# 1.4057

**X17CrNi16-2**

## Chromium-martensitic stainless steel with nickel addition

**C** 0.12 – 0.22 **Cr** 15.00 – 17.00 **Ni** 1.50 – 2.50

**General comments**

1.4057 is most commonly used in applications where the 12 % chromium steels do not exhibit sufficient resistance to corrosion or when the toughness of the 12 % martensitic stainless steels is not sufficient.

**Relevant current and obsolete standards**

| | | |
|---|---|---|
| EN 10088-3 | 1.4057 | X17CrNi16-2 |
| AISI | 431 | |
| BS | 321S31 / 431S29 | |
| JIS | 431 | |
| AFNOR | Z15CN16-02 | |
| DIN 17440 | 1.4057 | |
| SIS | 2321 | |
| aviation and aerospace industry | WL4044 | |

**General properties**

| | |
|---|---|
| corrosion resistance | good |
| mechanical properties | good |
| forgeability | average |
| weldability | good |
| machinability | poor |

**Special properties**

can be used to temperatures around 400 °C
ferromagnetic grade

**Physical properties**

| | |
|---|---|
| density (kg/dm³) | 7.70 |
| electrical resistivity at 20 °C (Ω mm²/m) | 0.70 |
| magnetizability | yes |
| thermal conductivity at 20 °C (W/m K) | 25 |
| specific heat capacity at 20 °C (J/kg K) | 460 |
| thermal expansion ($K^{-1}$) | 20 – 100 °C: 10.0 x $10^{-6}$ |
| | 20 – 200 °C: 10.5 x $10^{-6}$ |
| | 20 – 300 °C: 10.5 x $10^{-6}$ |
| | 20 – 400 °C: 10.5 x $10^{-6}$ |

**Typical applications**

automotive industry
chemical industry
aerospace industry
petrochemical industry
mechanical engineering

Note: available from stock
Employment according to the Pressure Equipment Directive 97/23/EC possible after consultation

**Processing properties**

| | |
|---|---|
| automated machining | seldom |
| machinable | yes |
| hammer and die forging | seldom |
| cold forming | yes |
| cold heading | not common |
| suited to polishing | yes |

**Conditions**

annealed, tempered

**Demand tendency**

rising

**Corrosion resistance (PRE = 17.5 – 21.26)**

The formation of chromium carbides and the associated chromium depleted regions that form around these precipitates make this grade of steel susceptible to intergranular corrosion. Surface condition plays an important role in the corrosion resistance of this steel with polished surfaces exhibiting far superior corrosion resistance compared with rougher surfaces on the same material.

**Heat treatment and mechanical properties**

1.4057 can be soft annealed by holding at a temperature in the range 680 °C to 800 °C followed by slow cooling in an oven or air. In this condition, the following mechanical properties can be expected:

| Property | | Specification |
|---|---|---|
| tensile strength (N/mm²) | $R_m$ | ≤ 950 |
| hardness | HB | ≤ 295 |

Note: the HB values could be 60 units higher and the tensile strengths 150 N/mm² higher due to cold work during straightening of profiles ≤ 35 mm.

# 1.4057

**X17CrNi16-2** | **C** 0.12 – 0.22 **Cr** 15.00 – 17.00 **Ni** 1.50 – 2.50

1.4057 can be hardened by holding at a temperature between 950 °C – 1060 °C followed by cooling in air or oil.

The tempering temperature is dependent on the desired strength. Since this grade of steel is susceptible to 475 °C embrittlement, care must be taken to limit exposure to the temperature range 420 °C to 520 °C, both during fabrication and service.

Two heat treated conditions are usually specified, namely: QT800 (tempered between 750 °C and 800 °C followed by a second tempering treatment between 650 °C and 700 °C)* and QT900 (tempered between 600 °C and 650 °C). The number behind the designation QT relates to the minimum tensile strength. In these conditions, the following mechanical properties can be expected:

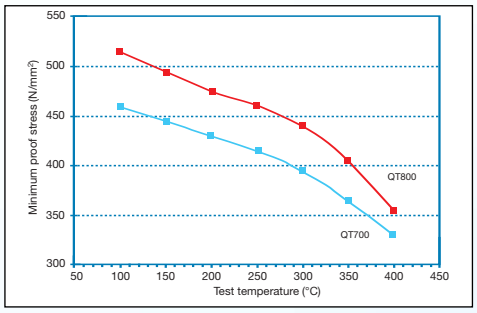
| | | Spec. QT800 | Typical |
|---|---|---|---|
| yield strength (N/mm²) | $R_{p0.2}$ | ≥ 600 | 620 |
| tensile strength (N/mm²) | $R_m$ | 800 – 950 | 820 |
| tensile elongation (%) | $A_5$ | ≥ 14 | 20 |
| impact energy (J) 25 °C | ISO-V | ≥ 25 | |

| | | Spec. QT900 | Typical |
|---|---|---|---|
| yield strength (N/mm²) | $R_{p0.2}$ | ≥ 700 | 710 |
| tensile strength (N/mm²) | $R_m$ | 900 – 1050 | 920 |
| tensile elongation (%) | $A_5$ | ≥ 12 | 16 |
| impact energy (J) 25 °C | ISO-V | ≥ 25 | |

The mechanical properties (d ≥ 160 mm) have to be agreed on for thicker dimensions, or the delivered product is based on the values given.

*Should the nickel content be on the lower end of the specification, then a simple tempering treatment at a temperature between 620 °C and 720 °C will be sufficient.

## Elevated temperature properties




Minimum tensile properties at various temperatures, shown in the diagramm, are specified in the EN 10088-3.

## Welding

When welding 1.4057 with a matching filler, the work piece is usually heated to a temperature of between 100 °C and 300 °C prior to welding and is tempered as soon as possible after welding to restore some ductility to the weld zone. For optimal properties, the entire work piece should be re-heat treated. When the mechanical properties are not of primary concern, then Novonit® 4430 or 4370 can be used as the filler material. When these two fillers are used, pre-heating of the work piece is not required. Care must be taken to ensure that no nitrogen or carbon containing gasses are used for the shielding gas since this can adversely affect the properties of the weldment. To ensure adequate corrosion resistance of the weldment, any spatter or heat tint must be removed.

## Forging

Care should be taken when forging since 1.4057, since gradual heating to a temperature of about 850 °C is recommended prior to more rapid heating to a temperature of between 1150 °C and 1180 °C. Forging then takes place between 1180 °C – 950 °C followed by slow cooling in an oven or in dry ash or similar material to promote slow cooling.

## Machining

The machinability of this grade of stainless steel is directly related to its hardness. 1.4057 machines similar to carbon steels of the same hardness. Although it must be realised that the machining parameters will vary depending on the structure/hardness of the steel, the following parameters can be used as a guideline when using coated hardmetal cutting tools:

| | Depth of cut (mm) | 6 | 3 | 1 |
|---|---|---|---|---|
| | Feed rate (mm/r) | 0.5 | 0.4 | 0.2 |
| **Solution annealed $R_m$ 700 – 800 N/mm²** | Cutting speed (m/min) | 100 | 130 | 165 |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Revision-No. 4057-1 Created: 01.08.07 