Pressure derating of fittings

General information:

This document shows the pressure derating of different fittings made out of polyethylene (PE) for piping systems intended for the conveyance of water for human consumption, including raw water prior treatment and water for general purposes. The contents of this document is in accordance with general standards (ISO 4427-3, EN 12201 / EN 1555, DVS 2205 1 / AD B 9).

Table 1: Maximum allowable operating pressure (PN) for 20 °C and 50 years, for water (c=1.25) acc. EN12201

SDR	Maximum allowable operating pressure (PN)		
	PE 40	PE 80	PE 100
41	-	3.2	4
33	-	4	5
26	-	5	6
21	-	6	8
17	-	8	10
11	-	12.5	16
7,4	10	20	25

Fittings

There are various ways how to manufacture PE fittings depending on dimension and operation conditions. Fabricated fittings made out of pipe segments can have a derating of the pressure resistance caused by the geometry and / or of the welding.

Segmented tees

There are different possibilities to produce tees out of PE. Full pressure rating is given if the tee is fabricated by injection moulding, machining out of one blank or by reinforcement with FRP.
The following derating rules for the calculation of the PN shall apply (acc. ISO 4427-3):

$$PN = f_T \cdot PN_{pipe}$$

f_T derating factor for segmented tees, having a value of 0.5 (acc. ISO 4427-3)

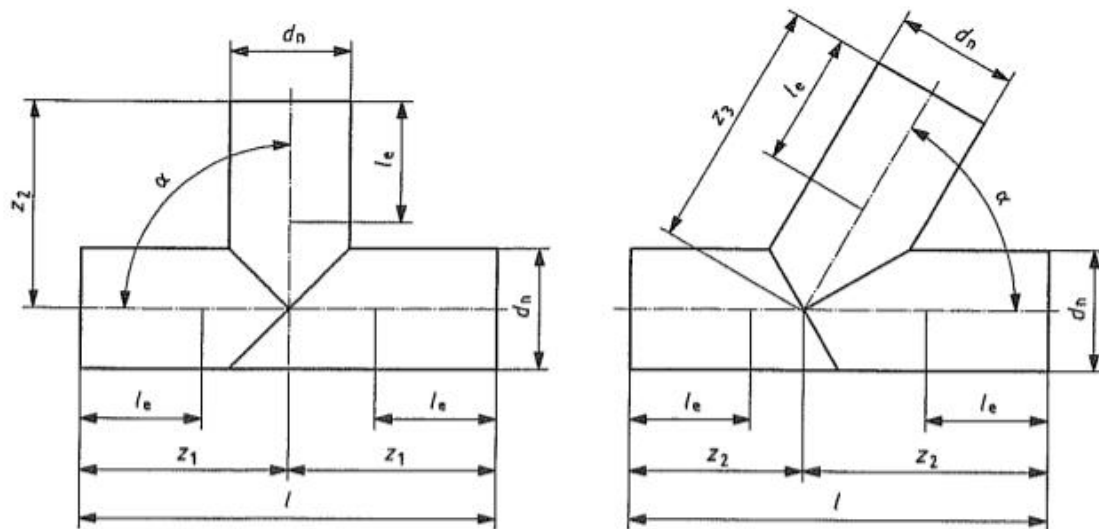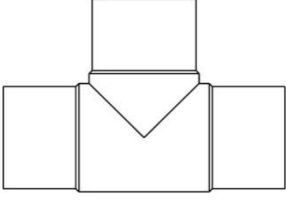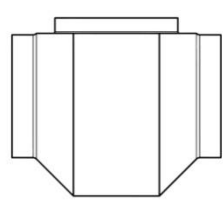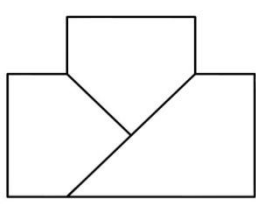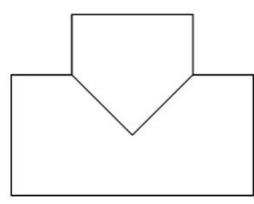PN_{pipe} ist he nominal pressure of the used pipe

Figure 1: Tees 90° and 60° fabricated out of pipe segments

d_n ... nominal outside diameter
l_e ... length of fusion end piece
z_1, z_2, z_3 ... nominal lengths of fitting branch to axis
α ... nominal angle of fitting

Various ways how tees can be manufactured

Table 2: Different types of tee and there derating factor (f_T); HS - Heated Butt Welding, WE – Hot Gas Extrusion welding

moulded	machined	segmented HS	segmented WE
$f_T = 1$	$f_T = 1$	$f_T = 0.5$	$f_T \sim 0.3^*$
EN12201 / EN 1555	EN12201 / EN 1555	ISO 4427-3	DVS 2205-1 / AD B9

* Accurate value has to be calculated acc. AD B9 for the required dimension

Segmented bends:

For fabricated bends out of pipe segments the following rules for the calculation of the PN shall apply (acc. ISO 4427-3):

$$PN = f_B \cdot PN_{pipe}$$

f_B derating factor related to the bend segment design;
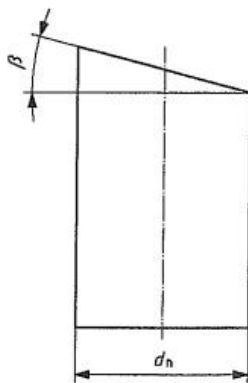PN_{pipe} ist he nominal pressure of the used pipe

Figure 2: Segment design ß cut angle

Table 3: Derating factors for segmented bends

Cut angle β	Derating factor f_B
≤ **7.5**°	1.0
7.5° < β ≤ 15°	0.8

The maximum cut angle ß shall not be greater than 15°.

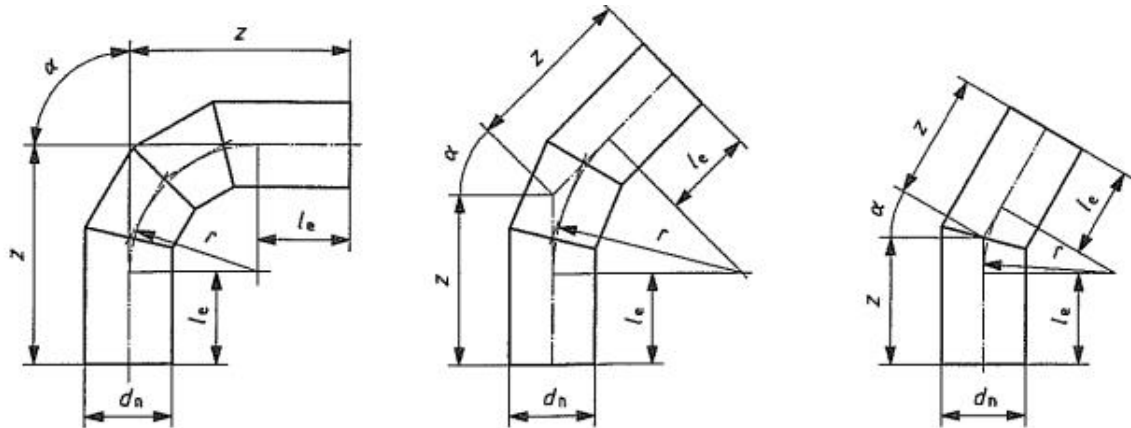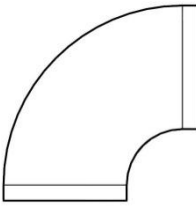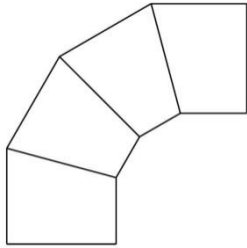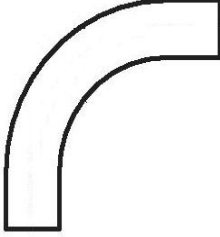
Figure 3: Design of segmented bends 90°, 45° and 30°.

d_n the nominal outside diameter
l_e the length of the fusion end
r   the nominal radius of the fitting
z   the nominal length of the fitting branch to the axis
α   the nominal angle of the fitting

Various ways how bends can be manufactured

Table 3: Different types of bends and there derating factor (f_B)

moulded	segmented HS	Swept bends
$f_B = 1$	$f_B = 0.5*$	$f_B = 1$
EN12201 / EN 1555	ISO 4427-3	ISO 4427-3

* depending on cut angle, see table 3