

# Bonded system - 80-90° L-bends with foam pads

calculation according to Design Manual chapter 4.5

**LOGSTOR**

## Conditions

Flow temperature, T <sub>f</sub>	120	°C
Installation temperature, T <sub>ins</sub>	10	°C
Soil cover, H	0.9	m

Insulation class **Series 1**

## Steel material properties

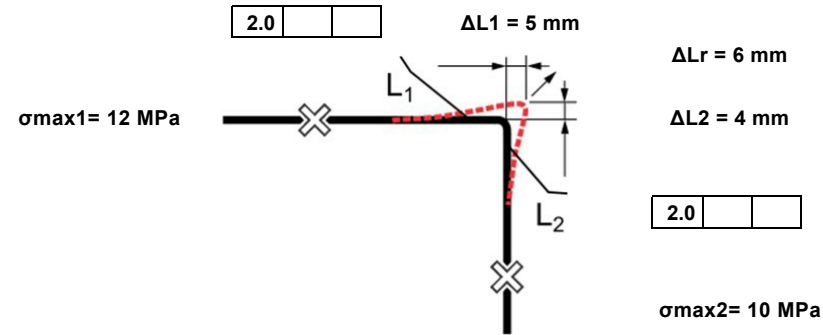
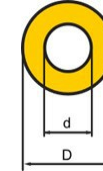
Expansion coefficient, α	0.0000123	°K <sup>-1</sup>
Modulus of elasticity	207,143	MPa

## Soil parameters

Soil density, ρ	19	kN/m <sup>3</sup>
Soil friction angle, φ	32.5	°
Friction coefficient, μ	0.40	

## Example

Nominal size	DN 65		Dist. to anchor point, L <sub>1</sub>	3.61
Steel pipe diameter, d	76.1	mm	Dist. to anchor point, L <sub>2</sub>	3
Wall thickness, s	2.9	mm		
Jacket pipe diameter D	140	mm		



## Multiple calculations

Input				Output													
Node no.	L1	L2	Nominal size	d	D	ΔL1	F1 min	Foam pads for ΔL1			ΔL2	F2 min	Foam pads for ΔL2			ΔLr mm	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
SC10.2	3.61	3	DN 65	76.1	140	5	1.8	2.0			4	1.7	2.0			6	1
SC10.4	3	39.48	DN 65	76.1	140	4	1.7	2.0	1.0		41	2.9	3.0	1.5		41	2
SC11.2	10.79	3.28	DN 65	76.1	140	14	2.2	2.5			4	1.7	2.0			14	1
SC11.4	3.28	14.32	DN 65	76.1	140	4	1.7	2.0			18	2.4	2.5			18	1
SC10.5.2	4.64	2.27	DN 40	48.3	110	6	1.6	2.0			3	1.4	1.5			7	1
SC10.5.3	2.27	1.49	DN 40	48.3	110	3	1.4	1.5			2	1.2	1.5			4	1
SC10.6	6.75	1.49	DN 40	48.3	110	9	1.7	2.0			2	1.2	1.5			9	1
8	10	50	DN 65	76.1	140	13	2.2	2.5	1.5		47	3.0	3.0	1.5		49	2
9	10	50	DN 65	76.1	140	13	2.2	2.5	1.5		47	3.0	3.0	1.5		49	2
10	10	50	DN 65	76.1	140	13	2.2	2.5	1.5		47	3.0	3.0	1.5		49	2

See LOGSTOR Design Manual:

<https://www.logstor.com/documentation>

# Bonded system - Z-bends with foam pads

calculation according to Design Manual chapter 4.5

**LOGSTOR**

## Conditions

Flow temperature, T <sub>f</sub>	120	°C
Installation temperature, T <sub>ins</sub>	10	°C
Soil cover, H	0.9	m
Insulation class	Series 1	

## Steel material properties

Expansion coefficient, $\alpha$	0.0000123	°K <sup>-1</sup>
Modulus of elasticity	207,143	MPa

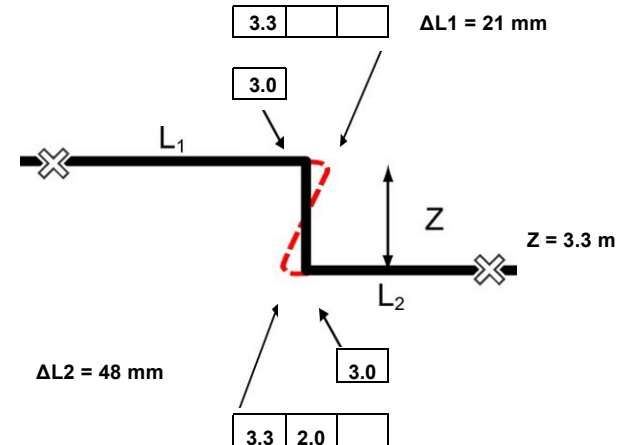
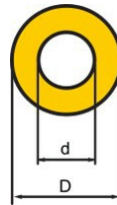
## Soil parameters

Soil density, $\rho$	19	kN/m <sup>3</sup>
Soil friction angle, $\phi$	32.5	°
Friction coefficient, $\mu$	0.40	

## Example

Nominal size	DN 150	
Steel pipe diameter, d	168.3	mm
Wall thickness, s	4.0	mm
Casing diameter D	250	mm

Dist. to virtual anchor, L <sub>1</sub>	16.32	m
Dist. to virtual anchor, L <sub>2</sub>	41.32	m



## Multiple calculations

Input					Output											
Node no.	L1 m	L2 m	Nominal size	d mm	D mm	ΔL1 mm	ΔL2 mm	Z m	Layers for ΔL1	Foam pads for ΔL1			Layers for ΔL2	Foam pads for ΔL2		
										1	2	3		1	2	3
NPS1-NPS2	16.32	41.32	DN 150	168.3	250	21	48	3.3	1	3.3			2	3.3	2.0	
2	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
3	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
4	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
5	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
6	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
7	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
8	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
9	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	
10	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5	

See LOGSTOR Design Manual

<https://www.logstor.com/documentation>

# Bonded system - Z-bends with foam pads

calculation according to Design Manual chapter 4.5

**LOGSTOR**

## Conditions

Flow temperature, T <sub>f</sub>	120	°C
Installation temperature, T <sub>ins</sub>	10	°C
Soil cover, H	0.9	m
Insulation class	Series 1	

## Steel material properties

Expansion coefficient, $\alpha$	0.0000123	°K <sup>-1</sup>
Modulus of elasticity	207,143	MPa

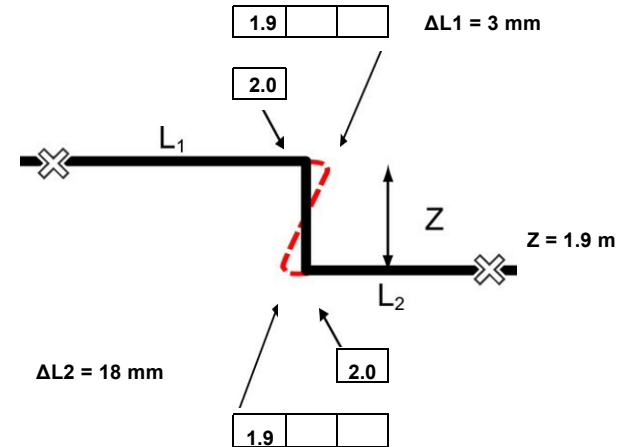
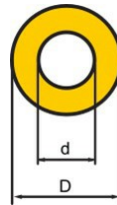
## Soil parameters

Soil density, $\rho$	19	kN/m <sup>3</sup>
Soil friction angle, $\phi$	32.5	°
Friction coefficient, $\mu$	0.40	

## Example

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter D	200	mm

Dist. to virtual anchor, L <sub>1</sub>	2	m
Dist. to virtual anchor, L <sub>2</sub>	14	m



## Multiple calculations

Input					Output												
Node no.	L1 m	L2 m	Nominal size	d mm	D mm	ΔL1 mm	ΔL2 mm	Z m	Layers for ΔL1	Foam pads for ΔL1			Layers for ΔL2	Foam pads for ΔL2			
										1	2	3		1	2	3	
SC3-SC3.4	2	14	DN 100	114.3	200	3	18	1.9	1	1.9			1	1.9			
2	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
3	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
4	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
5	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
6	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
7	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
8	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
9	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		
10	50	100	DN 65	76.1	140	47	56	2.7	2	2.7	1.5		2	2.7	1.5		

See LOGSTOR Design Manual

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# Bonded system - Perpendicular branches with foam pads

calculation according to Design Manual chapter 5.3

**LOGSTOR**

## Conditions

Flow temperature, $T_f$	120	°C
Installation temperature, $T_{ins}$	10	°C
Soil cover, $H$	0.9	m

Insulation class	Series 1
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## Steel material properties

Expansion coefficient, $\alpha$	0.0000123	°K <sup>-1</sup>
Modulus of elasticity	207,143	Mpa

## Soil parameters

Soil density, $\rho$	19	kN/m <sup>3</sup>
Soil friction angle, $\phi$	32.5	°
Friction coefficient, $\mu$ :	0.40	

## Limitations

The calculations apply for branches under the following conditions:

Temperature:

$$T_f \leq 110^\circ\text{C}$$

$$\Delta T \leq 100^\circ\text{C}$$

Soil cover:

$$\text{Main pipe : } 0.6 \leq H \leq 1.0 \text{ m}$$

$$\text{Branch: } H \geq 0.5 \text{ m}$$

## Important

For preheated systems the expansion shall be calculated for the full temperature rise from installation to max operation.

i.e.

$T_{ins}$  = the installation temperature before preheating

$T_f$  = the max operating temperature

## Example

### Main pipe

Nominal size	DN 150
Steel pipe diameter, $d_1$	168.3 mm
Wall thickness, $s_1$	4.0 mm
Casing diameter $D_1$	250 mm

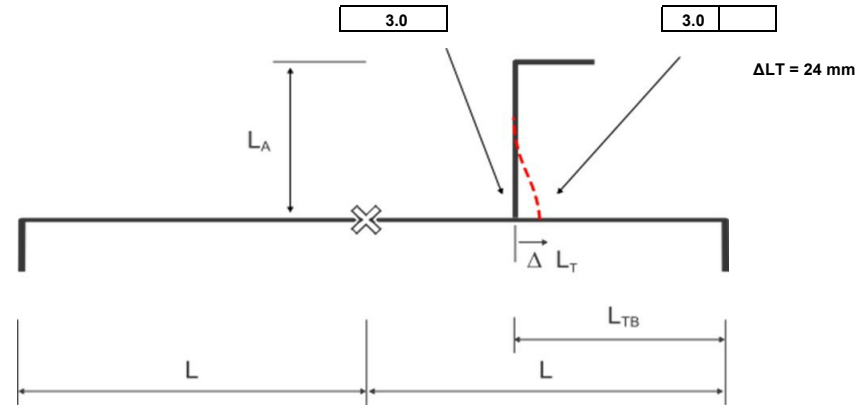
Pipe length, $L$	41.12 m
Dist. branch to bend, $L_{TB}$	18.67 m

Axial stress at branch,  $\sigma_{aT}$  38 Mpa

### Branch pipe

Nominal size	DN 100
Steel pipe diameter, $d_2$	114.3 mm
Wall thickness, $s_2$	3.6 mm
Casing diameter $D_2$	200 mm

$L_{A,max}$	12 m
Branch length, $L_A$	1.9 m



## Multiple calculations

### Input

### Output

Node no.	L		Branch length	Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee	$\Delta T$	$F_{min}$	Foam pads for $\Delta T$		Max branch length	Warnings	
	m	m		Main	Branch	$d_1$	$D_1$	$d_2$	$D_2$				1	2		Main pipe	Branch
SC3	41.12	18.67	1.9	DN 150	DN 100	168.3	250	114.3	200	38	24	2.9	3.0		12		
SC8	40	26.25	2.06	DN 125	DN 40	139.7	225	48.3	110	64	13	1.9	2.0		20		
SC10	19.35	4.66	3.6	DN 100	DN 65	114.3	200	76.1	140	12	18	2.4	2.5		12		
SC11	19.35	1.77	10.79	DN 100	DN 65	114.3	200	76.1	140	5	21	2.5	2.5		12		
SC10.5	39.48	17.52	4.64	DN 65	DN 40	76.1	140	48.3	110	60	19	2.0	2.0		20		
6	100	25	20	DN 80	DN 50	88.9	160	60.3	125	76	33	2.3	2.5	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	160	60.3	125	76	33	2.3	2.5	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	160	60.3	125	76	33	2.3	2.5	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	160	60.3	125	76	33	2.3	2.5	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	160	60.3	125	76	33	2.3	2.5	1.5	20		

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