| **Quality** | **46S20** | **Free-cutting Steel** | *Technical card* |
|---|---|---|---|
| According to standard | **ISO 683-4: 2018** | | ***Lucefin Group*** |
| Number | **1.0727** | | *rev. 2018* |

## Chemical composition

| **C%** | **Si%** max | **Mn%** | **P%** max | **S%** | **Pb%** | |
|---|---|---|---|---|---|---|
| 0,42-0,50 | 0,40 | 0,70-1,10 | 0,06 | 0,15-0,25 | - | Product deviations are allowed |
| ± 0.03 | ± 0.03 | ± 0.04 | ± 0.008 | ± 0.03 | - | |

## Temperature °C

| **Hot-forming** | **Natural state +U** | **Soft annealing +A** | **Carburizing** | **Hardening on carburized surface** | **Stress-relieving +SR** |
|---|---|---|---|---|---|
| 1230-950 | (HB 234 max) | 680 air | | | |
| **Normalizing +N** | **Direct hardening** | **Direct hardening** | **Stress-relieving +SR** | **Pre-heating welding** | **Stress-relieving after welding** |
| 860 air | 840 water | 860 oil or polymer | 540-680 furnace cooling | not recommended | |

## Mechanical properties

**Hot-rolled** natural forming condition ISO 683-4: 2018
Testing at room temperature (longitudinal)

| size mm from | to | **R** N/mm² | **HBW** max |
|---|---|---|---|
| 5 | 10 | 590-800 | 234 |
| 10 | 16 | 590-780 | 228 |
| 16 | 40 | 590-760 | 222 |
| 40 | 63 | 580-730 | 213 |
| 63 | 100 | 560-710 | 207 |

**Hot-rolled** quenched and tempered
Testing at room temperature (longitudinal)

| **R** N/mm² | **Rp** 0.2 N/mm² min | **A**% min | ***HBW*** *for inform.* |
|---|---|---|---|
| 700-850 | 490 | 12 | *213-253* |
| 700-850 | 490 | 12 | *213-253* |
| 650-800 | 430 | 13 | *200-240* |
| 630-780 | 370 | 14 | *192-232* |
| 630-780 | 370 | 14 | *192-232* |

**Cold-drawn** +C EN 10277: 2018
Values valid also for +C+G
Testing at room temperature (longitudinal)

| size mm from | to | **R** [a] N/mm² | **Rp** 0.2 [a] N/mm² min | **A**% min | ***HBW*** *for inform.* |
|---|---|---|---|---|---|
| 5 [b] | 10 | 740-980 | 570 | 5 | *224-295* |
| 10 | 16 | 690-930 | 470 | 6 | *210-278* |
| 16 | 40 | 640-880 | 400 | 7 | *198-263* |
| 40 | 63 | 610-850 | 380 | 8 | *183-253* |
| 63 | 100 | 580-820 | 340 | 8 | *172-246* |

Hot-rolled **Peeled** +SH
Values valid also for +SH+G
Testing at room temperature (longitudinal)

| **R** N/mm² | **Rp** 0.2 N/mm² min | **A**% min | **HBW** max |
|---|---|---|---|
| - | - | - | - |
| - | - | - | - |
| 590-760 | - | - | 222 |
| 580-730 | - | - | 213 |
| 560-710 | - | - | 207 |

[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

**Cold-drawn** + quenching and tempering +C+QT EN 10277: 2018
Testing at room temperature (longitudinal)

| size mm from | to | **R** [c] N/mm² | **Rp** 0.2 [c] N/mm² min | **A**% [c] min | ***HB*** [c] *for inform.* |
|---|---|---|---|---|---|
| 5 [b] | 10 | - | - | - | - |
| 10 | 16 | - | - | - | - |
| 16 | 40 | 650-800 | 430 | 13 | *200-240* |
| 40 | 63 | 630-780 | 370 | 14 | *192-232* |
| 63 | 100 | 630-780 | 370 | 14 | *192-232* |

Quenched and tempered + **cold-drawn** +QT+C
Testing at room temperature (longitudinal)

| **R** N/mm² | **Rp** 0.2 N/mm² min | **A**% min | ***HB*** *for inform.* |
|---|---|---|---|
| 850-1000 | 595 | 8 | *253-298* |
| 800-950 | 560 | 9 | *240-286* |
| 700-850 | 490 | 10 | *213-253* |
| 700-850 | 490 | 11 | *213-253* |
| 650-850 | 455 | 11 | *200-253* |

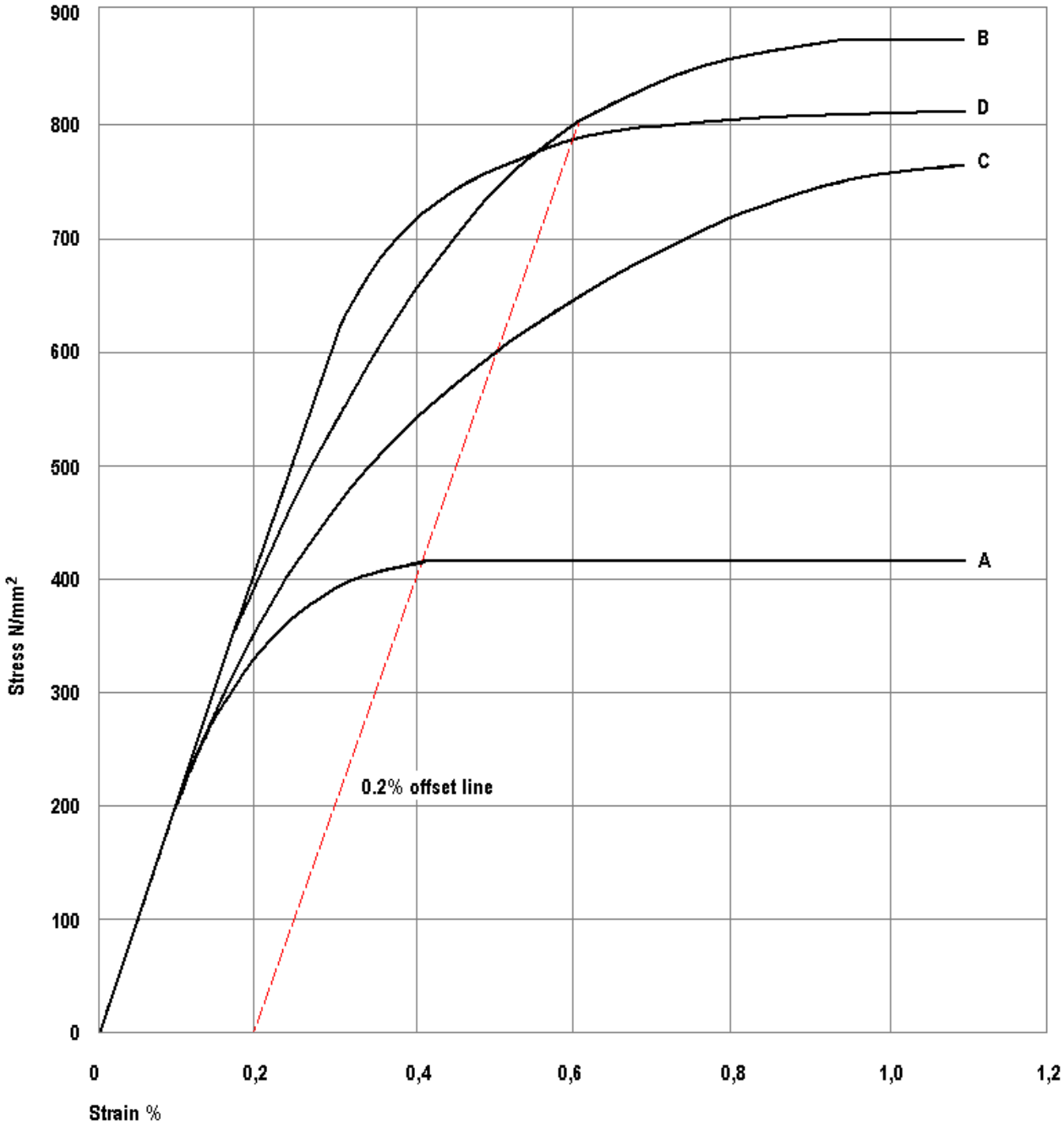
[c] values valid also for +C+QT+G and +QT+SH
[b] for thickness < 5 mm, mechanical properties should be agreed before order placement

**Table of tempering** values obtained at room temperature on rounds of Ø 10 mm after quenching at 850 °C in oil

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **HB** | 560 | 560 | 525 | 482 | 390 | 327 | 279 |
| **HRC** | 55 | 55 | 53 | 50 | 42 | 35 | 29 |
| **R** N/mm² | 2070 | 2070 | 1950 | 1760 | 1340 | 1080 | 930 |
| Temp. at **°C** | **50** | **100** | **200** | **300** | **400** | **500** | **600** |

| **EUROPE** EN | **ITALY** UNI | **CHINA** GB | **GERMANY** DIN | **FRANCE** AFNOR | **U.K.** B.S. | **RUSSIA** GOST | **USA** AISI/SAE |
|---|---|---|---|---|---|---|---|
| 46S20 | 46S20 | Y45 | 45S20 | 45MF4 | 46S20 | | 1146/1144 |

**Comulative effects of cold drawing, straightening, and stress relieving on the yield and tensile strength of 1144 (~ 46S20) hot rolled steel.**




A hot rolled
B cold drawn
C cold drawn and straightened
D cold drawn, straightened and stress relieved

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