CD home

Parker

# Ermeto Original
# *Tubes*

# General recommendations for tubes

## 1. Steel types, mechanical properties, conditions

**Steel types, mechanical properties and conditions of EO steel tubes**

| Steel type | Tensile strength Rm | Yield point ReH | Ductile yield A5 (longit.) | Condition |
|---|---|---|---|---|
| Fine grain E235 acc. to EN 10305-4 (St. 37.4 as per DIN 1630) | 340 N/mm² min. 49,000 lb/in² | 235 N/mm² min. 34,000 lb/in² | 25 % min. | Seamless, cold drawn under inert gas, normal annealed, abbreviation NBK, DIN 2391C, Part 2 |

**Steel types, mechanical properties and conditions of EO stainless steel tubes**

| Steel type | Tensile strength Rm | Yield point (1 % proof stress) | Ductile yield A5 (longit.) | Condition |
|---|---|---|---|---|
| Abbreviation 1.4571 X6CrNiMoTi17122 | 500 N/mm² min. 72,500 lb/in² | 245 N/mm² min. 35,500 lb/in² | 35 % min. | Seamless, cold drawn free of scale, heat treated in accordance with DIN 17458 tab. 6 |
| Abbreviation 1.4541 X6CrNiTi1810 | 500 N/mm² min. 72,500 lb/in² | 235 N/mm² min. 35,500 lb/in² | 35 % min. | |

## 2. Tests and certifications

All tubes are subjected to a non-destructive leak test and marked accordingly as proof. This marking replaces a works certificate DIN 50 049-2.2. Test class 1 DIN 17458 Table 7 applies for tubes made of 1.4571 and 1.4541.

## 3. Recommended bend radius

A bend radius of 3x the external tube diameter is recommended for cold bending of tubes with tube benders or by hand.

## 4. Welding suitability and weldability

Tubes of E235 are weldable according to usual techniques. Types made of 1.4571 and 1.4541 (stainless) are suitable for arc welding. The welding filler should be selected in accordance with DIN 8556 part 1 taking into account the type of application and the welding technique.

## 5. Approximate calculation of the flow resistance in straight tubelines

The flow resistance and thus the tubeline efficiency is influenced by the tube inside diameter, the volume flow (measured or calculated) and the properties of the medium. Laminar flow should be considered in order to keep losses in the system down to a minimum. The transition from laminar to turbulent flow, which brings an increase in the flow resistance is generally defined by the Reynolds number Re 2320. Since the transition cannot be pinpointed exactly, the transition range can only be determined by measuring. If, for simplified calculation, transition at Re 2320 and a "technically smooth" tube inner surface are assumed, the limit speeds w crit. and the laminar to turbulent flow volume flow v crit. when transition takes place, can be estimated according to the following formulas:

$$w_{crit.} = \frac{2.32 \cdot \nu}{d_i} \text{ [m / s]}$$

$$\dot{v}_{crit.} = 0.109 \cdot d_i \cdot \nu \text{ [l / min]}$$

$d_i$ = tube bore ∅ in mm

$\nu$ = kinematic viscosity in mm² / s.

For approximate calculation of the pressure drop in bar/1 m tube length, the following formulas can be used:

1. Laminar range:

$$\rho_v = \frac{0.32 \cdot w \cdot \nu \cdot \rho}{d_i^2 \cdot 10^3} = \frac{6.79 \cdot \dot{v} \cdot \nu \cdot \rho}{d_i^4 \cdot 10^3} \text{ [bar / 1 m]}$$

2. Turbulent range:

$$\rho_v = \frac{0.281 \cdot w^{1.75} \cdot \nu^{0.25} \cdot \rho}{d_i^{1.25} \cdot 10^3}$$

$$= \frac{59 \cdot \dot{v}^{1.75} \cdot \nu^{0.25} \cdot \rho}{d_i^{4.75} \cdot 10^3} \text{ [bar / 1 m]}$$

$w$ = flow speed in m/s; $\nu$ = kinetic viscosity in mm²/s; $\dot{v}$ = volume flow in l/min.; $\rho$ = density of the medium in kg/m³; $d_i$ = pipe internal diameter in mm.

Detailed calculations of the flow resistance require an exact knowledge of the tubeline system and the operating conditions. Refer to the relevant literature for other methods of calculations.

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# Seamless EO steel tubes Material St. 37.4

## Tolerances DIN 2391, part 1

| Order Code | | | | | | | Design pressure bar | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Phosphated and oiled | Zinc plated yellow | Chromium[6]-free | Tube O.D. (mm) | Tolerance | Wall thickness (mm) | Tube I.D. (mm) | DIN 2413 I Static | DIN 2413 III Dynamic | Burst pressure bar | Weight kg/m |
| **R04X0.5** | **R04X0.5VZ** | | 4 | | 0.50 | 3.0 | 313 | 273 | 1160 | 0.047 |
| | **R04X0.75VZ** | | 4 | ±0.08 | 0.75 | 2.5 | 409 | 391 | 1820 | 0.063 |
| **R04X1** | **R04X1VZ** | | 4 | | 1.00 | 2.0 | 522 | 500 | 2700 | 0.074 |
| | **R05X1VZ** | **R04X1CF** | 5 | ±0.08 | 1.00 | 3.0 | 432 | 416 | 2120 | 0.099 |
| | **R06X0.75VZ** | | 6 | | 0.75 | 4.5 | 333 | 288 | 1150 | 0.103 |
| **R06X1** | **R06X1VZ** | **R06X1CF** | 6 | | 1.00 | 4.0 | 389 | 372 | 1650 | 0.123 |
| **R06X1.5** | **R06X1.5VZ** | | 6 | ±0.08 | 1.50 | 3.0 | 549 | 526 | 2550 | 0.166 |
| | **R06X2VZ** | | 6 | | 2.00 | 2.0 | 692 | 662 | >3500 | 0.197 |
| | **R06X2.25VZ** | | 6 | | 2.25 | 1.5 | 757 | 725 | >3500 | 0.208 |
| **R08X1** | **R08X1VZ** | **R08X1CF** | 8 | | 1.00 | 6.0 | 333 | 288 | 1175 | 0.222 |
| **R08X1.5** | **R08X1.5VZ** | **R08X1.5CF** | 8 | ±0.08 | 1.50 | 5.0 | 431 | 412 | 1925 | 0.240 |
| **R08X2** | **R08X2VZ** | | 8 | | 2.00 | 4.0 | 549 | 526 | 2500 | 0.296 |
| | **R08X2.5VZ** | | 8 | | 2.50 | 3.0 | 658 | 630 | 2650 | 0.339 |
| **R10X1** | **R10X1VZ** | **R10X1CF** | 10 | | 1.00 | 8.0 | 282 | 248 | 900 | 0.222 |
| **R10X1.5** | **R10X1.5VZ** | **R10X1.5CF** | 10 | | 1.50 | 7.0 | 373 | 357 | 1450 | 0.314 |
| **R10X2** | **R10X2VZ** | | 10 | ±0.08 | 2.00 | 6.0 | 478 | 458 | 2025 | 0.395 |
| | **R10X2.5VZ** | | 10 | | 2.50 | 5.0 | 576 | 551 | 2675 | 0.462 |
| | **R10X3VZ** | | 10 | | 3.00 | 4.0 | 666 | 638 | >3500 | 0.518 |
| **R12X1** | **R12X1VZ** | **R12X1CF** | 12 | | 1.00 | 10.0 | 235 | 209 | 750 | 0.271 |
| **R12X1.5** | **R12X1.5VZ** | **R12X1.5CF** | 12 | | 1.50 | 9.0 | 353 | 303 | 1150 | 0.388 |
| **R12X2** | **R12X2VZ** | **R12X2CF** | 12 | ±0.08 | 2.00 | 8.0 | 409 | 391 | 1600 | 0.493 |
| | **R12X2.5VZ** | | 12 | | 2.50 | 7.0 | 495 | 474 | 2025 | 0.586 |
| | **R12X3VZ** | | 12 | | 3.00 | 6.0 | 576 | 551 | 2600 | 0.666 |
| | **R12X3.5VZ** | | 12 | | 3.50 | 5.0 | 651 | 624 | | 0.734 |
| | **R14X1.5VZ** | | 14 | | 1.50 | 11.0 | 302 | 264 | 975 | 0.462 |
| **R14X2** | **R14X2VZ** | | 14 | | 2.00 | 10.0 | 357 | 342 | 1325 | 0.592 |
| | **R14X2.5VZ** | | 14 | ±0.08 | 2.50 | 9.0 | 434 | 415 | 1650 | 0.709 |
| **R14X3** | **R14X3VZ** | | 14 | | 3.00 | 8.0 | 507 | 485 | 2200 | 0.814 |
| | | | 14 | | 3.50 | 7.0 | 576 | 551 | 2625 | 0.906 |
| **R15X1** | **R15X1VZ** | | 15 | | 1.00 | 13.0 | 188 | 170 | 575 | 0.345 |
| **R15X1.5** | **R15X1.5VZ** | **R15X1.5CF** | 15 | | 1.50 | 12.0 | 282 | 248 | 950 | 0.499 |
| **R15X2** | **R15X2VZ** | | 15 | ±0.08 | 2.00 | 11.0 | 336 | 321 | 1275 | 0.641 |
| **R15X3** | | | 15 | | 3.00 | 9.0 | 478 | 458 | 2000 | 0.888 |
| **R16X1.5** | **R16X1.5VZ** | | 16 | | 1.50 | 13.0 | 264 | 233 | 850 | 0.536 |
| **R16X2** | **R16X2VZ** | **R16X2CF** | 16 | ±0.08 | 2.00 | 12.0 | 353 | 303 | 1175 | 0.691 |
| **R16X2.5** | **R16X2.5VZ** | | 16 | | 2.50 | 11.0 | 386 | 370 | 1500 | 0.832 |
| **R16X3** | **R16X3VZ** | | 16 | | 3.00 | 10.0 | 452 | 433 | 1850 | 0.962 |
| **R18X1** | **R18X1VZ** | | 18 | | 1.00 | 16.0 | 157 | 143 | 450 | 0.419 |
| **R18X1.5** | **R18X1.5VZ** | **R18X1.5CF** | 18 | | 1.50 | 15.0 | 235 | 209 | 700 | 0.610 |
| **R18X2** | **R18X2VZ** | | 18 | ±0.08 | 2.00 | 14.0 | 313 | 273 | 975 | 0.789 |
| **R18X2.5** | **R18X2.5VZ** | | 18 | | 2.50 | 13.0 | 348 | 333 | 1300 | 0.956 |
| | **R18X3VZ** | | 18 | | 3.00 | 12.0 | 409 | 391 | 1575 | 1.111 |

**Surface finish:**

- Phosphated and oiled:
- Tubes with I.D. 1.5–5 mm: outside and inside oiled.
- Tubes from 6 mm I.D.: outside and inside phosphated and oiled.
- Zinc plated yellow:
  These dimensions are externally zinc plated (coating 8–12 µm), inside oiled.
- Chromium[6]-free:
  These dimensions are externally thick coat passivated (thickness of coat 8–12 µm), inside oiled.

**Calculation pressures:**

Calculation pressures given are according to DIN 2413 part I for **static stress**

$$P = \frac{20 \cdot K \cdot s \cdot c}{S \cdot d_a} \text{ (bar)}$$

Material characteristic value K = 235N/mm$^2$ and DIN 2413 part III for **dynamic stress**

$$P = \frac{20 \cdot K \cdot s \cdot c}{S \cdot (da + s \cdot c)} \text{ (bar)}$$

Material characteristic value K = 226 N/mm$^2$ (permanent fatigue strength)

Safety correction value S = 1.5 for static and dynamic stress. Factor c for consideration of wall thickness divergence **for static and dynamic stress** = 0.8 for tube O.D. 4 and 5; 0.85 for tube o.d. 6 and 8; 0.9 for larger tube O.D.

## Seamless EO steel tubes (Continued) Material St. 37.4

Tolerances DIN 2391, part 1

| Order Code | | | | | | | Design pressure bar | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Phosphated and oiled | Zinc plated yellow | Chromium[6]-free | Tube O.D. (mm) | Tolerance | Wall thickness (mm) | Tube I.D. (mm) | DIN 2413 I Static | DIN 2413 III Dynamic | Burst pressure bar | Weight kg/m |
| | **R20X1.4VZ** | | 20 | | 1.50 | 17 | 212 | 190 | 675 | 0.684 |
| **R20X2** | **R20X2VZ** | **R20X2CF** | 20 | | 2.00 | 16 | 282 | 248 | 900 | 0.888 |
| **R20X2.5** | **R20X2.5VZ** | | 20 | ±0.08 | 2.50 | 15 | 353 | 303 | 1100 | 1.079 |
| **R20X3** | **R20X3VZ** | | 20 | | 3.00 | 14 | 373 | 357 | 1400 | 1.258 |
| **R20X3.5** | **R20X3.5VZ** | | 20 | | 3.50 | 13 | 426 | 408 | 1650 | 1.424 |
| | **R20X4VZ** | | 20 | | 4.00 | 12 | 478 | 458 | 2000 | 1.578 |
| **R22X1.5** | **R22X1.5VZ** | | 22 | | 1.50 | 19 | 192 | 173 | 550 | 0.758 |
| **R22X2** | **R22X2VZ** | **R22X2CF** | 22 | ±0.08 | 2.00 | 18 | 256 | 227 | 775 | 0.986 |
| **R22X2.5** | **R22X2.5VZ** | | 22 | | 2.50 | 17 | 320 | 278 | 1025 | 1.202 |
| | **R22X3VZ** | | 22 | | 3.00 | 16 | 343 | 328 | 1175 | 1.406 |
| **R25X2** | **R25X2VZ** | | 25 | | 2.00 | 21 | 226 | 201 | 725 | 1.134 |
| **R25X2.5** | **R25X2.5VZ** | | 25 | | 2.50 | 20 | 282 | 248 | 850 | 1.387 |
| **R25X3** | **R25X3VZ** | **R25X3CF** | 25 | ±0.08 | 3.00 | 19 | 338 | 292 | 1025 | 1.628 |
| **R25X4** | **R25X4VZ** | | 25 | | 4.00 | 17 | 394 | 378 | 1500 | 2.072 |
| **R25X4.5** | **R25X4.5VZ** | | 25 | | 4.50 | 16 | 437 | 418 | 1625 | 2.275 |
| **R28X1.5** | **R28X1.5VZ** | | 28 | | 1.50 | 25 | 151 | 138 | 425 | 0.980 |
| **R28X2** | **R28X2VZ** | **R28X2CF** | 28 | | 2.00 | 24 | 201 | 181 | 600 | 1.282 |
| **R28X2.5** | **R28X2.5VZ** | | 28 | ±0.08 | 2.50 | 23 | 252 | 223 | 750 | 1.572 |
| **R28X3** | **R28X3VZ** | | 28 | | 3.00 | 22 | 302 | 264 | 900 | 1.850 |
| | **R30X2VZ** | | 30 | | 2.00 | 26 | 188 | 170 | 575 | 1.381 |
| **R30X2.5** | **R20X2.5VZ** | | 30 | | 2.50 | 25 | 235 | 209 | 725 | 1.695 |
| **R30X3** | **R30X3VZ** | **R30X3CF** | 30 | ±0.08 | 3.00 | 24 | 282 | 248 | 850 | 1.998 |
| **R30X4** | **R30X4VZ** | | 30 | | 4.00 | 22 | 336 | 321 | 1175 | 2.565 |
| **R30X5** | **R30X5VZ** | | 30 | | 5.00 | 20 | 409 | 391 | 1600 | 3.083 |
| **R35X2** | **R35X2VZ** | **R35X2CF** | 35 | | 2.00 | 31 | 161 | 147 | 450 | 1.628 |
| **R35X2.5** | **R35X2.5VZ** | | 35 | | 2.50 | 30 | 201 | 181 | 600 | 2.004 |
| **R35X3** | **R35X3VZ** | **R35X3CF** | 35 | ±0.15 | 3.00 | 29 | 242 | 215 | 700 | 2.367 |
| | **R35X4VZ** | | 35 | | 4.00 | 27 | 322 | 280 | 960 | 3.058 |
| **R38X2.5** | **R38X2.5VZ** | | 38 | | 2.50 | 33 | 186 | 168 | 550 | 2.189 |
| **R38X3** | **R38X3VZ** | | 38 | | 3.00 | 32 | 223 | 199 | 675 | 2.589 |
| **R38X4** | **R38X4VZ** | **R38X4CF** | 38 | ±0.15 | 4.00 | 30 | 297 | 260 | 900 | 3.354 |
| **R38X5** | **R38X5VZ** | | 38 | | 5.00 | 28 | 332 | 318 | 1150 | 4.069 |
| | **R38X6VZ** | | 38 | | 6.00 | 26 | 390 | 373 | | 4.735 |
| | **R38X7VZ** | | 38 | | 7.00 | 24 | 446 | 427 | 1700 | 5.352 |
| **R42X2** | **R42X2VZ** | **R42X2CF** | 42 | | 2.00 | 38 | 134 | 123 | 375 | 1.973 |
| **R42X3** | **R42X3VZ** | **R42X3CF** | 42 | ±0.2 | 3.00 | 36 | 201 | 181 | 575 | 2.885 |
| **R42X4** | **R42X4VZ** | | 42 | | 4.00 | 34 | 269 | 237 | 850 | 3.749 |
| **R50X6** | | | 50 | ±0.2 | 6.00 | 38 | 338 | 292 | | 6.511 |
| **R65X8** | | | 65 | ±0.3 | 8.00 | 49 | 347 | 299 | | 11.246 |

**Remarks:**

Corrosion – additional allowances are not considered for the calculation of pressures. Tube with a diameter ratio of

$\frac{da}{di_{max.}} \geq 1.35$ are calculated for static stress in accordance with DIN 2413 coverage III, but with $K = 235\ N/mm^2$.

When a specific factor of safety is required, calculations should be based upon the burst pressures shown in the above tables.

**Temperature range:** –40° up to 120°C without pressure reductions.

**For increased temperatures:**

control calculation according to DIN 2413 II required (static application above 120 °C).

$$P = \frac{20 \cdot K \cdot s \cdot c}{S\,(da - s \cdot c)}$$

Material strength K for increased temperatures:

| Temperature in °C | K $_{(Nmm^2)}$ |
|---|---|
| up to 200 | 185 |
| up to 250 | 165 |

R

## Seamless EO stainless steel tubes Material-No.: 1.4571/1.4541

Tolerances DIN 2391, part 1

| Order Code | | Tube O.D. (mm) | Tolerance | Wall thickness (mm) | Tube I.D. (mm) | 1.4571 Design pressure bar DIN 2413-I Static | 1.4541 Design pressure bar DIN 2413-I Static | 1.4571 burst pressure bar | Weight kg/m |
|---|---|---|---|---|---|---|---|---|---|
| 1.4571 | 1.4541 | | | | | | | | |
| **R04X171** | | 4 | ±0.08 | 1.0 | 2 | 600 | 539 | | 0.075 |
| **R06X171** | **R06X141** | 6 | ±0.08 | 1.0 | 4 | 426 | 383 | 1850 | 0.125 |
| **R06X1.571** | | 6 | ±0.08 | 1.5 | 3 | 600 | 539 | 2900 | 0.169 |
| **R08X171** | **R08X141** | 8 | ±0.08 | 1.0 | 6 | 368 | 297 | 1300 | 0.175 |
| **R08X1.571** | | 8 | | 1.5 | 5 | 472 | 424 | 2050 | 0.244 |
| **R10X171** | **R10X141** | 10 | | 1.0 | 8 | 294 | 242 | 950 | 0.225 |
| **R10X1.571** | **R10X1.541** | 10 | ±0.08 | 1.5 | 7 | 389 | 349 | 1750 | 0.319 |
| **R10X271** | | 10 | | 2.0 | 6 | 498 | 447 | 2400 | 0.401 |
| **R12X171** | **R12X141** | 12 | | 1.0 | 10 | 245 | 205 | 850 | 0.275 |
| **R12X1.571** | **R12X1.541** | 12 | ±0.08 | 1.5 | 9 | 368 | 297 | 1400 | 0.394 |
| **R12X271** | | 12 | | 2.0 | 8 | 426 | 383 | 1900 | 0.501 |
| **R14X1.571** | | 14 | | 1.5 | 11 | 315 | 258 | 1200 | 0.469 |
| **R14X271** | | 14 | ±0.08 | 2.0 | 10 | 420 | 334 | 1550 | 0.601 |
| **R14X2.571** | | 14 | | 2.5 | 9 | 452 | 406 | 2100 | 0.720 |
| **R15X171** | | 15 | | 1.0 | 13 | 196 | 166 | 675 | 0.351 |
| **R15X1.571** | **R15X1.541** | 15 | ±0.08 | 1.5 | 12 | 294 | 242 | 1100 | 0.507 |
| **R15X271** | | 15 | | 2.0 | 11 | 392 | 314 | 1400 | 0.651 |
| **R16X1.571** | | 16 | ±0.08 | 1.5 | 13 | 276 | 228 | 950 | 0.545 |
| **R16X271** | **R16X241** | 16 | | 2.0 | 12 | 368 | 297 | 1300 | 0.701 |
| **R16X2.571** | | 16 | ±0.08 | 2.5 | 11 | 403 | 362 | 1850 | 0.845 |
| **R16X371** | | 16 | | 3.0 | 10 | 472 | 424 | 2400 | 0.977 |
| **R18X1.571** | **R18X1.541** | 18 | ±0.08 | 1.5 | 15 | 245 | 205 | 800 | 0.620 |
| **R18X271** | | 18 | | 2.0 | 14 | 327 | 267 | 1150 | 0.801 |
| **R20X271** | | 20 | | 2.0 | 16 | 294 | 242 | 1050 | 0.901 |
| **R20X2.571** | | 20 | ±0.08 | 2.5 | 15 | 368 | 297 | 1400 | 1.095 |
| **R20X371** | | 20 | | 3.0 | 14 | 389 | 349 | 1800 | 1.277 |
| **R22X1.571** | | 22 | ±0.08 | 1.5 | 19 | 200 | 170 | 650 | 0.770 |
| **R22X271** | | 22 | | 2.0 | 18 | 267 | 222 | 900 | 1.002 |
| **R25X2.571** | | 25 | ±0.08 | 2.5 | 20 | 294 | 242 | 1050 | 1.408 |
| **R25X371** | | 25 | | 3.0 | 19 | 353 | 286 | 1275 | 1.653 |
| **R28X1.571** | | 28 | ±0.08 | 1.5 | 25 | 158 | 135 | 550 | 0.995 |
| **R28X271** | | 28 | | 2.0 | 24 | 210 | 177 | 700 | 1.302 |
| **R30X2.571** | | 30 | ±0.08 | 2.5 | 25 | 245 | 205 | 850 | 1.722 |
| **R30X371** | | 30 | ±0.08 | 3.0 | 24 | 294 | 242 | 1150 | 2.028 |
| **R30X471** | | 30 | | 4.0 | 22 | 392 | 314 | 1500 | 2.605 |
| **R35X271** | | 35 | ±0.15 | 2.0 | 31 | 168 | 143 | 550 | 1.653 |
| **R38X471** | | 38 | ±0.15 | 4.0 | 30 | 309 | 254 | 1150 | 3.405 |
| **R42X271** | | 42 | ±0.2 | 2.0 | 38 | 140 | 121 | 475 | 2.003 |
| **R42X371** | | 42 | | 3.0 | 36 | 210 | 177 | 750 | 2.930 |

## Seamless EO stainless steel tubes (continued) Material-No.: 1.4571/1.4541

**Calculation pressure:**
Calculation pressures given are according to DIN 2413 part I for **static stress**

$$P = \frac{20 \cdot K \cdot s \cdot c}{S \cdot d_a} \text{ (bar)}$$

Material characteristic value K=245 N/mm$^2$ (1.4571), K=235 N/mm$^2$ (1.4541) (1% proof stress)
Safety factor S = 1.5
Factor c for consideration of wall thickness divergence: 0.9

For range of application for which a certain safety value compared to burst pressure is demanded for tubes of 1.4571 grade stainless steel, the measured burst pressures are contained in tube-tables. Burst pressure values for tubes of 1.4541 grade stainless steel are not available. Calculation pressures according to DIN 2413 part III for **dynamic stress** are not listed, because in DIN 17458 the permanent fatigue stress is not listed. Until standards will be available for gauge localization of permanent fatigue strength we recommend for calculations to use DIN 2413 part III with the following characteristic values:
permanent fatigue strength K=190 N/mm$^2$ for tubes of 1.4571 and 1.4541; S=1.5; C=0.9.

**Remarks:**
Corrosion: additional allowances are not considered for the calculation of pressures.
Tubes with a diameter proportion da/di ≥ 1.35 are calculated according to DIN 2413 part III with above characteristic values.

**Permissible temperature range and required pressure reductions.** This is based on calculated pressures at the elevated temperatures shown, taking into consideration the recommended reduction in proof stress (DIN 17458).

| Temperature | | –60° up to +20° C | 50°C | 100°C | 200°C | 300°C | 400°C |
|---|---|---|---|---|---|---|---|
| Pressure reductions in % | 1.4571 | – | 5.5 | 11.5 | 21.5 | 29 | 34 |
| | 1.4541 | – | 4.5 | 11 | 20 | 29 | 33 |

Interpolation is acceptable for intermediate temperature levels.

## Seamless EO steel tubes Material C-STEEL

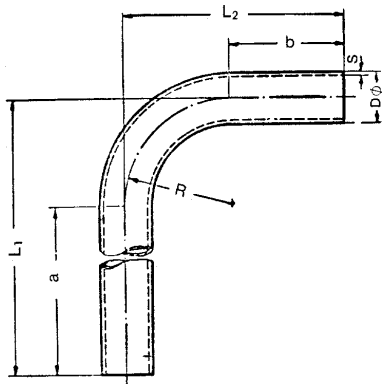
for hydraulic and pneumatic pressure lines.
US Norm SAE J 524, C-Steel.
Test according ASTM A 179-90 A/ASME SA 179.
Quality and leak tested.

| Order Code (With Tube O.D. and wall thickness Inch | Tube O.D. (mm) | Tolerance | Wall thickness (mm) | Design pressure bar DIN 2413 I Static | DIN 2413 III Dynamic | burst pressure bar | Weight kg/m |
|---|---|---|---|---|---|---|---|
| **R1/4X0.049** | 6.35 | ±0.08 | 1.24 | 553 | 450 | – | 0.157 |
| **R3/8X0.049** | 9.53 | ±0.08 | 1.24 | 368 | 316 | – | 0.254 |
| **R3/8X0.065** | 9.53 | ±0.08 | 1.65 | 489 | 405 | – | 0.321 |
| **R1/2X0.049** | 12.70 | ±0.08 | 1.24 | 276 | 243 | – | 0.352 |
| **R1/2X0.065** | 12.70 | ±0.08 | 1.65 | 367 | 314 | – | 0.450 |
| **R5/8X0.083** | 16.00 | ±0.08 | 2.11 | 374 | 320 | – | 0.716 |
| **R3/4X0.095** | 19.05 | ±0.08 | 2.41 | 357 | 307 | – | 0.990 |
| **R3/4X0.104** | 19.05 | ±0.08 | 2.64 | 391 | 333 | – | 1.069 |
| **R3/4X0.109** | 19.05 | ±0.08 | 2.67 | 410 | 347 | – | 1.112 |
| **R1X0.095** | 25.40 | ±0.08 | 2.41 | 268 | 236 | – | 1.368 |
| **R1X0.120** | 25.40 | ±0.08 | 3.05 | 338 | 292 | – | 1.680 |
| **R11/4X0.120** | 31.75 | ±0.08 | 3.05 | 271 | 239 | – | 2.157 |
| **R11/2X0.156** | 38.10 | ±0.15 | 3.96 | 293 | 257 | – | 3.336 |

R

## Seamless EO tube bends 90° Material St. 37.4 and 1.4571

For minimum flow loss




| Order Code St.37.4 | Order Code 1.4571 | Tube O.D. D | Tolerance ± | Wall-thickness S | Tube I.D. mm | Bending radius R | Leg length a | Leg length b | Length $L_1$ | Length $L_2$ | Weight kg/piece |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **RB16X2VZ** | **RB16X271** | 16 | 0.08 | 2.0 | 12 | 30 | 200 | 40 | 230 | 70 | 0.198 |
| **RB18X1.5VZ** | **RB18X1.571** | 18 | 0.08 | 1.5 | 15 | 36 | 200 | 35 | 236 | 71 | 0.178 |
| **RB20X2VZ** | | 20 | 0.08 | 2.0 | 16 | 36 | 200 | 45 | 236 | 81 | 0.268 |
| **RB20X2.5VZ** | **RB20X2.571** | 20 | 0.08 | 2.5 | 15 | 36 | 200 | 45 | 236 | 81 | 0.326 |
| **RB22X1.5VZ** | | 22 | 0.08 | 1.5 | 19 | 38 | 200 | 40 | 238 | 78 | 0.227 |
| **RB22X2VZ** | **RB22X271** | 22 | 0.08 | 2.0 | 18 | 38 | 200 | 40 | 238 | 78 | 0.296 |
| **RB25X2VZ** | | 25 | 0.08 | 2.0 | 21 | 44 | 200 | 50 | 244 | 94 | 0.362 |
| **RB25X2.5VZ** | **RB25X2.571** | 25 | 0.08 | 2.5 | 20 | 44 | 200 | 50 | 244 | 94 | 0.442 |
| **RB25X3VZ** | | 25 | 0.08 | 3.0 | 19 | 44 | 200 | 50 | 244 | 94 | 0.519 |
| **RB28X1.5VZ** | | 28 | 0.08 | 1.5 | 25 | 48 | 200 | 50 | 248 | 98 | 0.319 |
| **RB28X2VZ** | **RB28X271** | 28 | 0.08 | 2.0 | 24 | 48 | 200 | 50 | 248 | 98 | 0.417 |
| **RB28X3VZ** | | 28 | 0.08 | 3.0 | 22 | 48 | 200 | 50 | 248 | 98 | 0.601 |
| **RB30X2.5VZ** | | 30 | 0.08 | 2.5 | 25 | 50 | 200 | 60 | 250 | 110 | 0.575 |
| **RB30X3VZ** | **RB30X371** | 30 | 0.08 | 3.0 | 24 | 50 | 200 | 60 | 250 | 110 | 0.677 |
| **RB30X4VZ** | | 30 | 0.08 | 4.0 | 22 | 50 | 200 | 60 | 250 | 110 | 0.869 |
| **RB35X2VZ** | **RB35X271** | 35 | 0.15 | 2.0 | 31 | 60 | 200 | 65 | 260 | 125 | 0.586 |
| **RB35X3VZ** | | 35 | 0.15 | 3.0 | 29 | 60 | 200 | 65 | 260 | 125 | 0.852 |
| **RB38X2.5VZ** | | 38 | 0.15 | 2.5 | 33 | 65 | 200 | 75 | 265 | 140 | 0.827 |
| **RB38X3VZ** | | 38 | 0.15 | 3.0 | 32 | 65 | 200 | 75 | 265 | 140 | 0.979 |
| **RB38X4VZ** | **RB38X471** | 38 | 0.15 | 4.0 | 30 | 65 | 200 | 75 | 265 | 140 | 1.268 |
| **RB38X5VZ** | | 38 | 0.15 | 5.0 | 28 | 65 | 200 | 75 | 265 | 140 | 1.538 |
| **RB42X2VZ** | **RB42X271** | 42 | 0.20 | 2.0 | 38 | 80 | 200 | 85 | 280 | 165 | 0.809 |
| **RB42X3VZ** | | 42 | 0.20 | 3.0 | 36 | 80 | 200 | 85 | 280 | 165 | 1.183 |
| **RB50X6*** | | 50 | 0.20 | 6.0 | 38 | 180 | 150 | 150 | 330 | 330 | 3.496 |
| **RB65X8*** | | 65 | 0.30 | 8.0 | 49 | 180 | 160 | 160 | 330 | 330 | 6.294 |

Tolerances for leg length a, b = ±2.5 mm

For tube bends, contrary to straight tubes of the same wall thickness there is a higher stress at the inside of the bend and a reduction of the fatigue strength, because of the out-of-round of tube. Details see DIN 2413 section 4.7.

Tube bends material St. 37.4 are zink plated yellow.

*phosphated and oiled