| **Quality** | **P355NL1** | **Creep-resisting Steel** | *Technical card* |
|---|---|---|---|
| According to standards | **EN 10028-3: 2017** | | ***Lucefin Group*** |
| Number | **1.0566** | | *rev. 2018* |

## Chemical composition

| **C%** max | **Si%** max | **Mn%** | **P%** max | **S%** max | **Al%** total min | **Cr%** max | **Cu%** max | **Mo** max | **Cr%+Cu%+Mo%** max |
|---|---|---|---|---|---|---|---|---|---|
| 0,18 | 0,50 | 1,10-1,70 | 0,025 | 0,010 | 0,020 [b) c)] | 0,30 | 0,30 | 0,08 | 0,45 |
| +0.02 | +0.06 | ±0.10 | +0.005 | +0.003 | -0.005 | +0.05 | +0.05 | +0.03 | **Product** deviations |

| **N%** max | **Nb%** max | **Ni%** max | **Ti%** max | **V%** max | **Nb% + Ti% + V%** max |
|---|---|---|---|---|---|
| 0,012 | 0,05 | 0,50 | 0,03 | 0,10 | 0,12 |
| +0.002 | +0.01 | +0.05 | +0.01 | +0.01 | **Product** deviations |

**CEV** *C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15*
max 0,43 for thickness ≤ 60 mm
max 0,45 for thickness 60 < t ≤ 250

[b)] The Al total content may fall short this minimum if niobium, titanium or vanadium are additionally used for nitrogen binding
[c)] If only aluminium is used for nitrogen binding, a ratio Al / N ≥ 2 shall apply.

## Temperature °C

| **Hot-forming** | **Normalization +N** | **Soft annealing +A** |
|---|---|---|
| 1100-950 | 890-950 | 700 |
| | air | air |

*Temperature values are valid for analysis close to:*

| *C%* | *Mn%* | *Si%* |
|---|---|---|
| *0,18* | *1,40* | *0,30* |

In some cases, the piece can be normalized and tempered **+NT** or quenched and tempered **+QT**

| **Normalization Tempering** | **Quenching Tempering** | **Stress-relieving +SR** |
|---|---|---|
| 890-950 air | 880-900 water | 50° under the |
| 595-620 air | 595-660 air | t. of tempering |

| **Pre-heating welding** | **Stress-relieving after welding** |
|---|---|
| 150 | slow cooling |

| **Ac1** | **Ac3** | **Ms** |
|---|---|---|
| - | - | - |

## Mechanical properties

**Hot-rolled +N** normalized EN 10028-3: 2017

Traction test at room temperature in longitudinal direction

| size mm | | **R** | **ReH** min | **A%** (L) | **Kv2** (L) J min. at **°C** [c)] | | | | | **Kv2** (T) J min. at **°C** | | | | | ***HB*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| from | to | N/mm² | N/mm² | min | -50 | -40 | -20 | 0 | +20 | -50 | -40 | -20 | 0 | +20 | *for information* |
| | 16 | 490-630 | 355 | 22 | | | | | | | | | | | *149-192* |
| 16 | 40 | 490-630 | 345 | 22 | [d)] | | | | | | [d)] | [d)] | | | *149-192* |
| 40 | 60 | 490-630 | 335 | 22 | 30 | 40 | 50 | 70 | 80 | | 27 | 35 | 50 | 60 | *149-192* |
| 60 | 100 | 470-610 | 315 | 21 | | | | | | | | | | | *141-183* |
| 100 | 150 | 460-600 | 305 | 21 | | | | | | | | | | | *139-178* |
| 150 | 250 | 450-590 | 295 | 21 | | | | | | | | | | | *135-176* |

[c)] The values apply for product thicknesses up to 40 mm.
[d)] A minimum impact energy value of 40 J may be agreed at the time of enquiry and order. (L) = longitudinal (T) = tangenzial

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Thermal expansion** | $10^{-6}$•K | 10.8 | 11.7 | 11.9 | 12.5 | 13.0 | 13.6 | 14.1 | 14.5 | 14.9 |
| **Mod. of elasticity** long. | GPa | 217 | 213 | 212 | 207 | 199 | 192 | 184 | 175 | 164 |
| **Mod. of elasticity** tang. | GPa | 83 | 82 | 81 | 79 | 76 | 74 | 71 | 67 | 63 |
| **Specific heat** | J/(Kg*K) | 423 | 456 | 461 | 479 | 499 | 517 | 536 | 558 | 587 |
| **Thermal conductivity** | W/(m•K) | 37.6 | 41.6 | 42.2 | 43.2 | 42.9 | 41.2 | 39.1 | 36.6 | 34.1 |
| **Density** | Kg/dm³ | | | 7.83 | | | | | | |
| **Electrical resistivity** | Ohm•mm²/m | 0.182 | 0.236 | 0.247 | 0.296 | 0.368 | 0.455 | 0.556 | 0.675 | 0.813 |
| **Electrical conductivity** | Siemens•m/mm² | 5.49 | 4.24 | 4.05 | 3.38 | 2.71 | 2.20 | 1.80 | 1.48 | 1.23 |
| **°C** | | **-100** | **0** | **+20** | **+100** | **+200** | **+300** | **+400** | **+500** | **+600** |

Physical properties according to DIN SEW 310 (08/1992)

| **EUROPE** EN | **ITALIY** UNI | **CHINA** GB | **GERMANY** DIN | **FRANCE** AFNOR | **UK** B.S. | **RUSSIA** GOST | **USA** AISI/SAE |
|---|---|---|---|---|---|---|---|
| P355NL1 | FeE 355 KT | Q420q-D | TStE355 ~ | A510 FP | 225-490 ~ | 22K ~ | LF6 |

The material must be fine-grain > 6, must have undergone the normalization heat treatment or normalization and tempering one and must be suitable for welding.