

| | | | |
|------------------------|------------------------|-----------------------|-----------------------|
| Quality | C15E | Case-hardening | <i>Technical card</i> |
| According to standards | ISO 683-3: 2018 | Steel | Lucefin Group |
| Number | 1.1141 | | <i>rev. 2024</i> |

Chemical composition

| C% | Si% | Mn% | P% max | S% max | Cr% max | Mo% max | Ni% max | Cu% max | |
|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|------------|--------------------------------|
| 0,12-0,18 | 0,15-0,40 | 0,30-0,60 | 0,035 | 0,035 | 0,40 | 0,10 | 0,40 | 0,30 | Product deviations are allowed |
| ± 0.02 | ± 0.03 | ± 0.04 | + 0.005 | ± 0.005 | ± 0.05 | ± 0.03 | ± 0.03 | + 0.05 | |

C 15R n° 1.1140 S% 0.020-0.040 product deviation ± 0.005%
C15Pb on request, this steel grade can be supplied with addition of lead (Pb) 0.15-0.35%

Temperature °C

| Hot-forming | Normalizing +N | Core hardening | Carbonitriding | Carburizing | Hardening carburizing surface | Str-reliev. +SR |
|----------------------------|--|---------------------------|---------------------|--|-------------------------------------|---|
| 1150-850 | 890-920 air (HB 95 – 150) | 880-920 water | 750-930 gas | 880-980 | 780-820 water | 150 200 |
| Soft annealing +A | Isothermal annealing +I | Intermediate annealing | Natural state +U | Pre-heating welding | Stress-relieving after welding | |
| 690 air (HB max 143) | 930 furnace cooling to 650, then air (HB 115-145) | 650-700 air | (HB 170) | welding must be carried out on the annealed state and before carburizing | 100 | slow cooling |
| | | | | Ac1 | Ac3 | Ms * core ** carburizing surface |
| | | | | 725 | 860 | 460* 220** |

Mechanical properties

C15 Hot-rolled values obtained on test blanks after core hardening + stress-relieving UNI 7846: 1978. Use only as reference.

| size mm | Testing at room temperature (longitudinal) | | | | |
|-------------|--|------------------------|-----------|------------|-------------------------|
| | R | Rp 0.2 | A% | Kcu | HB |
| test blanks | N/mm ² | N/mm ² min. | min. | J min. | |
| 11 | 740-1180 | 440 | 9 | 22.5 | 224-354 |
| 30 | 540-780 | 295 | 13 | 30 | 158-232 for information |
| 63 | - | - | - | - | - |

Tensile strength after hardening and tempering at +200 °C. **Lucefin** experience

| size mm | d ≤ 16 | > 16 d ≤ 40 |
|---------------------------------|--------|-------------|
| R N/mm ² min. | 800 | 600 |

| Heat treatment | Temperature (+ ... °C) - min. values | | | Fatigue data |
|-------------------|--------------------------------------|------------|------------|--|
| | 20 | 200 | 300 | |
| +A | 249 | | | Cyclic yield strength, σ_y' N/mm ² low cycle fatigue |
| +N | 269 | | | |
| +A | 0.19 | | | Cyclic strength exponent, n' low cycle fatigue |
| +N | 0.18 | | | |
| +A | 824 | | | Cyclic strength coefficient, K' N/mm ² low cycle fatigue |
| +N | 813 | | | |
| +A | 807 | | | Fatigue strength coefficient, σ_f' N/mm ² low cycle fatigue |
| +N | 984 | | | |
| +A | - 0.12 | | | Fatigue strength exponent, b low cycle fatigue |
| +N | - 0.13 | | | |
| +A | 0.42 | | | Fatigue ductility coefficient, g_f' low cycle fatigue |
| +N | 0.81 | | | |
| +A | - 0.53 | | | Fatigue ductility exponent, c low cycle fatigue |
| +N | - 0.58 | | | |
| +N | 170 | | | Fatigue limit, σ_L' N/mm ² high cycle fatigue |

+A = Annealed +N = Normalized

C15E 1.1141 - C15R 1.1140 EN ISO 683-7:24

Lucefin Group

| Cold-drawn +C ^{c)} | | | | | | Hot-rolled + Peeled +SH | | | |
|-----------------------------|-----|--|-----------------------|-----|----------|--|-----------------------|-----|--------|
| size mm | | Testing at room temperature (longitudinal) | | | | Testing at room temperature (longitudinal) | | | |
| from | to | R ^{a)} | Rp 0.2 ^{a)} | A% | HBW | R | Rp 0.2 | A% | HBW |
| | | N/mm ² | N/mm ² min | min | for inf. | N/mm ² | N/mm ² min | min | |
| 5 ^{b)} | 10 | 500-800 | 380 | 7 | 152-240 | - | - | - | - |
| 10 | 16 | 480-780 | 340 | 8 | 146-232 | - | - | - | - |
| 16 | 40 | 430-730 | 280 | 9 | 128-224 | 330-600 | | | 98-178 |
| 40 | 63 | 380-670 | 240 | 11 | 110-203 | 330-600 | | | 98-178 |
| 63 | 100 | 340-600 | 215 | 12 | 100-178 | 330-600 | | | 98-178 |
| size mm | | Soft annealing +A+SH Peeled, Ground +G | | | | Soft annealing +A+C Cold-drawn | | | |
| from | to | HBW max | | | | HBW max | | | |
| 5 ^{b)} | 10 | - | | | | 238 | | | |
| 10 | 16 | - | | | | 231 | | | |
| 16 | 40 | 143 | | | | 216 | | | |
| 40 | 63 | 143 | | | | 198 | | | |
| 63 | 100 | 143 | | | | 178 | | | |

a) for flats and special sections, yield point can be – 10% and tensile strength can be ± 10%

b) for thickness < 5 mm, mechanical properties should be agreed before order placement

c) values valid also for +C+G

C15 Forged UNI 8550: 1984. Use only as reference

| size mm | | Testing at room temperature (longitudinal) | | | | | |
|---------|----|--|-----------------------|---------|-----------|-------------|--|
| from | to | R | Rp 0.2 | A% | Kcu | HB | |
| | | N/mm ² | N/mm ² min | min (L) | J min (L) | for inform. | |
| | 11 | 735-1180 | 440 | 9 | 22.5 | 224-354 | |
| 11 | 25 | 540-785 | 345 | 11 | 30 | 158-234 | |
| 25 | 40 | 490-735 | 295 | 14 | 35 | 149-224 | |

Mechanical properties obtained on test blanks after core hardening + stress-relieving

L = longitudinal

| Jominy test HRC for information only | | | | | | | | | Max hardness of the layer casehardened and hardened as a function of carbon content | | | | | | | |
|--------------------------------------|----|----|----|----|----|----|----|----|---|------|------|------|------|------|------|------|
| distance in mm from quenched end | | | | | | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | C% | 0.40 | 0.50 | 0.60 | 0.70 | 0.80 | 0.90 | 1.00 |
| min | 39 | 35 | 31 | 27 | 25 | 22 | 20 | | HV1 | 653 | 746 | 800 | 865 | 900 | 865 | 832 |
| max | 45 | 42 | 35 | 33 | 32 | 28 | 26 | 24 | | | | | | | | |

| | | | | | | | | |
|----------------------------------|------------------------------------|---|-----------|------------|------------|------------|------------|-----------------------|
| Thermal Expansion | 10 ⁻⁶ • K ⁻¹ | ▶ | 11.1 | 12.1 | 12.9 | 13.5 | 13.9 | 14.1 |
| Mod. of Elasticity long. | GPa | | 210 | | | | | |
| Mod. of Elasticity tang. | GPa | | 80 | | | | | |
| Specific Heat Capacity | J/(Kg•K) | | 460 | 486 | 519 | 599 | | |
| Thermal Conductivity | W/(m•K) | | 58 | 51 | 48.9 | | | |
| Density | Kg/dm ³ | | 7.85 | | | | | |
| Specific Electric Resist. | Ohm•mm ² /m | | 0.11 | 0.21 | 0.29 | | | |
| Electrical Conductivity | Siemens•m/mm ² | | 9.09 | | | | | |
| °C | | | 20 | 100 | 200 | 300 | 400 | 500 600 |

The symbol ▶ indicates temperature between 20 °C and 100 °C, 20 °C and 200 °C ...

| EUROPE | ITALY | CHINA | GERMANY | FRANCE | U.K. | RUSSIA | USA |
|--------|-------|-------|---------|--------|------|--------|----------|
| EN | UNI | GB | DIN | AFNOR | B.S. | GOST | AISI/SAE |
| C15E | C15 | 15 | Ck15 | XC12 | | 15 | 1015 |