Contents

1. Purpose

It has to be ensured that the bends, elbows and tube coils which are not manufactured and tested according to a standard, customers‘ instructions and / or other tolerance data, range within certain tolerance limits and correspond consequently to a uniform quality.

2. Scope

This company standard applies to all bends, elbows and tube coils to be manufactured by Schmehmann for which no specifications relating to the tolerances to be kept have been given in the drawing, order or production order. This company standard applies to all materials and to the bending processes: bending by mandrel, bending without mandrel, upsetting bending processes (with and without mandrel) as well as the bending according to the 3-roll-procedure. This company standard is also applicable for particular bending methods, which have not been mentioned before.
Deviant requirements have to be pointed out separately by the customer when placing the order.

3. Definition of Terms

QS	= quality assurance
S - WN	= Schmehmann company standard
VGB-S-013-00-2017	= VGB-Richtlinie S-013-00-2017-04-DE

4. Dimensions

All dimensions in mm.

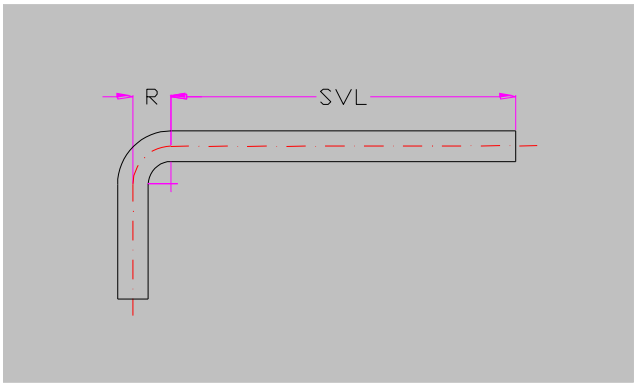
- Tube Coils

Nominal Size	≤ 30	> 30 ≤ 315	> 315 ≤ 1000	> 1000 ≤ 2000	> 2000 ≤ 4000	> 4000 ≤ 8000	>8000
Tolerance	+/- 1	+/- 2	+/- 3	+/- 4	+/- 6	+/- 8	+/- 10

- Bends and Elbows

Nominal Size	≤ 50	> 50 ... 100	>100 ... 250	>250 ... 500	>500 ... 1000	> 1000 ... 3000	> 3000
Tolerance	+/- 1	+/- 1,5	+/- 2	+/- 3	+/- 4	+/- 6	+/- 8

Dimensions = mean bending radius (Rm) + leg prolongation (SVL)



4.1 Radius tolerance for Elbows 180°

Nominal Size	≤ 50	> 50 ≤ 100	> 100 ≤ 250	> 250 ≤ 500	> 500
Tolerance	+/- 1,5	+/- 2	+/- 3	+/- 4	+/- 5

4.2 Radius tolerance for other bending

Nominal Size	≤ 100	> 100 ≤ 250	> 250 ≤ 500	> 500
Tolerance	+/- 15	+/- 20	+/- 35	+/- 50

5. Angles

The tolerances for angles on bends and elbows are as follows - depending on the degree of accuracy:

Degree of Accuracy f: +/- 0,5°
Degree of Accuracy m: +/- 1,0°
Degree of Accuracy g: +/- 2,0°

If no particulars are given, degree of accuracy **m** is applicable.

6. Corrugation Formation

The forming of corrugations in the bending compression zone shall basically be avoided. If a corrugation formation arises due to unfavourable ratio in radii / wall thickness, due to the material or other factors, the herein mentioned tolerance has to be kept after consultation with the responsible production manager respectively the QS department.
Flat corrugations are acceptable if h_m is not bigger than 3% of d_{a1} and the corrugation interval amounts to > 15 x h_m.

$h_m = (d_{a2} + d_{a4}) / 2 - d_{a3}$

h_m = mean corrugation height
d_{a1} = nominal outer diameter
d_{a2} = height of the biggest corrugation (Diameter)
d_{a3} = height of the valley between d_{a2} and d_{a4} (Diameter)
d_{a4} = height of the corrugation abutting to d_{a2} (Diameter)

7. Out-of-Roundness

The calculation for the measured out-of-roundness is as follows:

$$OV = 200 \times \frac{da_{max} - da_{min}}{da_{max} + da_{min}} \text{ (in \%)}$$

The acceptable out-of-roundness amounts to:

- if $R_m < 4 \times d_a$

$$OV_{zul} = \frac{20}{R_m/d_a}$$ however not to be more than 10% (after consultation with our QS up to 12.5% acceptable)

- if $R_m > 4 \times d_a$ maximum 5% (after consultation with our QS 7.5% acceptable)

OV = measured out-of-roundness
OV_{zul} = acceptable out-of-roundness
da_{max} = max. measured outer diameter
da_{min} = min. measured outer diameter
R_m = mean bending radius
d_a = nominal outer diameter

8. Wall Thickness

Bending Tension Zone: $$s_{min} = (s - w) \times \left(1 - \frac{1}{\frac{4 R_m}{d_a} + 2}\right) - 10\%$$

w = wall thickness reduction of the straight tube according to EN
s_{min} = minimum required wall thickness in the bending tension zone (outer zone of the bend)
s = nominal wall thickness

Bending Compression Zone: Refer to VGB-S-013-00-2017-04-DE (If required, it has to be pointed out separately when placing the order.)

9. Bending pressure zone: - In accordance with VGB R 501H / R 110L (if necessary, this must be indicated separately when ordering).

9.1 Radiustolerance

Bending process	3-roll-procedure	3D-bending process, 3-roll-procedure
Rohraußendurchmesser	< 101,6mm	> 101,6mm
Medium Bendingradius < 1500mm	± 10mm	± 30mm
Medium Bendingradius 1500 - 2500mm	± 20mm	± 20mm
Medium Bendingradius > 2500mm	± 30mm	± 80mm

9.2 Ovality

The permissible ovality in the 3D bending process is < 4.0% in the arc area and < 1.0% at the end of the arc.
The permissible ovality in the 3-roller bending process is < 8.0% in the arc area and < 2.0% at the end of the arc.

9.3 Wallthicknesstolerance

Depending on the bending radius, the reduction in wall thickness is 10 – 40% of the wall thickness used.

9.4 Surface

Depending on the process, an inner and outer surface is permissible that has slight drawing grooves in the longitudinal and transverse direction, as well as spiral depressions on the inside of the pipe in the area of the outer zone of the bend. Gentle transitions on the inner surface from the non-deformed to the deformed area are permissible.

10. Drawing scratches

More or less deep and visible grooves left by the tools on the workpiece surface, e.g. when bending, rolling and also sawing, are permissible. When bending using special bending processes, so-called drawing scratches can occur on the outside and/or inside, which are permissible.

11. Surface condition

Pipe bends, tube bends and tube coils are delivered without surface treatment (e.g. pickling, passivation, blasting) as standard.

12. Applicable Documents

VGB-S-013-00-2017-04-DE