

## 1.4313, X3CRNIMO13-4, F6NM, S41500

Martensitic stainless steel 1.4313, X3CrNiMo13-4, F6NM, UNS S41500, AISI 415 is a martensitic grade with high corrosion resistance, which exhibits good durability after good heat treatment. The mechanical properties of X3CrNiMo13-4 steel are due to the high concentration of Molybdenum and Nickel in the chemical composition. These alloy additives have limited the need to increase the carbon content in the grade - a given concentration is comparable to stainless austenitic grade. The presence of nickel ~ 4% - although not at a high level, significantly increases the steel's resistance to numerous corrosive environments - secondary mechanical properties. X3CrNiMo13-4 steel gives the user the ability to produce parts and components operating at temperatures up to about 300 °C, and components exposed to numerous corrosive environments while maintaining adequate surface conditions - not including chloride resistance. 1.4313 is delivered most often after heat improvement - in QT650, QT780 and QT900 conditions in the form of round bars. Semi-products are used to produce parts of turbines, pumps, compressors in the oil, chemical, metallurgical and energy industries exposed to high and low temperatures. Steel is not suitable for welding.

## Chemical Composition

| Grade                                        | Chemical Composition % |              |             |              |              |                |              |              |       |
|----------------------------------------------|------------------------|--------------|-------------|--------------|--------------|----------------|--------------|--------------|-------|
|                                              | C                      | Mn           | Si          | P            | S            | Cr             | Ni           | Mo           | N     |
| EN 1.4313,<br>X3CrNiMo13-4                   | Max<br>0.05            | Max<br>1.5   | Max<br>0.7  | Max<br>0.04  | Max<br>0.015 | 12.0 -<br>14.0 | 3.5 -<br>4.5 | 0.3 -<br>0.7 | >0.02 |
| ASTM UNS S41500,<br>F6NM, F 6NM, AISI<br>415 | Max<br>0.05            | 0.5 -<br>1.0 | Max<br>0.6  | Max<br>0.03  | Max<br>0.030 | 11.5 -<br>14.0 | 3.5 -<br>5.5 | 0.5 -<br>1.0 | -     |
| ASTM UNS J91540,<br>CA6NM, CA-6NM            | Max<br>0.06            | Max<br>1.0   | Max<br>1.0  | Max<br>0.04  | Max<br>0.030 | 11.5 -<br>14.0 | 3.5 -<br>4.5 | 0.4 -<br>1.0 | -     |
| AF Z6CN13-04, Z 6<br>CN 13-04                | Max<br>0.06            | Max<br>1.0   | Max<br>0.75 | Max<br>0.04  | Max<br>0.015 | 12.0 -<br>13.5 | 3.5 -<br>4.5 | 0.3 -<br>0.5 | -     |
| B.S. 425C11, 425 C<br>11                     | Max<br>0.1             | Max<br>1.0   | Max<br>1.0  | Max<br>0.04  | Max<br>0.03  | 11.5 -<br>13.5 | 3.4 -<br>4.2 | Max<br>0.6   | -     |
| JIS SCS5, SCS 5                              | Max<br>0.06            | Max<br>1.0   | Max<br>1.0  | Max<br>0.040 | Max<br>0.040 | 11.0 -<br>14.0 | 3.5 -<br>4.5 | -            | -     |

## Mechanical Properties

### ANNEALED CONDITION +A

- for dimensions Min 16mm
  - Tensile strength, Rm: <1100 MPa
  - Hardness, HB: <320
- for dimensions Min 16mm
  - Tensile strength, Rm: <1150 MPa
  - Hardness, HB: <380

**HEAT-TREATED CONDITION +QT760 FOR BARS**

- Tensile strength, Rm: 760 - 960 MPa
- The yield point, Re: Min 550 MPa
- Elongation, A:Min 16%
- Impact resistance for dimensions KV20°C: Min 70J

**HEAT-TREATED CONDITION +QT900 FOR BARS**

- Tensile strength, Rm: 900 - 1150 MPa
- The yield point, Re: Min 700 MPa
- Elongation, A:Min 10%
- Impact resistance for dimensions KV20°C: Min 60J

**HEAT-TREATED CONDITION +QT840 FOR BARS**

- Tensile strength, Rm: 840 - 1100 MPa
- The yield point, Re: Min 660 MPa
- Elongation, A:Min 14%
- Impact resistance for dimensions KV20°C: Min 55J

**OTHER MECHANICAL AND PHYSICAL PROPERTIES**

- Modulus of elasticity, E = 200 GPa
- Thermal capacity, c-1
- Thermal conductivity,  $\lambda = 15 \text{ W} \cdot \text{m}^{-1}$
- Specific resistance,  $\Omega: 0,8 \text{ m}\Omega \cdot \text{m}$

**Mechanical properties at elevated temperatures of X4CrNiMo16-5-1, 1.4418, Z8CND17-04**

| Properties                     |        | Temperature |         |         |         |         |       |       |
|--------------------------------|--------|-------------|---------|---------|---------|---------|-------|-------|
|                                |        | 100°C       | 150°C   | 200°C   | 250°C   | 300°C   | 350°C | 400°C |
| p0,2 (MPa)                     | +QT760 | Min 520     | Min 510 | Min 500 | Min 490 | Min 480 | -     | -     |
|                                | +QT900 | Min 660     | Min 640 | Min 620 | Min 600 | Min 580 | -     | -     |
|                                | +QT840 | Min 660     | Min 640 | Min 620 | Min 600 | Min 580 | -     | -     |
| Modulus of elasticity, E (GPa) |        | 195         | -       | 185     | -       | 175     | -     | 170   |
| -1)                            |        | 10,3        | -       | 10,8    | -       | 11,2    | -     | 11,6  |

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|                                | +QT900 | Min 660     | Min 640 | Min 620 | Min 600 | Min 580 | -     | -     |
|                                | +QT840 | Min 660     | Min 640 | Min 620 | Min 600 | Min 580 | -     | -     |
| Modulus of elasticity, E (GPa) |        | 195         | -       | 185     | -       | 175     | -     | 170   |
| -1                             |        | 10,3        | -       | 10,8    | -       | 11,2    | -     | 11,6  |

## Physical Properties

density (kg/dm<sup>3</sup>) 7.70

electrical resistivity at 20 °C (Ω mm<sup>2</sup>/m) 0.70

magnetizability yes

thermal conductivity at 20 °C (W/m K) 15

specific heat capacity at 20 °C (J/kg K) 430

thermal expansion (K<sup>-1</sup>) :

- 20 – 100 °C: 10.8 x 10<sup>-6</sup>
- 20 – 200 °C: 10.8 x 10<sup>-6</sup>
- 20 – 300 °C: 11.2 x 10<sup>-6</sup>
- 20 – 400 °C: 11.6 x 10<sup>-6</sup>

## Heat Treatment

- **Delivery condition +A-** Annealing at 600 - 650 °C AC
- **Delivery condition +QT650-** Hardening at 950 - 1050 °C with cooling in oil or air, tempering at 650 - 700 °C + 600 - 620 °C
- **Delivery condition +QT780-** Hardening at 950 - 1050 °C with cooling in oil or air, tempering at 550 - 600 °C
- **Delivery condition +QT900-** Hardening at 950 - 1050 °C with cooling in oil or air, tempering at 520 - 580 °C
- **Forging and rolling**at 1150 °C AC

## Welding Properties

Good weldability, 1.4313, X3CrNiMo13-4, F6NM, UNS S41500, AISI 415 is readily weldable using all standard welding techniques. Care must however be taken to ensure that hydrogen or carbon containing gasses are not used when welding under shielded gas. Pre-heating of the work piece to a temperature between 100°C and 200°C is recommended. After welding, the weldment should either be annealed or tempered, as described before. If a filler material is required, then either a matching filler or Novonit® 4430 should be used.

**Machining Properties**

The machinability of this grade of stainless steel is directly related to its hardness. 1.4313, X3CrNiMo13-4, F6NM, UNS S41500, AISI 415 machines similar to carbon steels of the same hardness. Although it must be realised that the machining parameters will vary depending on the heat treated condition and hardness of the steel

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