# Tube Bend Wall Thinning and Ovality

Wall thickness at the outside and inside of a tube bend from the bend radius (constant-volume geometry) and ovality from measured diameters.

**Method:** Constant-volume fibre-length geometry: t_e = t₀ R/(R + D/2); t_i = t₀ R/(R − D/2); ovality = (D_max − D_min)/D

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Tube outside diameter | 50.800 | mm |
| Wall thickness before bending | 4.5000 | mm |
| Bend centreline radius | 100.00 | mm |
| Largest measured diameter | 52.500 | mm |
| Smallest measured diameter | 49.500 | mm |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Extrados (outside) thickness | 3.5885 | mm |
| Intrados (inside) thickness | 6.0322 | mm |
| Extrados thinning | 20.255 | % |
| Ovality (D_max − D_min)/D | 5.9055 | % |

**Notes for this case**

- Geometric estimate (wall stretches with the fibre length). Real bends thin somewhat less; the minimum thickness after bending and ovality limits come from the design code.

## Formula and method

$$t_e = t_0 \frac{R}{R + D/2}, \quad t_i = t_0 \frac{R}{R - D/2}, \quad O = \frac{D_{max} - D_{min}}{D}$$

### Variables

| | | |
|---|---|---|
| $D$ | Tube outside diameter | m |
| $t_0$ | Wall thickness before bending | m |
| $R$ | Bend centreline radius | m |
| $D_{max}$ | Largest measured diameter | m |
| $D_{min}$ | Smallest measured diameter | m |
| $t_e$ | Extrados (outside) thickness | m |
| $t_i$ | Intrados (inside) thickness | m |
| $1 - t_e/t_0$ | Extrados thinning | - |
| $O$ | Ovality (D_max − D_min)/D | - |

### Method and standards

Constant-volume geometry: the wall at the extrados stretches, and at the intrados shortens, with the length of the fibre at R ± D/2 relative to the centreline, so the thickness changes in inverse proportion. Ovality is the difference of the measured diameters over the nominal diameter.

### Assumptions and limits

- Constant volume, no axial feed; the wall thickness must be less than D/2.
- The outer fibre radius R + D/2 is used for the whole wall; the mid-wall radius would give slightly less thinning, and real bends with axial push thin less still. The code minimum thickness after bending is not checked.

### References

- Constant-volume fibre-length geometry: $t_e = t_0 R/(R + D/2)$
- $t_i = t_0 R/(R - D/2)$; ovality = $(D_{max} - D_{min})/D$

## Report details

| | |
|---|---|
| Report reference | FCC-5RSC-Y24V (the same inputs always give the same reference) |
| Generated | 17 November 2026, 19:50 UTC |
| Calculator | Tube Bend Wall Thinning and Ovality |
| Method last reviewed | 13 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| Release checks | 2 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/boilers-power-plant/boiler-pressure-parts/tube-bend-thinning-ovality

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.