

## P355GH

### Heat-resistant pressure-vessel steels

|                        |                |
|------------------------|----------------|
| Material no.           | 1.0473         |
| according to           | DIN EN 10028-2 |
| Tensile strength class | B              |

#### Usage

These steel grades are characterised by a good weldability. They are used above all for manufacturing boilers, pressure vessels and pipes transporting hot liquids.

The user of these steel grades must make sure that his calculation, design and processing methods are appropriate for the material. The grades of this series offer good cold and hot-forming properties.

#### Chemical composition <sup>1)</sup>

(in percent by weight)

|                  | min.   | max.                 |
|------------------|--------|----------------------|
| C                | 0.100% | 0.220%               |
| Si               |        | 0.600%               |
| Mn               | 1.100% | 1.700%               |
| P                |        | 0.025%               |
| S                |        | 0.015%               |
| N <sup>2)</sup>  |        | 0.012%               |
| Al <sup>2)</sup> | 0.020% |                      |
| Cu               |        | 0.300% <sup>3)</sup> |
| Cr               |        | 0.300%               |
| Ni               |        | 0.300%               |
| Nb               |        | 0.020%               |
| V                |        | 0.020%               |
| Ti               |        | 0.030%               |
| Mo               |        | 0.080%               |

1)  $(Cr + Cu + Mo + Ni) \leq 0.70\%$

2)  $Al/N \geq 2$

3) A lower Cu-content and a maximum tin content may be agreed in the order, e. g. with respect to formability.

#### Mechanical properties <sup>1)</sup>

| Nom. thick. e | Yield strength R <sub>eH</sub> |
|---------------|--------------------------------|
| < 16 mm       | ≥ 355 MPa                      |
| ≥ 16 mm       | ≥ 345 MPa                      |

| Nom. thick. e | Tensile strength R <sub>m</sub> |
|---------------|---------------------------------|
| ≤ 60mm        | 510 – 650 MPa                   |

| Nom. thick. e | Total elongation A <sub>5</sub> |
|---------------|---------------------------------|
| 3 < e ≤ 60mm  | ≥ 20 %                          |

1) Transverse samples, normalised

#### Yield point at elevated temperature

| Test temperature | Yield point at elev. temp. R <sub>p0,2</sub> |           |
|------------------|--|-----------|
|                  | e ≤ 16 mm                                    | e > 16 mm |
| 50°C             | ≥ 343 MPa                                    | ≥ 334 MPa |
| 100°C            | ≥ 323 MPa                                    | ≥ 314 MPa |
| 150°C            | ≥ 299 MPa                                    | ≥ 291 MPa |
| 200°C            | ≥ 275 MPa                                    | ≥ 267 MPa |
| 250°C            | ≥ 252 MPa                                    | ≥ 245 MPa |
| 300°C            | ≥ 232 MPa                                    | ≥ 225 MPa |
| 350°C            | ≥ 214 MPa                                    | ≥ 208 MPa |
| 400°C            | ≥ 202 MPa                                    | ≥ 196 MPa |

#### Notch impact energy <sup>1)</sup>

| Test temperature | Notch impact energy |
|------------------|---------------------|
| +20°C            | ≥ 40J               |
| 0°C              | ≥ 34J               |
| -20°C            | ≥ 27J               |

1) Average values of 3 samples; one individual value may fall short of the required minimum value by not more than 30%. The sample width shall equal the product thickness if the latter is between 6 and 10 mm. The tests are performed by using samples similar to Charpy-V samples. The values specified in the table above are to be reduced proportionally to the sample width.

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#### Available dimensions

Hot-rolled coils unpickled, mill edge

| Thickness in mm | Width in mm |
|-----------------|-------------|
| 2.00 – 2.24     | 900 – 1400  |
| 2.25 – 2.49     | 900 – 1450  |
| 2.50 – 2.99     | 900 – 1500  |
| 3.00 – 3.99     | 900 – 1680  |
| 4.00 – 6.00     | 900 – 1750  |
| 6.01 – 12.70    | 900 – 1750  |

Widths < 900 mm and thicknesses > 12.70 mm on request

Hot-rolled slit strip

| Thickness in mm | Width in mm |
|-----------------|-------------|
| 2.00 – 2.24     | 100 – 690   |
| 2.25 – 2.49     | 100 – 715   |
| 2.50 – 2.99     | 100 – 740   |
| 3.00 – 4.50     | 100 – 800   |
| 4.50 – 6.00     | 116 – 800   |
| 6.01 – 7.00     | 175 – 800   |
| 7.01 – 8.00     | 233 – 800   |

< 100 mm on request

#### Welding

The steel grades of this series may be welded using the usual welding techniques.

#### Condition of delivery, scope of testing and certificate

The provisions of EN 10028-2, chapters 8.2 and 9 shall apply for delivery and inspection. The steel grades P235GH–P355GH are delivered in the normalised-rolled condition (condition of delivery N).