

Weldable normalized fine grained pressure vessel steels

ASTM , EN Weldable normalized fine grained pressure vessel steels, Weldable normalized fine grained pressure vessel steels plate, Weldable normalized fine grained pressure vessel steels sheet, Weldable normalized fine grained pressure vessel steels coil, Weldable normalized fine grained pressure vessel steels supplier

Weldable normalized fine grained pressure vessel steels description

The fine grained pressure vessel steels grades rolled under normalised conditions offer good cold-forming and hot-forming properties without negatively affecting the material properties. These steel grades are therefore also suitable for cold-bordering and cold-flanging as well as for cold-bending and cold-folding, considering the bending radii according to DIN 6935 for a steel grade of corresponding strength. With coldforming above 5% or hot-forming outside of the temperature range of 850 - 1.000 °C as well as after excess times, the steels rolled under normalised conditions should be subsequently normalised at 900 - 950 °C. The holding time after temperature equalisation should be approx. 1 minute per millimetre of plate thickness.

Weldable normalized fine grained pressure vessel steels Application

These fine-grain pressure vessel steel grades are characterised by a minimum yield strength of 275 - 460 MPa, by good weldability and high resistance to brittle cracking. These grades are used above all for manufacturing vessels for pressurised gas (LPG, butane and propane tanks), pressure vessels, steam boiler parts, pressure piping, compressors etc.

The following special grades are available for extraordinary applications:

P...NL1 and P...NL2 or P...ML1 and P...ML2 for application temperatures below -20 °C;

P...NH for operating temperatures of up to 400 °C.

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The user of these steel grades must make sure that his calculation, design and processing methods are appropriate for the material. The welding technique used must be suitable for the intended application and comply with the state-of-the-art.

The main grade of Weldable normalized fine grained pressure vessel steels are :

Material #: 1.0486, 1.0487, 1.0488, 1.1104, 1.0562, 1.0565, 1.0566, 1.1106.

EN 10028-3: P275N,P275NH , P275NL1, P275NL2, P355N, P355NH, P355NL1, P355NL2.

DIN 17102: StE 285, WStE 285, TStE 285, EStE 285, StE 355, WStE 355, TStE 355, EStE 355.

NFA 36-207 : A 510 AP, A 510 AP, A 510 FP 1.

UNI 7382 : Fe E 355 KG, Fe E 355-2, Fe E 355-3.

BS 1501: 224 Gr. 400, 224 Gr. 430, 223 Gr. 490, 224 Gr. 490, 225Gr. 490

UNE 36081: AE 355 KG

ASTM: A 516 Gr. 60, A 662 Gr. A, A 537 CL 1, A 662 Gr. C, A 737 Gr. B

Weldable normalized fine grained pressure vessel steels equivalent grades

| Material # | EN 10028-3 | DIN 17102 | NFA 36-207 | UNI 7382 | BS 1501 | UNE 36081 | ASTM |
|------------|------------|-----------|------------|-------------|-------------|-----------|--------------|
| 1.0486 | P275N | StE 285 | | | 224 Gr. 400 | | |
| 1.0487 | P275NH | WStE 285 | | | 224 Gr. 430 | | A 516 Gr. 60 |
| 1.0488 | P275NL1 | TStE 285 | | | | | A 662 Gr. A |
| 1.1104 | P275NL2 | EStE 285 | | | | | |
| 1.0562 | P355N | StE 355 | A 510 AP | Fe E 355 KG | 223 Gr. 490 | AE 355 KG | A 537 CL 1 |
| 1.0565 | P355NH | WStE 355 | A 510 AP | Fe E 355-2 | 224 Gr. 490 | | A 662 Gr. C |
| 1.0566 | P355NL1 | TStE 355 | A 510 FP 1 | Fe E 355-3 | 224 Gr. 490 | | A 737 Gr. B |

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| | | | | | | | |
|--------|---------|----------|--|--|--|--|--|
| 1.1106 | P355NL2 | EStE 355 | | | | | |
|--------|---------|----------|--|--|--|--|--|

Weldable normalized fine grained pressure vessel steels Supply Size

Thickness: 8mm to 200mm

Width: 1500mm to 4200mm

Length: 2000mm to 18000mm

Weldable normalized fine grained pressure vessel steels Delivery state

Hot Rolled, Cold Rolled, Normalized, Quenched, Tempering, Thermal Mechanical Control Process (TMCP), Electroslag Remelting Technical, HIC test.

Weldable normalized fine grained pressure vessel steels Services

Cutting, Painting, shot blast, and The third party inspection in DNV, BV, LR, GL, ABS, CCS, SGS, and others in super thick ship steel plate.

Weldable normalized fine grained pressure vessel steels Chemical composition

| Grade | C | Si | Mn | P | S | N | Al _{total} | Cu | Ni | Ti | V | Nb |
|-------------------------|------|------|------------------------------|-------|-------|-------|---------------------|------|------|------|------|------|
| | max. | max. | | max. | max. | max. | min. | max. | max. | max. | max. | max. |
| P275NH ²⁾⁵⁾ | 0,16 | 0,40 | 0,80 ⁴⁾ - 1,50 | 0,025 | 0,015 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,05 | 0,05 |
| P275NL1 ²⁾⁵⁾ | 0,16 | 0,40 | 0,80 ⁴⁾ - 1,50 | 0,025 | 0,015 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,05 | 0,05 |
| P275NL2 ²⁾⁵⁾ | 0,16 | 0,40 | 0,80 ⁴⁾ - | 0,020 | 0,010 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,05 | 0,05 |

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| | | | | | | | | | | | | |
|-------------------------|------|------|----------------|-------|-------|---------------------|---------------------|---------------|------|--------------------|--------------------|--------------------|
| | | | 1,50 | | | | | | | | | |
| P355N ²⁾⁶⁾ | 0,18 | 0,50 | 1,10 - 1,70 | 0,025 | 0,015 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,10 | 0,05 |
| P355NH ²⁾⁶⁾ | 0,18 | 0,50 | 1,10 - 1,70 | 0,025 | 0,015 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,10 | 0,05 |
| P355NL1 ²⁾⁶⁾ | 0,18 | 0,50 | 1,10 - 1,70 | 0,025 | 0,015 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,10 | 0,05 |
| P355NL2 ²⁾⁶⁾ | 0,18 | 0,50 | 1,10 - 1,70 | 0,020 | 0,010 | 0,012 | 0,020 ¹⁾ | 0,30 | 0,50 | 0,03 | 0,10 | 0,05 |
| P355M ²⁾ | 0,14 | 0,50 | ≤ 1,60 | 0,025 | 0,020 | 0,015 | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P355ML1 ²⁾ | 0,14 | 0,50 | ≤ 1,60 | 0,020 | 0,015 | 0,015 | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P355ML2 ²⁾ | 0,14 | 0,50 | ≤ 1,60 | 0,020 | 0,015 | 0,015 | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P420M ²⁾ | 0,16 | 0,50 | ≤ 1,70 | 0,025 | 0,020 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P420ML1 ²⁾ | 0,16 | 0,50 | ≤ 1,70 | 0,020 | 0,015 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P420ML2 ²⁾ | 0,16 | 0,50 | ≤ 1,70 | 0,020 | 0,015 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P460M ²⁾ | 0,16 | 0,60 | ≤ 1,70 | 0,025 | 0,020 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P460ML1 ²⁾ | 0,16 | 0,60 | ≤ 1,70 | 0,020 | 0,015 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |
| P460ML2 ²⁾ | 0,16 | 0,60 | ≤ 1,70 | 0,020 | 0,015 | 0,020 ⁷⁾ | 0,020 ⁷⁾ | ⁸⁾ | 0,50 | 0,05 ³⁾ | 0,10 ³⁾ | 0,05 ³⁾ |

¹⁾ If N is additionally fixed by means of Nb, Ti or V, the minimum Al content is not determined.

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If N is only fixed with Al, then: $Al/N \geq 2$.

2) $Cr \leq 0,30 \%$, $Mo \leq 0,08 \%$, $Cr + Cu + Mo \leq 0,45 \%$

3) $Nb + V + Ti \leq 0,15\%$

4) For thicknesses < 6.0 mm, a minimum content for Mn 0.60% is permitted.

5) $Nb + V + Ti \leq 0,05\%$

6) $Nb + V + Ti \leq 0,12\%$

7) The minimum value for Al_{total} does not apply if sufficient amounts of other nitrogen-fixing elements are present.

A carbon equivalent value

$$C_E = C + Mn/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15$$

may be agreed in the order, i.e. 0,40% max. for grades P275N, 0,43% for grades P355N, 0,39% for grades P355M, 0,43% for grades P420M and 0,45% for grades P460M.

8) $(Cr + Cu + Mo) \leq 0,60\%$

Weldable normalized fine grained pressure vessel steels Mechanical properties

| Grade | Min. yield strength | | Tensile strength | Min. total elongation [%] |
|---------|---------------------|------------|------------------|---------------------------|
| | MPa | | | |
| | $e^2 \leq 16$ | $e^2 > 16$ | | |
| P275NH | 275 | 265 | 390 - 510 | 24 |
| P275NL1 | 275 | 265 | 390 - 510 | 24 |

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| | | | | |
|---------|-----|-----|-----------|----|
| P275NL2 | 275 | 265 | 390 - 510 | 24 |
| P355N | 355 | 345 | 490 - 630 | 22 |
| P355NH | 355 | 345 | 490 - 630 | 22 |
| P355NL1 | 355 | 345 | 490 - 630 | 22 |
| P355NL2 | 355 | 345 | 490 - 630 | 22 |
| P355M | 355 | | 450 - 610 | 22 |
| P355ML1 | 355 | | 450 - 610 | 22 |
| P355ML2 | 355 | | 450 - 610 | 22 |
| P420M | 420 | 400 | 500 - 660 | 19 |
| P420ML1 | 420 | 400 | 500 - 660 | 19 |
| P420ML2 | 420 | 400 | 500 - 660 | 19 |
| P460M | 460 | 440 | 530 - 720 | 17 |
| P460ML1 | 460 | 440 | 530 - 720 | 17 |
| P460ML2 | 460 | 440 | 530 - 720 | 17 |

¹⁾ Transverse samples

²⁾ Nominal thickness e [mm]

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