

|                        |                              |                       |
|------------------------|------------------------------|-----------------------|
| <b>Quality</b>         | <b>102Cr6</b>                | <i>Technical card</i> |
| According to standards | <b>UNI EN ISO 4957: 2002</b> | <i>Lucefin Group</i>  |
| Number                 | <b>1.2067</b>                |                       |

### Chemical composition

| C%        | Si%       | Mn%       | P%      | S%      | Cr%       | Product deviations are allowed |
|-----------|-----------|-----------|---------|---------|-----------|--------------------------------|
| 0,95-1,10 | 0,15-0,35 | 0,25-0,45 | max     | max     | 1,35-1,65 |                                |
| ± 0.03    | ± 0.03    | ± 0.04    | + 0.005 | + 0.005 | ± 0.05    |                                |

### Temperature °C

| Hot-forming              | Quenching <sup>1)</sup>                                                                         | Quenching <sup>2)</sup>                              | Tempering <sup>1) 2)</sup> | Stress relief annealing <sup>x)</sup> |            | <sup>x)</sup> annealing must be carried out after machining and before final heat treatment |
|--------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------|---------------------------------------|------------|---------------------------------------------------------------------------------------------|
| 1050-900                 | Heating up to 650, pause, then 820 water                                                        | 850 oil/ polymer salt bath 500-550 salt bath 180-200 | 180-220 air                | 600-650 furnace cooling               |            |                                                                                             |
| Soft annealing           | Spheroidizing +AC                                                                               | Recrystallization annealing                          |                            | Pre-heating welding                   |            | Stress-relieving after welding                                                              |
| 740-770 air              | 770-780 cooling 15-20 °C/h to 730, pause, 10 °C/h to 600, then cooling 40 °C/h to 300, then air | 750 furnace cooling to 300, then air (HB max 220)    |                            | not recommended                       |            |                                                                                             |
| HB max 223 <sup>a)</sup> | (HB max 207)                                                                                    |                                                      |                            | <b>Ac1</b>                            | <b>Ac3</b> | <b>Ms</b>                                                                                   |
|                          |                                                                                                 |                                                      |                            | 750                                   | 785        | 210                                                                                         |
|                          |                                                                                                 |                                                      |                            |                                       |            | <b>Mf</b>                                                                                   |
|                          |                                                                                                 |                                                      |                            |                                       |            | -10 subcooling                                                                              |

<sup>a)</sup> in the cold-drawn condition (+A+C), hardness can be 20 HB higher than in the annealed condition (+A)

### Mechanical and physical properties

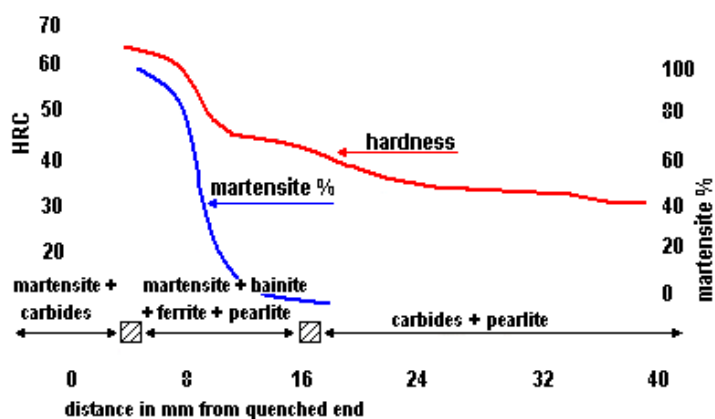
**Table of tempering** values obtained at room temperature on round of Ø 10 mm after quenching at 840 °C in oil

| HB                                  | 739 | 722 | 706  | 688  | 654  | 595  | 543  | 496  | 442  | 409  | 371  | 336  | 301  | 243  |
|-------------------------------------|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|
| HRC                                 | 65  | 64  | 63   | 62   | 60   | 57   | 54   | 51   | 47   | 44   | 40   | 36   | 32   | 23   |
| R N/mm <sup>2</sup>                 |     |     | 2400 | 2500 | 2470 | 2300 | 2100 | 1900 | 1650 | 1410 | 1250 | 1110 | 1010 | 810  |
| R <sub>p0.2</sub> N/mm <sup>2</sup> |     |     | 1800 | 2080 | 2190 | 2090 | 1900 | 1700 | 1500 | 1300 | 1100 | 950  | 800  | 690  |
| A %                                 |     |     |      |      |      |      |      |      | 5.0  | 7.0  | 9.0  | 12.0 | 16.0 | 18.0 |
| C %                                 |     |     |      |      |      |      |      |      | 22   | 30   | 34   | 44   | 50   | 54   |
| K Mesnager J                        |     |     | 5    | 7    | 8    | 9    | 11   | 14   | 18   | 24   | 30   | 44   | 57   | 70   |
| Tempering at °C                     | 50  | 100 | 150  | 200  | 250  | 300  | 350  | 400  | 450  | 500  | 550  | 600  | 650  | 700  |

**HRC** from surface to core for diameter Ø quenched at 850 °C in oil

Hardness variations show the mass effect

| mm   | 0  | 5  | 10   | 15   | 20 |
|------|----|----|------|------|----|
| Ø 10 | 65 | 64 |      |      |    |
| Ø 30 | 64 | 62 | 59   | 58   |    |
| Ø 40 | 62 | 57 | 52.5 | 50.5 | 50 |



Hardness/structure curves

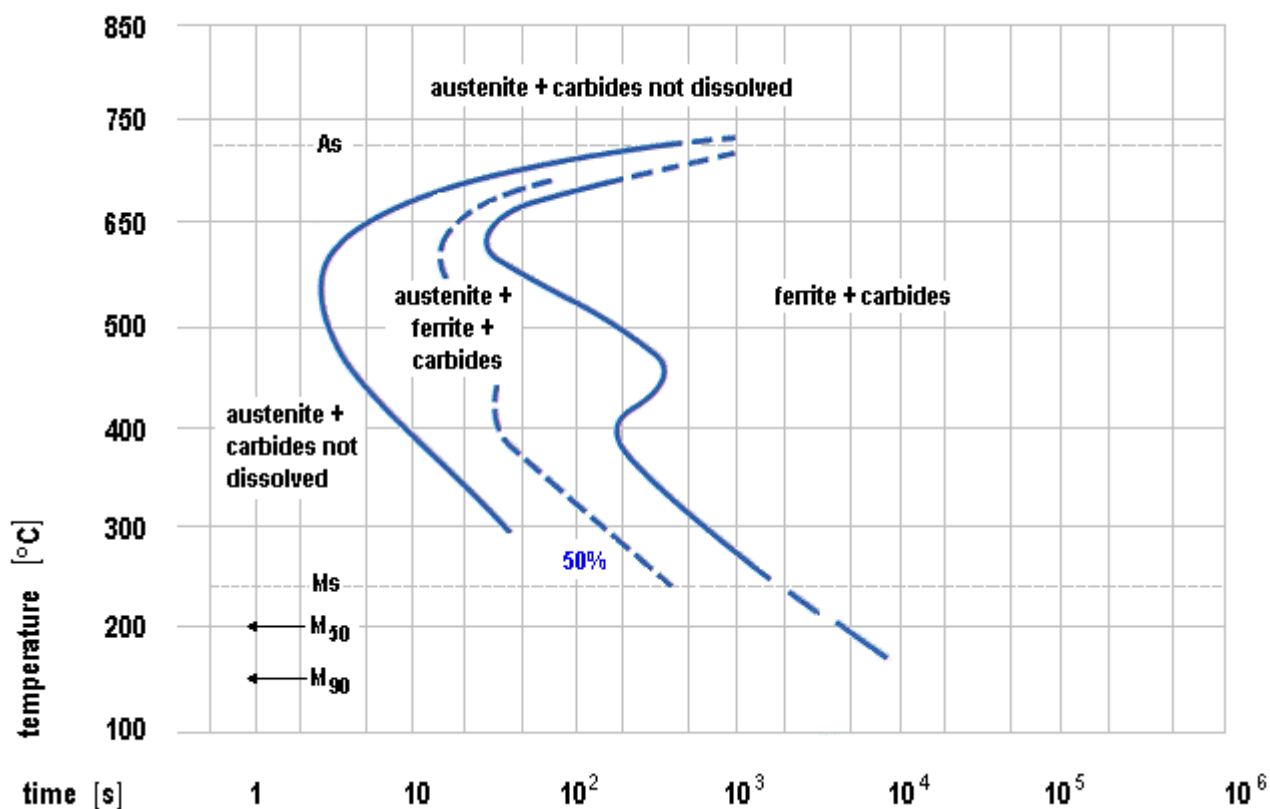
|                                    |                                   |                                 |      |                                                     |      |                                                      |         |
|------------------------------------|-----------------------------------|---------------------------------|------|-----------------------------------------------------|------|------------------------------------------------------|---------|
| Thermal expansion                  | 10 <sup>-6</sup> •K <sup>-1</sup> | 12.5                            | 13.2 | 13.6                                                | 14.0 | 14.3                                                 |         |
| Thermal conductivity               | W/(m•K)                           | 33.0                            |      | 32.2                                                |      | 31.4                                                 |         |
| Modulus of elasticity              | long. GPa                         | 212                             |      |                                                     |      |                                                      |         |
| Modulus of elasticity              | tang. GPa                         | 81                              |      |                                                     |      |                                                      |         |
| Testing at °C                      |                                   | 20                              | 100  | 200                                                 | 300  | 400                                                  | 500 700 |
| Specific heat capacity<br>J/(Kg•K) | Density<br>Kg/dm <sup>3</sup>     | Thermal conductivity<br>W/(m•K) |      | Specific electric resist.<br>Ohm•mm <sup>2</sup> /m |      | Electrical conductivity<br>Siemens.m/mm <sup>2</sup> |         |
| 460                                | 7.85                              |                                 |      | 0.30                                                |      | 3.33                                                 |         |

**102Cr6****Lucefin Group**

| Heat treatment                                                                       | Temperature (+ ... °C) - min. values |     |     |     |     |     |     |     | Data under fatigue                                                              |
|--------------------------------------------------------------------------------------|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|---------------------------------------------------------------------------------|
|                                                                                      | 20                                   | 200 | 300 | 350 | 400 | 450 | 500 | 600 |                                                                                 |
| +QT                                                                                  | 1339                                 |     |     |     |     |     |     |     | Cyclic yield strength, $\sigma_y'$<br>N/mm <sup>2</sup> low cycle number        |
| +QT                                                                                  | 0.15                                 |     |     |     |     |     |     |     | Cyclic strength exponent, $n'$<br>low cycle number                              |
| +QT                                                                                  | 3328                                 |     |     |     |     |     |     |     | Cyclic strength coefficient, $K'$<br>N/mm <sup>2</sup> low cycle number         |
| +QT                                                                                  | 2620                                 |     |     |     |     |     |     |     | Fatigue strength coefficient, $\sigma_f'$<br>N/mm <sup>2</sup> low cycle number |
| +QT                                                                                  | - 0.09                               |     |     |     |     |     |     |     | Fatigue strength exponent, $b$<br>low cycle number                              |
| +QT                                                                                  | 0.15                                 |     |     |     |     |     |     |     | Fatigue ductility coefficient, $g_f'$<br>low cycle number                       |
| +QT                                                                                  | - 0.56                               |     |     |     |     |     |     |     | Fatigue ductility exponent, $c$<br>low cycle number                             |
| +QT quenched an tempered, quenching at 830-870 °C in oil and tempering at 150-180 °C |                                      |     |     |     |     |     |     |     |                                                                                 |

**Time – temperature – transformation diagram for isothermal cooling**

Extract from Gerdau catalogue



| EUROPE EN | ITALY UNI | CHINA GB | GERMANY DIN | FRANCE AFNOR | U.K. B.S. | RUSSIA GOST | USA AISI/SAE |
|-----------|-----------|----------|-------------|--------------|-----------|-------------|--------------|
| 102Cr6    | 100Cr6    | Cr2      | 100Cr6      | 100Cr6       |           | 9Ch         | 52100        |