

Seamless Steel Tube to EN10305-1

Table 1 - Delivery conditions

| Designation | Symbol | Description |
|--------------------------------|--------|--|
| Cold drawn / hard | +C | No heat treatment after the final cold drawing process. |
| Cold drawn / soft | +LC | After the final heat treatment there is a suitable drawing pass. |
| Cold drawn and stress relieved | +SR | After the final cold drawing process there is a stress relief heat treatment in a controlled atmosphere. |
| Annealed | +A | After the final cold drawing process the tubes are annealed in a controlled atmosphere. |
| Normalised | +N | After the final cold drawing operation the tubes are normalised in a controlled atmosphere. |

Table 2 - Chemical composition (cast analysis)^a

| Steel grade | | % by mass | | | | | |
|-------------------|--------------|-----------|---------|---------|--------|--------|---------|
| Steel name | Steel number | C max. | Si max. | Mn max. | P max. | S max. | Al max. |
| E215 | 1.0212 | 0,10 | 0,05 | 0,70 | 0,025 | 0,025 | 0,025 |
| E235 | 1.0308 | 0,17 | 0,35 | 1,20 | 0,025 | 0,025 | - |
| E355 ^b | 1.0580 | 0,22 | 0,55 | 1,60 | 0,025 | 0,025 | - |

a) Elements not included in this table (but see footnote b) shall not be intentionally added to the steel without the agreement of the purchaser, except for elements which may be added for finishing the cast. All appropriate measures shall be taken to prevent the addition of undesirable elements from scrap or other materials used in the steel making process.

b) Additions of Nb, Ti, and V are permitted at the discretion of the manufacturer. The content of these elements shall be reported.

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Table 3 - Permissible deviations of the product analysis from the specified limits given in Table 2

| Element | Limiting value for cast analysis in accordance with Table 2 in % by mass | Permissible deviation of the product analysis in % by mass |
|---------|---|---|
| C | ≤0,22 | + 0,02 |
| Si | ≤0,55 | + 0,05 |
| Mn | ≤1,60 | + 0,10 |
| P | ≤0,025 | + 0,005 |
| S | ≤0,040 | +/- 0,005 |
| Al | ≥0,025 | - 0,005 |

Table 4 - Mechanical properties at room temperature

| Steel grade | | Minimum values for the delivery condition ^{a,b} | | | | | | | | | | | |
|-------------|--------------|--|--------|-----------------------|--------|-----------------------|-------------------------|--------|-----------------------|--------|-----------------------|--------------------------------------|--------|
| Steel name | Steel number | +C ^c | | +LC ^c | | +SR | | | +A ^d | | +N | | |
| | | R _m MPa | A % | R _m MPa | A % | R _m MPa | R _e H MPa | A % | R _m MPa | A % | R _m MPa | R _e H ^e MPa | A % |
| E215 | 1.0212 | 430 | 8 | 380 | 12 | 380 | 280 | 16 | 280 | 30 | 290 to 430 | 215 | 30 |
| E235 | 1.0308 | 480 | 6 | 420 | 10 | 420 | 350 | 16 | 315 | 25 | 340 to 480 | 235 | 25 |
| E355 | 1.0580 | 640 | 4 | 580 | 7 | 580 ^f | 450 ^f | 10 | 450 | 22 | 490 to 630 | 355 | 22 |

a) R_m: tensile strength; R_eH: upper yield strength (see EN10002-1); A: elongation after fracture. For symbols for the delivery condition see Table 1.

b) 1 MPa = 1 N/mm²

c) Depending on the degree of cold work in the finishing pass the yield strength may nearly be as high as the tensile strength. For calculation purposes the following relationships are recommended:

- for delivery condition +C: R_eH ≥ 0.8 R_m

- for delivery condition +LC: R_eH ≥ 0.7 R_m

d) For calculation purposes the following relationship is recommended: R_eH ≥ 0.5 R_m

e) For tubes with outside diameter ≤ 30 mm and wall thickness ≤ 3 mm the R_eH minimum values are 10MPa lower than the values given in this table.

f) For tubes with outside diameter > 160 mm: R_eH ≥ 420 MPa