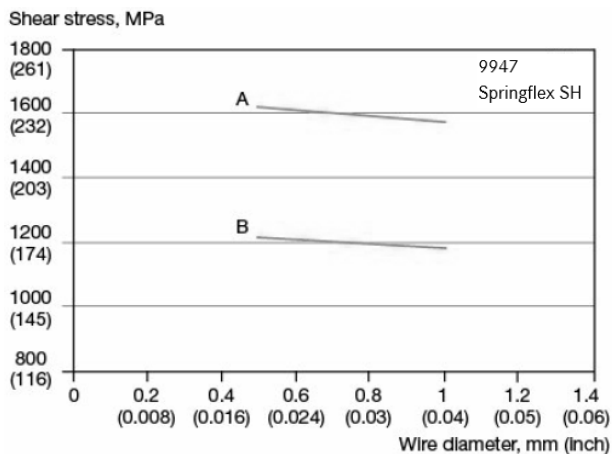


Figure 4. Setting limit and maximum permissible shear stress. Setting limit curve A, and maximum permissible shear stress, curve B, as a function of the wire diameter. The setting limit is defined as the shear stress at which the relaxation is 2 % after a load time of 24 hours. Curve B lies 25 % below curve A.

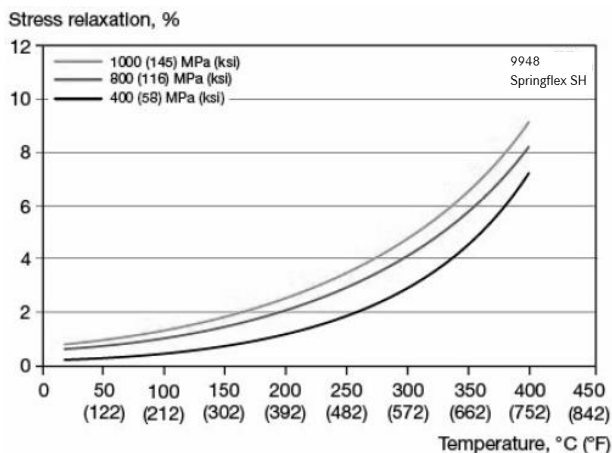


Figure 5. Relaxation 24 hours. Relaxation (load loss) at various shear stresses as a function of service temperature. This diagram refers to a wire diameter of 1.0 mm (0.039 in.).

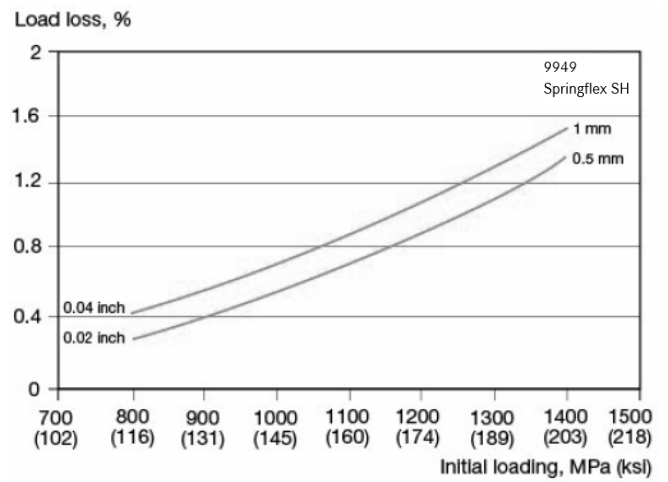


Fig 6. Relaxation, 24 hours. Relaxation (load loss) at various shear stresses as a function of wire diameter.

Physical Properties

Density: 7.8 g/cm³, 0.28 lb/in³

Specific heat capacity

| | |
|----------------|---------------------------------------|
| 500 J/kg °C | in the temperature range 50 – 100 °C |
| 0.12 Btu/lb °F | in the temperature range 120 – 212 °F |

Thermal conductivity

| Temperature °C | W/m °C | Temperature °F | Btu/ft h °F |
|----------------|--------|----------------|-------------|
| 20 | 14 | 68 | 9 |
| 100 | 16 | 212 | 9 |
| 200 | 17 | 390 | 10 |
| 300 | 19 | 570 | 11 |

Resistivity

| Temperature °C | μΩm | Temperature °F | μΩin. |
|----------------|------|----------------|-------|
| 20 - 100 | 0.84 | 120 - 212 | 33 |

Thermal expansion

Mean values in temperature ranges (x10⁻⁶)

Cold worked

Metric units

| Temperature °C per °C | 30 - 100 | 30 - 200 | 30 - 300 | 30 - 400 |
|-----------------------|----------|----------|----------|----------|
| | 12-5 | 11.5 | 11.5 | 12.0 |

Imperial units

| Temperature °F per °F | 86 - 200 | 86 - 400 | 86 - 600 | 86 - 800 |
|-----------------------|----------|----------|----------|----------|
| | 7.0 | 6.5 | 6.5 | 6.5 |

Aged

Metric units

| Temperature °C per °C | 30 - 100 | 30 - 200 | 30 - 300 | 30 - 400 |
|-----------------------|----------|----------|----------|----------|
| | 13.0 | 13.5 | 13.5 | 14.0 |

Imperial units

| Temperature °F per °F | 86 - 200 | 86 - 400 | 86 - 600 | 86 - 800 |
|-----------------------|----------|----------|----------|----------|
| | 7.0 | 7.5 | 7.5 | 8.0 |

Magnetic permeability, μ_{max}

| | | | | |
|------------|---|---|---|-----|
| Annealed | - | - | - | 60 |
| Cold drawn | - | - | - | 120 |

Shear modulus, MPa (ksi)

as delivered: approx. 77,000 (11,165)

tempered: approx. 80,000 (11,600)

Modulus of elasticity, MPa (ksi)

as delivered: approx. 200,000 (29,000)

tempered: approx. 208,000 (30,160)

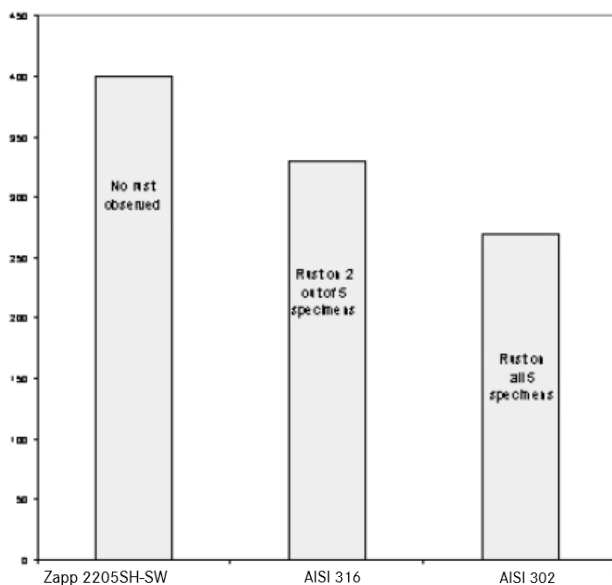
Corrosion Resistance

Chloride induced corrosion

In seawater and other high chloride content environments, Zapp 2205SH-SW has better corrosion resistance than stainless steel of type ASTM 316 because of its high PRE-number (Pitting Resistance Equivalent, a parameter for comparing the resistance of different steels to pitting). The PRE-number is defined as, in weight-%: $PRE = \% Cr + 3.3 \times \% Mo + 16 \times \% N$. The better resistance of Zapp 2205SH-SW can be demonstrated by e.g. salt spray testing, where samples are sprayed with water containing 5 % NaCl at 35 °C (95 °F) and checked every 24 hours. See the diagram below.

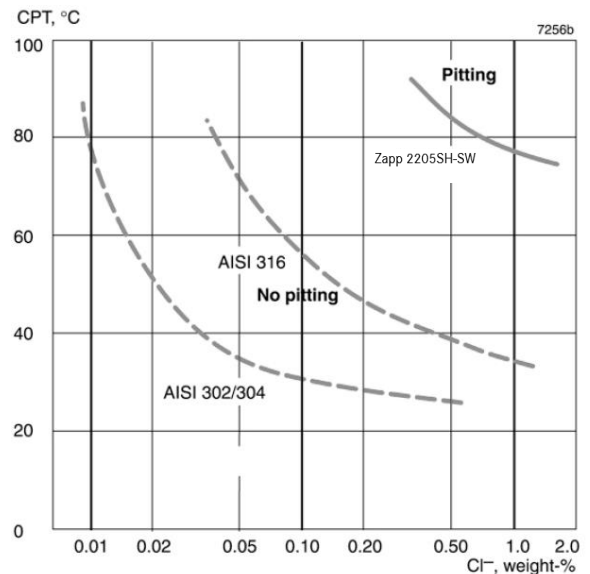
Neutral salt spray test according to ASTM B 117

Testing time, hours



Critical pitting temperature

In high saline content environments such as salt water, the aggressiveness of the environment increases as the temperature rises. All stainless steels have a critical pitting temperature above which there is a risk of pitting. The critical pitting temperature for Zapp 2205SH-SW and ASTM 316, as a function of chloride concentrations, is shown in the diagram.



Crevice corrosion

Crevice corrosion is, in principle, the same as pitting corrosion, but occurs in crevices and cracks, e.g. between flange joints, under deposits on the metal surface or in welds with incomplete penetration. Crevice corrosion often occurs at lower temperatures and at lower chloride contents than those necessary for pitting to occur. Resistance is influenced by the content of Cr, Mo and N in the same way as pitting resistance.

Stress corrosion cracking

Stress corrosion cracking leading to catastrophic failure might occur with standard austenitic steels.

Zapp 2205SH-SW, thanks to its duplex structure, is significantly more resistant to this type of corrosion.

Bending

The minimum bending radius should not be less than half the wire diameter. The wire surface should be free from any tooling damage because slight imperfections in the surface can lead to fracture, even at large bending radii.

Heat Treatment

Spring tempering will increase the tensile strength by 200 MPa (29 ksi) up to to 450 MPa (65 ksi) depending on tensile and tempering conditions. We recommend 450 °C (840 °F) / 1 – 3 h for batch tempering. To obtain best results, when tempering in a continuous conveyor furnace, where holding time at full temperature is very short, the temperature should be increased preferably to about 500 °C (930 °F). The holding time should be 3 – 10 minutes. Shorter times may result in uneven tempering.

Zapp Precision Metals (Sweden) AB

PRECISION WIRE

Järnverksleden 18

81 134 Sandviken

Sweden

Phone +46 26 191800

precisionmetals-sweden@zapp.com

www.zapp.com

The illustrations, drawings, dimensional and weight data and other information included in this data sheet are intended only for the purposes of describing our products and represent non-binding average values. They do not constitute quality data, nor can they be used as the basis for any guarantee of quality or durability. The applications presented serve only as illustrations and can be construed neither as quality data nor as a guarantee in relation to the suitability of the material. This cannot substitute for comprehensive consultation on the selection of our products and on their use in a specific application. The brochure is not subject to change control.

Last revision: December 2019