

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.6	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

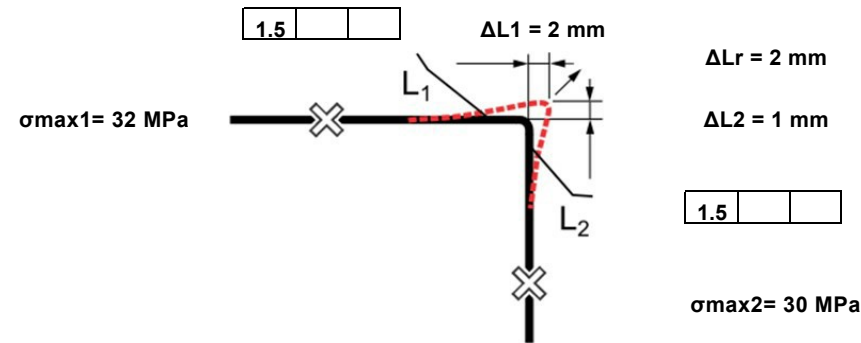
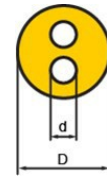
Soil parameters

Soil density, ρ	19	kN/m³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 50	
Steel pipe diameter, d	60.3	mm
Wall thickness, s	2.9	mm
Casing diameter D	225	mm

Dist. to virtual anchor, L_1	2.9	m
Dist. to virtual anchor, L_2	2.1	m



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	
1	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
2	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
3	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
4	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
5	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
6	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
7	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
8	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
9	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
10	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2

See LOGSTOR design manual for TwinPipes:

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

Bonded system - Friction length

calculations according to Design Manual chapter 3

LOGSTOR

Version: 1.0.4

30/6-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

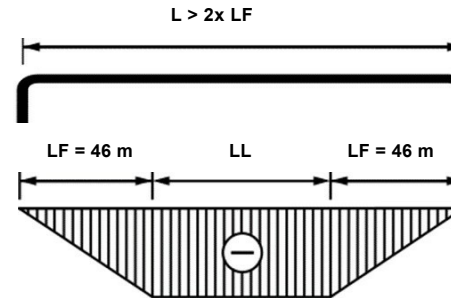
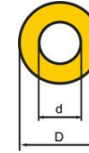
Density of soil, ρ	19.00	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	0.40	

Results

Calculated max axial stress, σ_{max}	163	MPa
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Example

Nominal size	DN 125	
Steel pipe diameter, d	139.7	mm
Wall thickness, s	3.6	mm
Casing diameter, D	250	mm
Soil cover, H	1.2	m
Soil friction, F	5.49	kN/m



$\sigma_{max} = 163 \text{ Mpa}$

Multiple calculations

Pipe dimensions, Series 2					Soil cover, H (m)						Warnings
					0.5		1		1.5		
Nominal size	d mm	s mm	D mm	A mm ²	Soil friction F (kN/m)	Friction length LF (m)	Soil friction F (kN/m)	Friction length LF (m)	Soil friction F (kN/m)	Friction length LF (m)	
DN 20	26.9	2.6	110	198	1.00	32	1.95	17	2.91	11	
DN 25	33.7	2.6	110	254	1.00	41	1.96	21	2.91	14	
DN 32	42.4	2.6	125	325	1.15	46	2.23	24	3.32	16	
DN 40	48.3	2.6	125	373	1.15	53	2.23	27	3.32	18	
DN 50	60.3	2.9	140	523	1.30	66	2.51	34	3.73	23	
DN 65	76.1	2.9	160	667	1.50	73	2.89	38	4.28	26	
DN 80	88.9	3.2	180	862	1.71	82	3.27	43	4.83	29	
DN 100	114.3	3.6	225	1,252	2.18	94	4.13	50	6.08	34	
DN 125	139.7	3.6	250	1,539	2.46	102	4.63	54	6.79	37	
DN 150	168.3	4.0	280	2,065	2.81	120	5.23	64	7.66	44	
DN 200	219.1	4.5	355	3,034	3.68	135	6.76	73	9.84	50	
DN 250	273.0	5.0	450	4,210	4.85	142	8.75	79	12.65	54	
DN 300	323.9	5.6	500	5,600	5.55	165	9.89	93	14.22	64	
DN 350	355.6	5.6	560	6,158	6.34	159	11.20	90	16.05	63	
DN 400	406.4	6.3	630	7,919	7.36	176	12.82	101	18.28	71	
DN 450	457.0	6.3	710	8,920	8.53	171	14.68	99	20.84	70	
DN 500	508.0	6.3	800	9,930	9.89	164	16.82	96	23.76	68	
DN 600	610.0	7.1	900	13,448	11.69	188	19.50	113	27.30	81	

See LOGSTOR Design Manual:

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

Bonded system - Installation length

calculations according to Design Manual chapter 3

LOGSTOR

Version: 1.0.4

30/6-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Insulation class	Series 2	
Allowable axial stress, σ_{all}	190	MPa

$\Delta T = 65 \text{ K} \Rightarrow \sigma_{max} = 163 \text{ Mpa} < \sigma_{all}$
No stress reduction required, use L_f!

Steel material properties

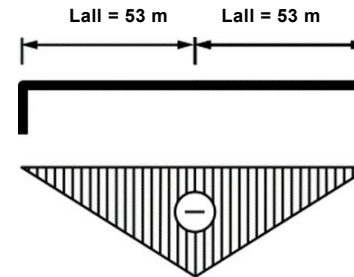
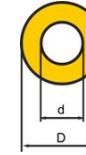
Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

Density of soil, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 125	
Steel pipe diameter, d	139.7	mm
Wall thickness, s	3.6	mm
Casing diameter, D	250	mm
Soil cover, H	1.2	m



$\sigma_{all} = 190.0 \text{ Mpa}$

Multiple calculations

Pipe dimensions, Series 2					Soil cover, H (m)						Warnings
					0.5		1		1.5		
Nominal size	d mm	s mm	D mm	A mm²	Soil friction F (kN/m)	Installation length Lall (m)	Soil friction F (kN/m)	Installation length Lall (m)	Soil friction F (kN/m)	Installation length Lall (m)	
DN 20	26.9	2.6	110	198	1.00	38	1.95	19	2.91	13	
DN 25	33.7	2.6	110	254	1.00	48	1.96	25	2.91	17	
DN 32	42.4	2.6	125	325	1.15	54	2.23	28	3.32	19	
DN 40	48.3	2.6	125	373	1.15	62	2.23	32	3.32	21	
DN 50	60.3	2.9	140	523	1.30	76	2.51	40	3.73	27	
DN 65	76.1	2.9	160	667	1.50	84	2.89	44	4.28	30	
DN 80	88.9	3.2	180	862	1.71	96	3.27	50	4.83	34	
DN 100	114.3	3.6	225	1,252	2.18	109	4.13	58	6.08	39	
DN 125	139.7	3.6	250	1,539	2.46	119	4.63	63	6.79	43	
DN 150	168.3	4.0	280	2,065	2.81	140	5.23	75	7.66	51	
DN 200	219.1	4.5	355	3,034	3.68	156	6.76	85	9.84	59	
DN 250	273.0	5.0	450	4,210	4.85	165	8.75	91	12.65	63	
DN 300	323.9	5.6	500	5,600	5.55	192	9.89	108	14.22	75	
DN 350	355.6	5.6	560	6,158	6.34	185	11.20	105	16.05	73	
DN 400	406.4	6.3	630	7,919	7.36	205	12.82	117	18.28	82	
DN 450	457.0	6.3	710	8,920	8.53	199	14.68	115	20.84	81	
DN 500	508.0	6.3	800	9,930	9.89	191	16.82	112	23.76	79	
DN 600	610.0	7.1	900	13,448	11.69	219	19.50	131	27.30	94	

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.7	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

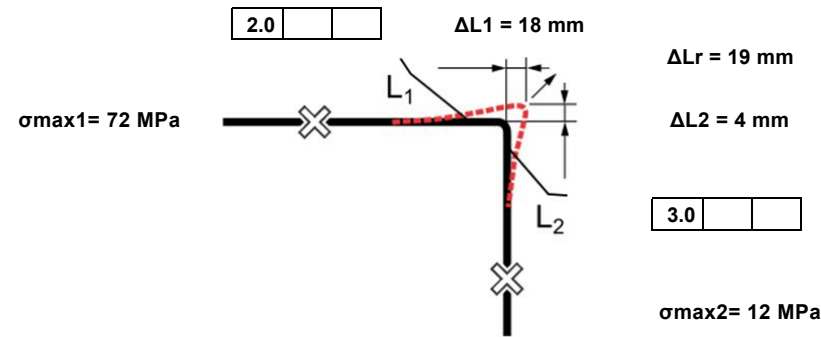
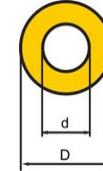
Soil density, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter, D	225	mm

Dist. to anchor point, L₁
Dist. to anchor point, L₂

30.4
5



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
2	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
3	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
4	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
5	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
6	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
7	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
8	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
9	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1
10	10	50	DN 65	76.1	160	7.1	1.9	2			21	2.5	2.5			22	1

calculations according to Design Manual chapter 4

Version: 1.0.4

25/4-2025

Flow temperature, T_f
Installation temperature, T_{ins}
Soil cover, H

Insulation class

Series 2

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity, E	209,714 MPa

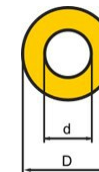
Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	0.40	

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter, D	225	mm

Dist. to anchor point, L1
Dist. to anchor point, L2

2.4

1


$$\sigma_{\max 1}=8 \text{ MPa}$$

2.0		
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 $\Delta L1 = 2 \text{ mm}$ $\Delta L_r = 4 \text{ mm}$ $\Delta L2 = 4 \text{ mm}$

1

 $\sigma_{\max 2} = 16 \text{ MPa}$

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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/25/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.7	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

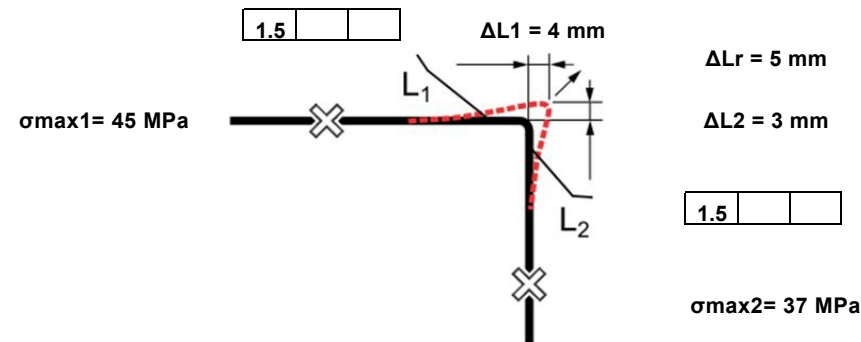
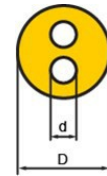
Soil parameters

Soil density, ρ	19	kN/m³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 50	
Steel pipe diameter, d	60.3	mm
Wall thickness, s	2.9	mm
Casing diameter D	225	mm

Dist. to virtual anchor, L_1	7	m
Dist. to virtual anchor, L_2	4.4	m



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	
1	50	100	DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
2			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
3			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
4			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
5			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
6			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
7			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
8			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
9			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
10			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1

See LOGSTOR design manual for TwinPipes:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

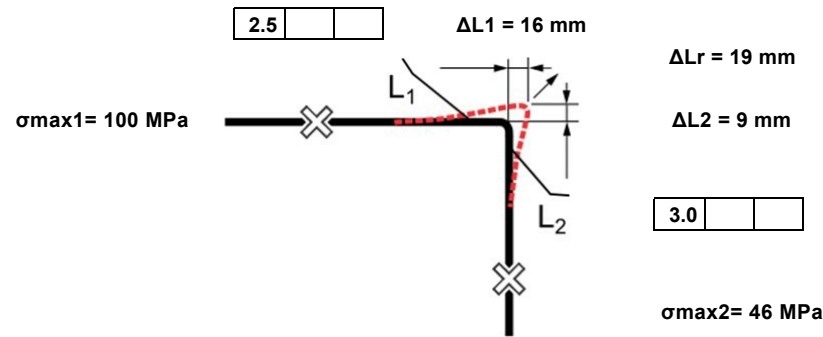
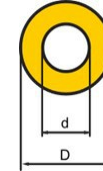
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1	30.4
Dist. to anchor point, L2	14.05



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

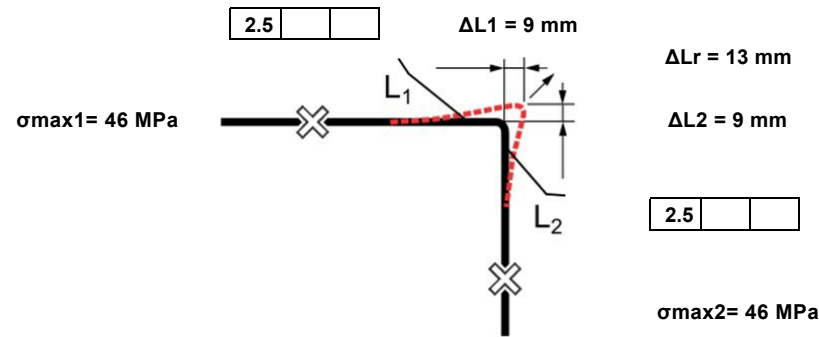
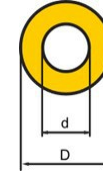
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	14
Dist. to anchor point, L ₂	14.05



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1.1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

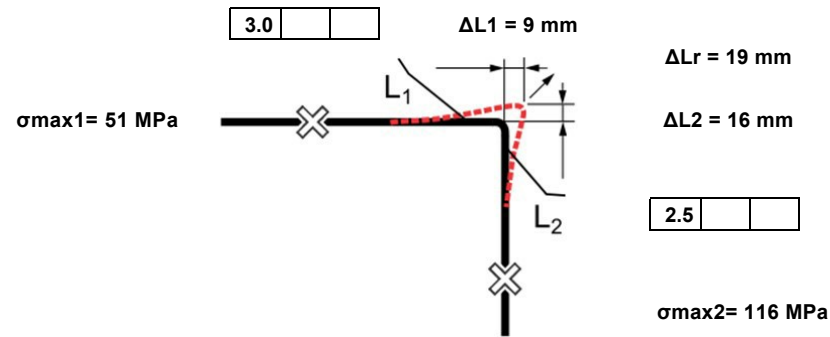
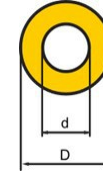
Soil density, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1
Dist. to anchor point, L2

14
32.1



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
2			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
3			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
4			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
5			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
6			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
7			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
8			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
9			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	
10			76.1	160	6.7	1.9	2			13	2.2	2.5			15	1	

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

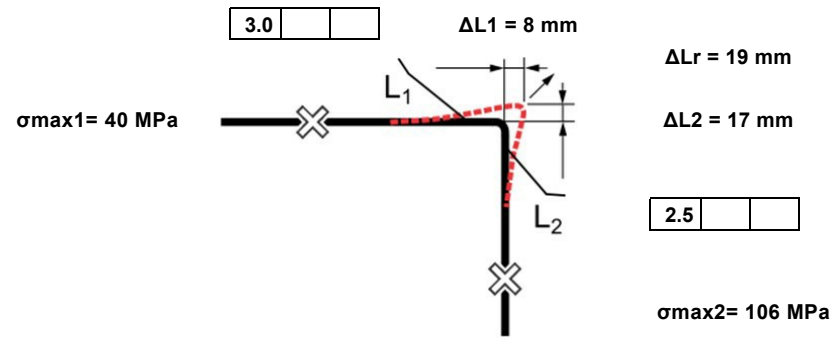
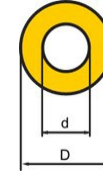
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	12
Dist. to anchor point, L ₂	32.1



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

calculations according to Design Manual chapter 4

Version: 1.0.4

4/6-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.9	m

Insulation class	Series 2
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Steel material properties

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity, E	209,714 MPa

Soil parameters

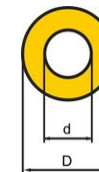
Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter, D	225	mm

Dist. to anchor point, L1
Dist. to anchor point, L2

12
39


$$\sigma_{\max 1}=36 \text{ MPa}$$

3.0		
-----	--	--

$$\Delta L1 = 8 \text{ mm}$$
 $\Delta L_r = 21 \text{ mm}$
$$\Delta L2 = 20 \text{ mm}$$

2.5		
-----	--	--

 $\sigma_{\max 2} = 116 \text{ MPa}$

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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
2			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
3			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
4			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
5			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
6			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
7			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
8			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
9			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
10			DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1.2	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

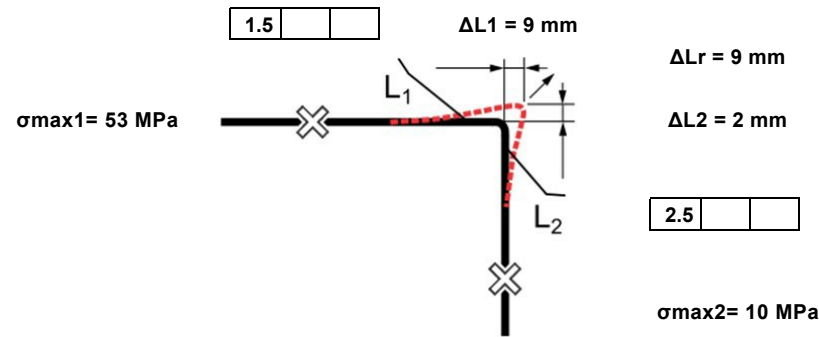
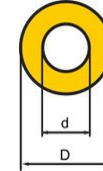
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1	13.5
Dist. to anchor point, L2	2.5



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
2	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
3	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
4	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
5	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
6	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
7	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
8	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
9	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1
10	10	50	DN 65	76.1	160	6.6	1.9	2			12	2.2	2.5			14	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

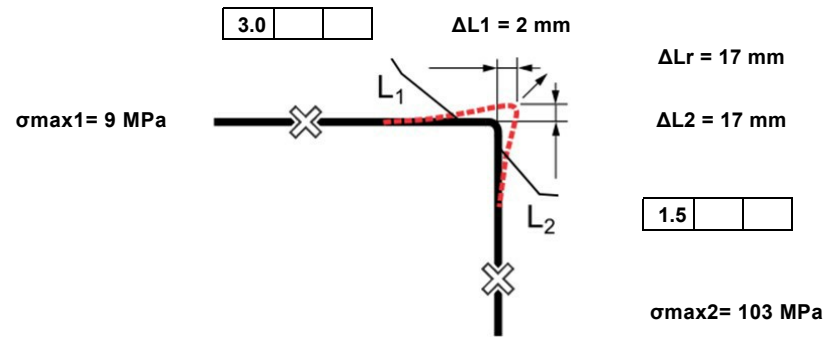
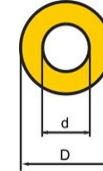
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	2.6
Dist. to anchor point, L ₂	31.2



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

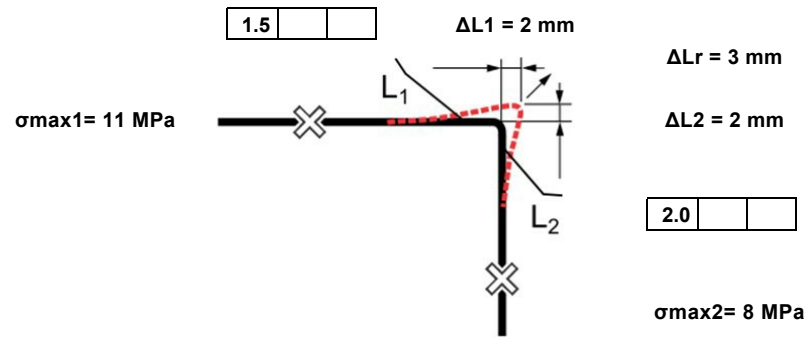
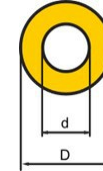
Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

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

Example

Nominal size	DN 80		Dist. to anchor point, L1	3
Steel pipe diameter, d	88.9	mm	Dist. to anchor point, L2	2
Wall thickness, s	3.2	mm		
Casing diameter, D	180	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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/28/2025

Conditions

Flow temperature, T_f °C
 Return temperature, T_r °C
 Installation temperature, T_{ins} °C
 Soil cover, H = m

Insulation class

Steel material properties

Expansion coefficient, α °K⁻¹
 Modulus of elasticity MPa

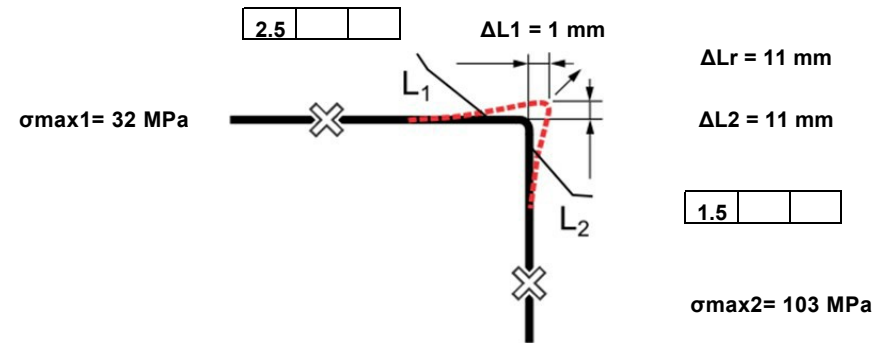
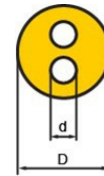
Soil parameters

Soil density, ρ kN/m³
 Soil friction angle, ϕ °
 Friction coefficient, μ :

Example

Nominal size
 Steel pipe diameter, d mm
 Wall thickness, s mm
 Casing diameter D mm

Dist. to virtual anchor, L_1 m
 Dist. to virtual anchor, L_2 m



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	
1	50	100	DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
2			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
3			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
4			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
5			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
6			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
7			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
8			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
9			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1
10			DN 65	76.1	250	12	2.2	2.5			12	2.2	2.5			17	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/28/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.9	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

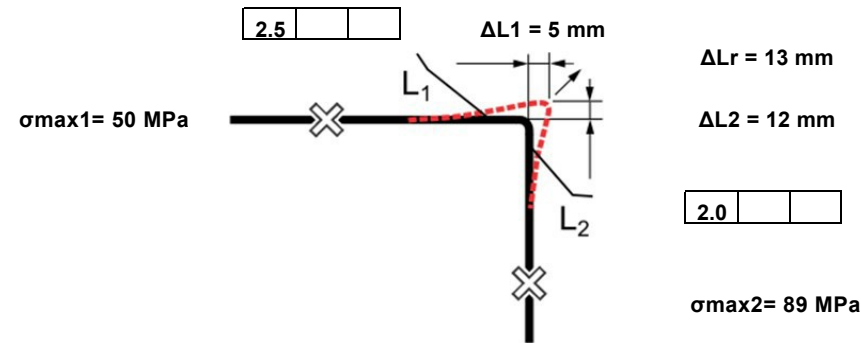
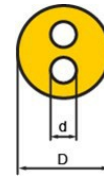
Soil parameters

Soil density, ρ	19	kN/m³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 80	
Steel pipe diameter, d	88.9	mm
Wall thickness, s	3.2	mm
Casing diameter D	280	mm

Dist. to virtual anchor, L_1	9	m
Dist. to virtual anchor, L_2	23.55	m



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	
1	50	100	DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
2			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
3			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
4			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
5			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
6			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
7			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
8			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
9			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1
10			DN 65	76.1	250	15	2.3	2.5			15	2.3	2.5			21	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 6/26/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

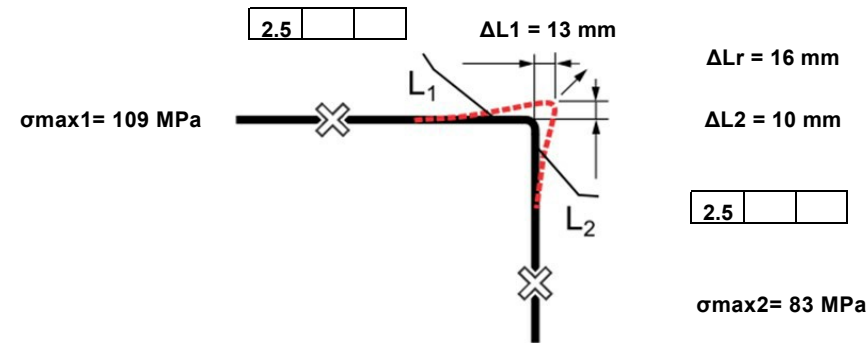
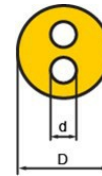
Soil parameters

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

Example

Nominal size	DN 80	
Steel pipe diameter, d	88.9	mm
Wall thickness, s	3.2	mm
Casing diameter D	280	mm

Dist. to virtual anchor, L_1	27.7	m
Dist. to virtual anchor, L_2	19.2	m



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	
1	50	100	DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
2			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
3			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
4			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
5			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
6			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
7			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
8			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
9			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
10			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 10-80° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.5

LOGSTOR

Version: 1.0.0

Date: 6/26/2025

Conditions

Flow temperature, T _f	75	°C
Return temperature, T _r	55	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H =	1.2	m

Insulation class **Series 2**

Soil parameters

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

Important

The calculation only apply when L₂ ≥ 0.2*L₁

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

i.e.

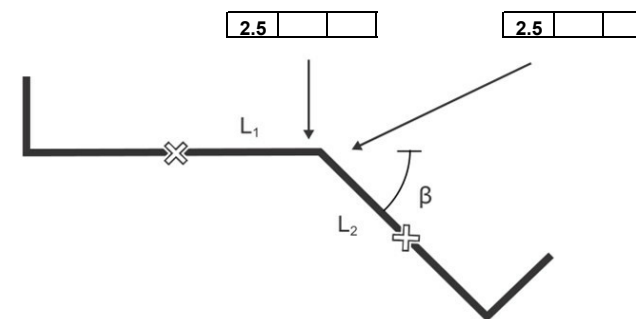
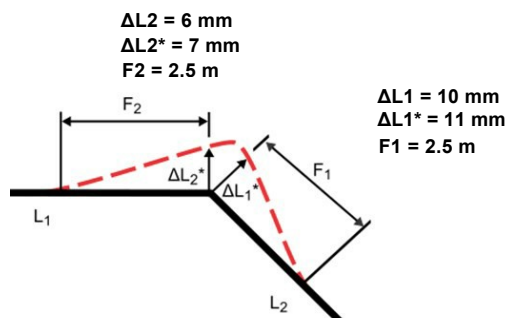
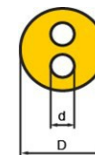
T_{ins} = the installation temperature before preheating

T_f = the max operating temperature

Example

Nominal size	DN 80	
Steel pipe diameter, d	88.9	mm
Wall thickness, s	3.2	mm
Casing diameter D	280	mm

Dist. to virtual anchor, L ₁	19.2	m
Dist. to virtual anchor, L ₂	9.9	m
Bend angle, β	81	°
Max allowed ΔL ₁ +ΔL ₂	129	mm



Multiple calculations

Input					Output														
Node no.	β	L1 m	L2	Nominal size	d	D	Max allowed ΔL1+ΔL2	ΔL1	ΔL1*	ΔL2	ΔL2*	F1 min	Foam pads for ΔL1			F2 min	Foam pads for ΔL2		
	Degrees	m	m		mm	mm	mm	mm	mm	mm	mm	m	1	2	3	m	1	2	3
1	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
2	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
3	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
4	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
5	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
6	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
7	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
8	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
9	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		
10	50	100	20	DN 65	76.1	250	58	11	22	9	21	2.5	2.5			2.5	2.5		

See LOGSTOR design manual for TwinPipes: <https://www.logstor.com/documentation>

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 6/26/2025

Conditions

Flow temperature, T_f °C
 Return temperature, T_r °C
 Installation temperature, T_{ins} °C
 Soil cover, H = m

Insulation class

Steel material properties

Expansion coefficient, α °K⁻¹
 Modulus of elasticity MPa

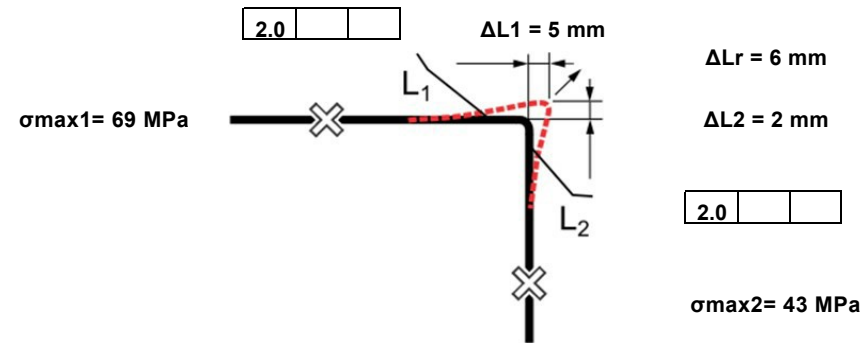
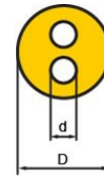
Soil parameters

Soil density, ρ kN/m³
 Soil friction angle, ϕ °
 Friction coefficient, μ :

Example

Nominal size
 Steel pipe diameter, d mm
 Wall thickness, s mm
 Casing diameter D mm

Dist. to virtual anchor, L_1 m
 Dist. to virtual anchor, L_2 m



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	
1	50	100	DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
2			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
3			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
4			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
5			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
6			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
7			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
8			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
9			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1
10			DN 65	76.1	250	9	2.0	2.0			9	2.0	2.0			13	1

See LOGSTOR design manual for TwinPipes:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.75	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

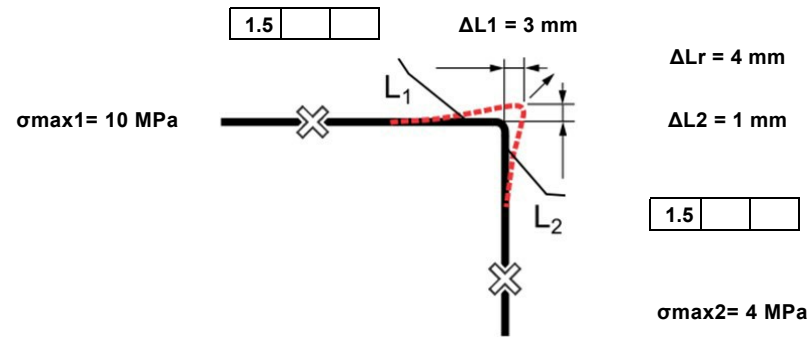
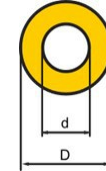
Soil parameters

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

Example

Nominal size	DN 125		
Steel pipe diameter, d	139.7	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	250	mm	

Dist. to anchor point, L ₁	4.3
Dist. to anchor point, L ₂	1.75



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
2	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
3	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
4	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
5	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
6	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
7	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
8	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
9	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1
10	10	50	DN 65	76.1	160	7.0	1.9	2			19	2.4	2.5			21	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.8	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

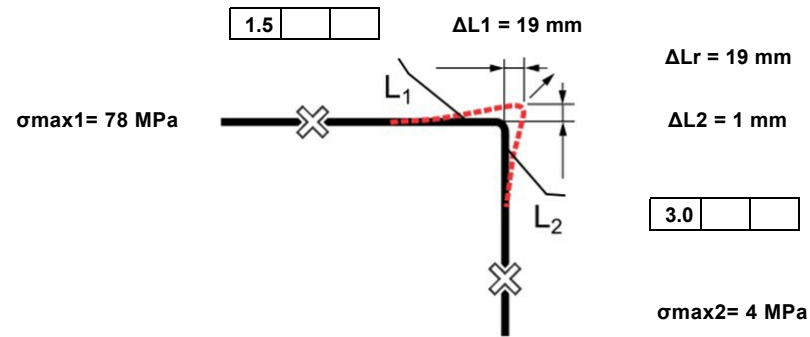
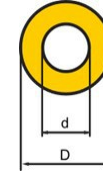
Soil density, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 125		
Steel pipe diameter, d	139.7	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	250	mm	

Dist. to anchor point, L₁
Dist. to anchor point, L₂

31.75
1.75



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
2	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
3	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
4	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
5	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
6	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
7	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
8	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
9	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
10	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.9	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

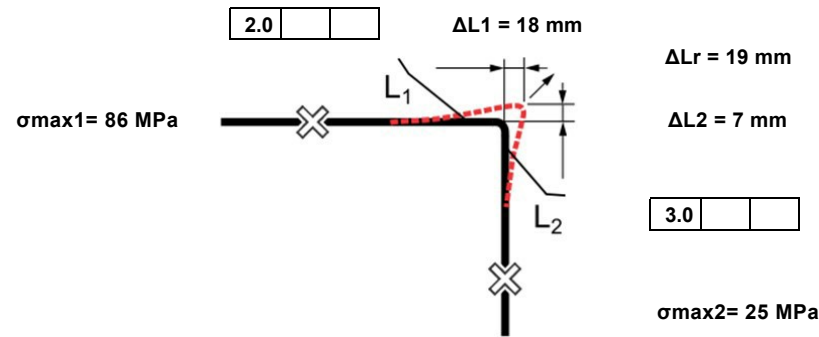
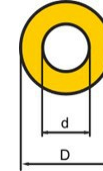
Soil parameters

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

Example

Nominal size	DN 125		
Steel pipe diameter, d	139.7	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	250	mm	

Dist. to anchor point, L ₁	31.75
Dist. to anchor point, L ₂	9.3



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
2	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
3	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
4	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
5	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
6	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
7	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
8	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
9	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
10	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.6	m
Insulation class	Series 2	

Steel material properties

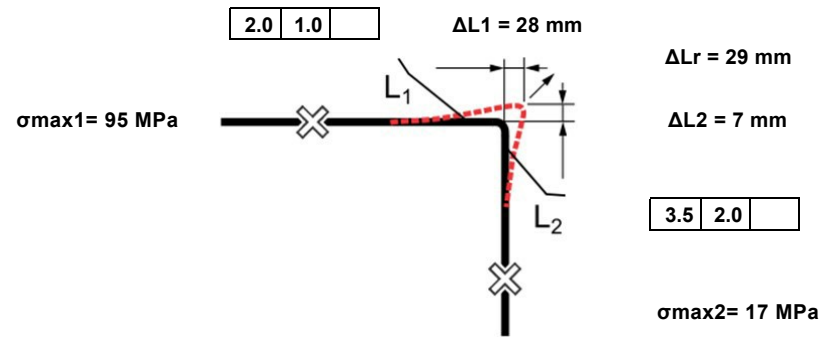
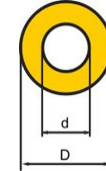
Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

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

Example

Nominal size	DN 125		Dist. to anchor point, L1	50.4
Steel pipe diameter, d	139.7	mm	Dist. to anchor point, L2	9.3
Wall thickness, s	3.6	mm		
Casing diameter, D	250	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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
2	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
3	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
4	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
5	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
6	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
7	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
8	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
9	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
10	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.9	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

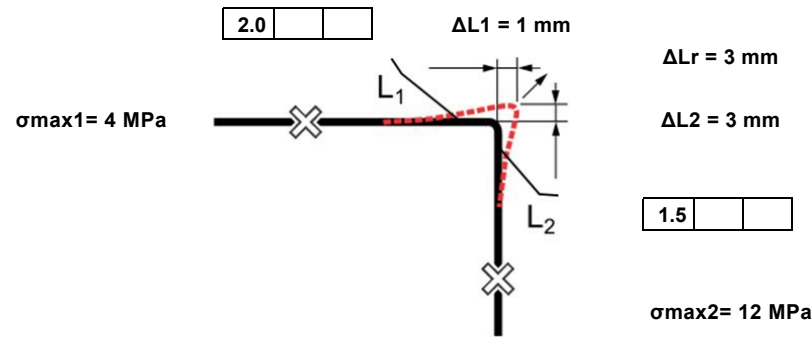
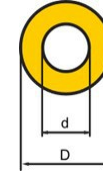
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	1.5
Dist. to anchor point, L ₂	3.9



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
2	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
3	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
4	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
5	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
6	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
7	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
8	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
9	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1
10	10	50	DN 65	76.1	160	6.9	1.9	2			16	2.3	2.5			18	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

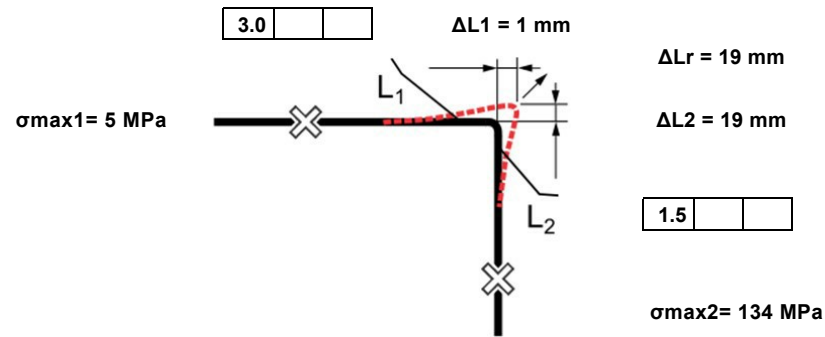
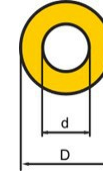
Soil density, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1
Dist. to anchor point, L2

1.5
40.5



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10			DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

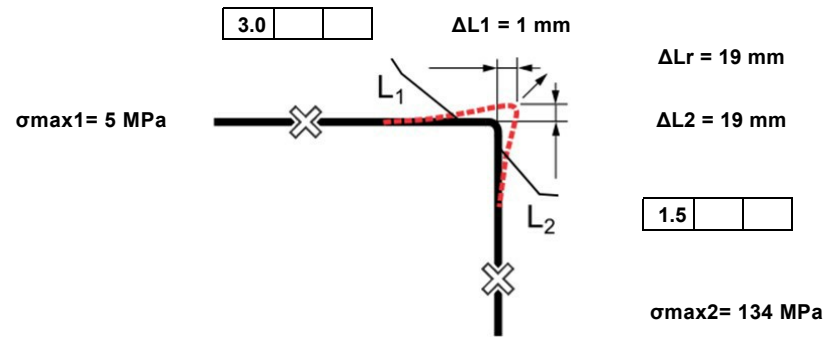
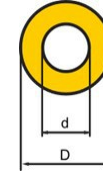
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	1.5
Dist. to anchor point, L ₂	40.5



Multiple calculations

Input				Output													
Node no.	L1	L2	Nominal size	d	D	$\Delta L1$	F1 min	Foam pads for $\Delta L1$			$\Delta L2$	F2 min	Foam pads for $\Delta L2$			ΔLr	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

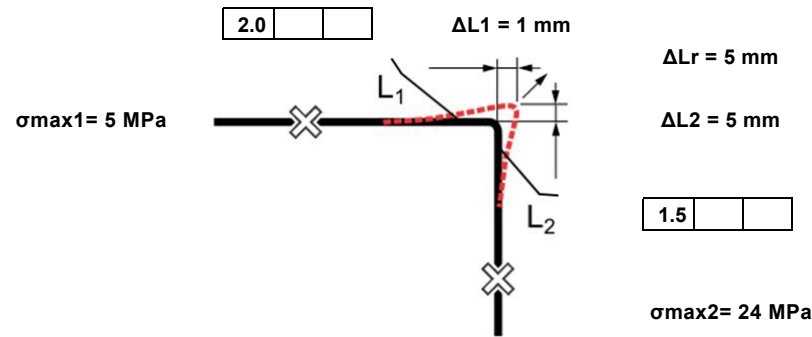
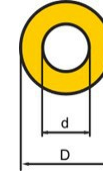
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	1.5
Dist. to anchor point, L ₂	7.35



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

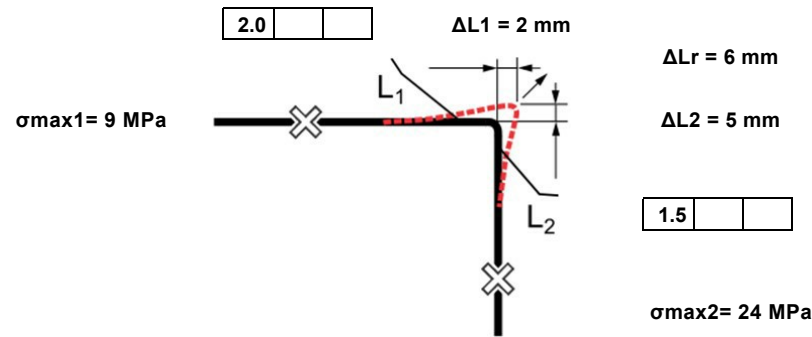
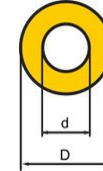
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1	2.6
Dist. to anchor point, L2	7.35



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

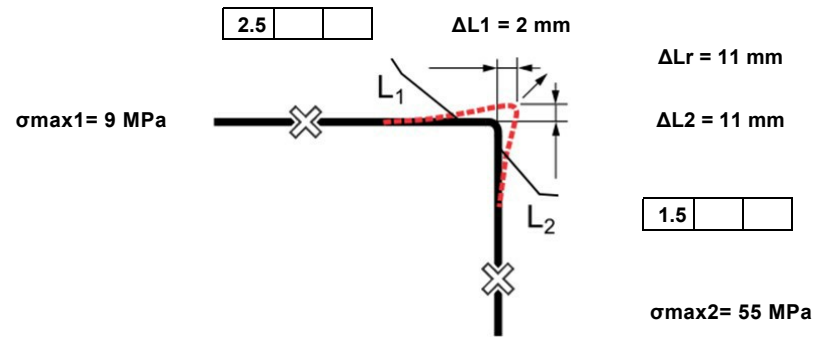
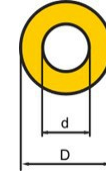
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	2.6
Dist. to anchor point, L ₂	16.7



Multiple calculations

Input				Output													
Node no.	L1	L2	Nominal size	d	D	$\Delta L1$	F1 min	Foam pads for $\Delta L1$			$\Delta L2$	F2 min	Foam pads for $\Delta L2$			ΔLr	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

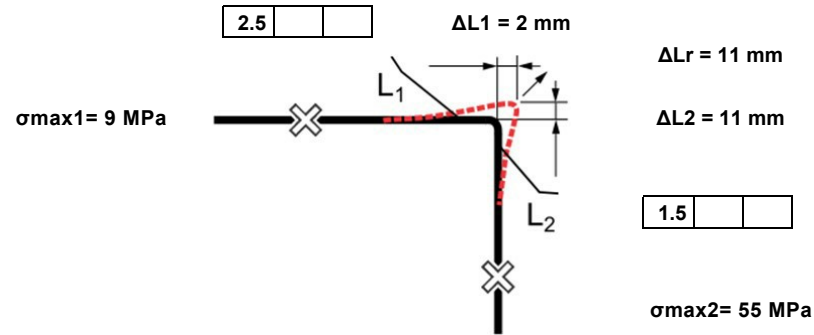
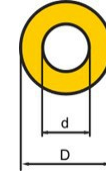
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L ₁	2.8
Dist. to anchor point, L ₂	16.7



Multiple calculations

Input				Output													
Node no.	L1	L2	Nominal size	d	D	$\Delta L1$	F1 min	Foam pads for $\Delta L1$			$\Delta L2$	F2 min	Foam pads for $\Delta L2$			ΔLr	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

calculations according to Design Manual chapter 4

30/4-2025

Flow temperature, T_f
Installation temperature, T_{ins}
Soil cover, H

Series 2

Expansion coefficient, α	0.0000120 $^{\circ}\text{K}^{-1}$
Modulus of elasticity, E	209,714 MPa

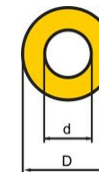
Soil density, ρ	19	kN/m ³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter, D	225	mm

Dist. to anchor point, L1
Dist. to anchor point, L2

2.8

6.75


$$\sigma_{\max 1}=9 \text{ MPa}$$

2.0		
-----	--	--

$$\Delta L1 = 2 \text{ mm}$$
 $\Delta L_r = 5 \text{ mm}$ $\Delta L2 = 5 \text{ mm}$

1

 $\sigma_{\max 2} = 22 \text{ MPa}$

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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f °C
 Return temperature, T_r °C
 Installation temperature, T_{ins} °C
 Soil cover, H = m

Insulation class

Steel material properties

Expansion coefficient, α °K⁻¹
 Modulus of elasticity MPa

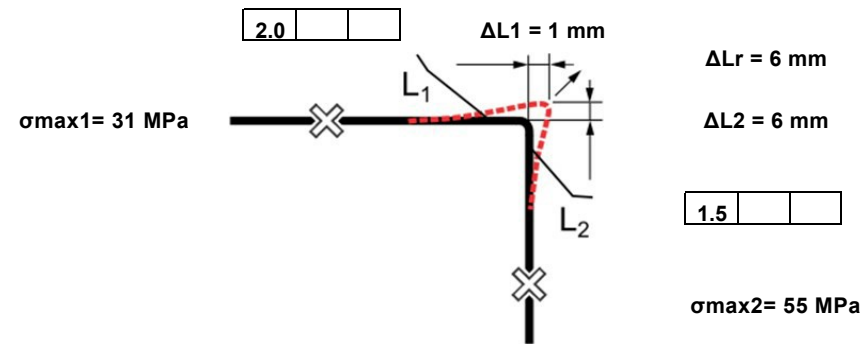
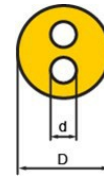
Soil parameters

Soil density, ρ kN/m³
 Soil friction angle, ϕ °
 Friction coefficient, μ :

Example

Nominal size
 Steel pipe diameter, d mm
 Wall thickness, s mm
 Casing diameter D mm

Dist. to virtual anchor, L_1 m
 Dist. to virtual anchor, L_2 m



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	
1	50	100	DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
2			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
3			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
4			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
5			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
6			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
7			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
8			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
9			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1
10			DN 65	76.1	250	18	2.4	2.5			18	2.4	2.5			26	1

See LOGSTOR design manual for TwinPipes:

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

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.6	m

Insulation class **Series 2**

Steel material properties

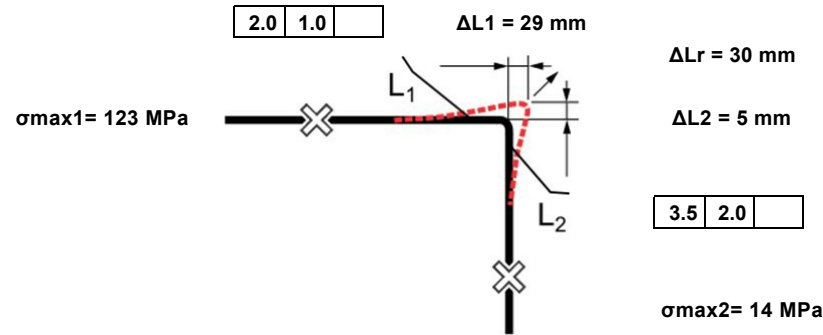
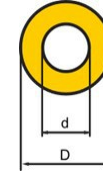
Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

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

Example

Nominal size	DN 100		Dist. to anchor point, L1	60
Steel pipe diameter, d	114.3	mm	Dist. to anchor point, L2	6.75
Wall thickness, s	3.6	mm		
Casing diameter, D	225	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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
2			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
3			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
4			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
5			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
6			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
7			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
8			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
9			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1
10			DN 65	76.1	160	7.2	1.9	2			23	2.5	2.5			24	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1.1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

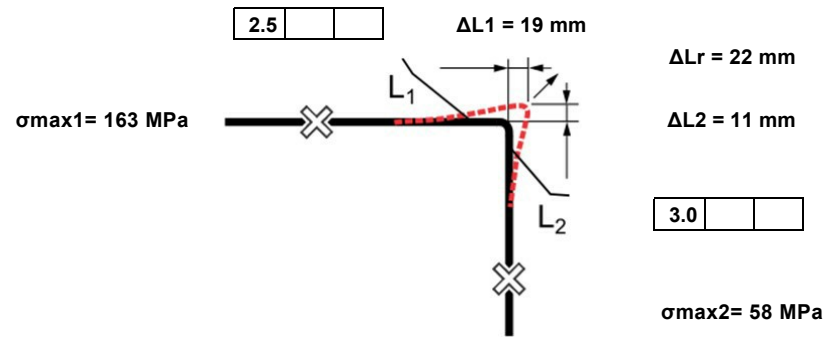
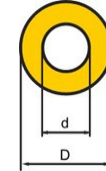
Soil parameters

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

Example

Nominal size	DN 125		
Steel pipe diameter, d	139.7	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	250	mm	

Dist. to anchor point, L1	50.4
Dist. to anchor point, L2	17.7



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
2	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
3	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
4	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
5	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
6	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
7	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
8	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
9	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1
10	10	50	DN 65	76.1	160	6.7	1.9	2			13	2.2	2.5			15	1

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

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

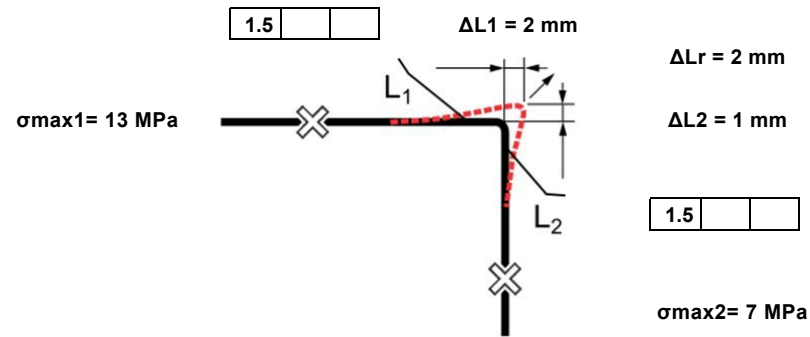
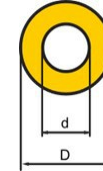
Soil parameters

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

Example

Nominal size	DN 50		
Steel pipe diameter, d	60.3	mm	
Wall thickness, s	2.9	mm	
Casing diameter, D	140	mm	

Dist. to anchor point, L1	2.8
Dist. to anchor point, L2	1.5



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

See LOGSTOR Design Manual:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.8	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

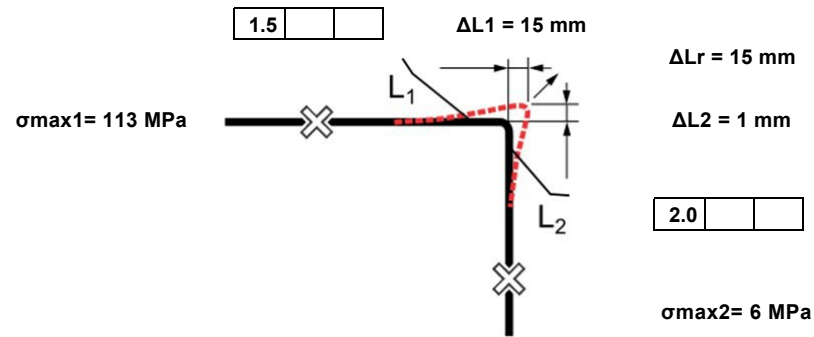
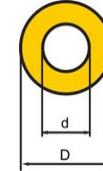
Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 50		
Steel pipe diameter, d	60.3	mm	
Wall thickness, s	2.9	mm	
Casing diameter, D	140	mm	

Dist. to anchor point, L₁
Dist. to anchor point, L₂

29.1
1.5



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
2	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
3	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
4	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
5	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
6	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
7	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
8	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
9	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1
10	10	50	DN 65	76.1	160	7.0	1.9	2			18	2.4	2.5			19	1

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.8	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

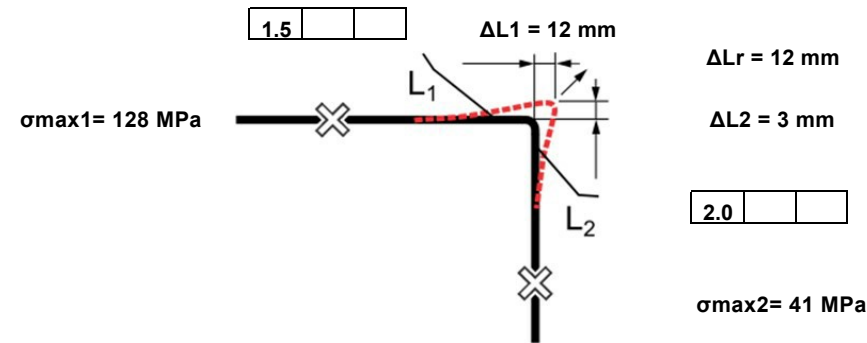
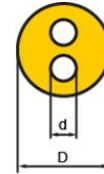
Soil parameters

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

Example

Nominal size	DN 40	
Steel pipe diameter, d	48.3	mm
Wall thickness, s	2.6	mm
Casing diameter D	180	mm

Dist. to virtual anchor, L_1	29.1	m
Dist. to virtual anchor, L_2	4.4	m



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	
1	50	100	DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
2			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
3			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
4			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
5			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
6			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
7			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
8			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
9			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
10			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1

See LOGSTOR design manual for TwinPipes:

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

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

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1	m
Insulation class	Series 2	

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

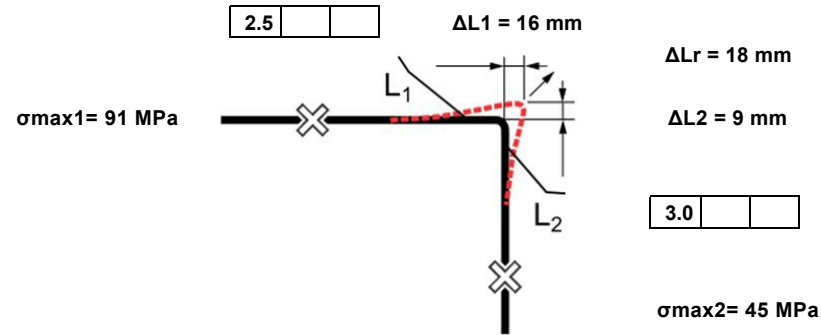
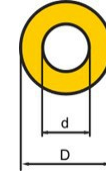
Soil parameters

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

Example

Nominal size	DN 100		
Steel pipe diameter, d	114.3	mm	
Wall thickness, s	3.6	mm	
Casing diameter, D	225	mm	

Dist. to anchor point, L1	27.6
Dist. to anchor point, L2	13.6



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	Number of layers
	m	m		mm	mm	mm	m	1	2	3	mm	m	1	2	3	mm	
1	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
2	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
3	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
4	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
5	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
6	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
7	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
8	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
9	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1
10	10	50	DN 65	76.1	160	6.8	1.9	2			15	2.3	2.5			16	1

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

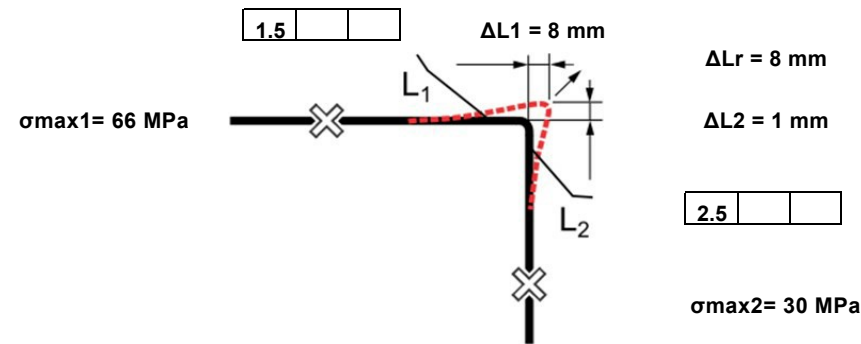
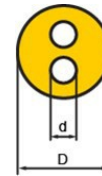
Soil parameters

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

Example

Nominal size	DN 80	
Steel pipe diameter, d	88.9	mm
Wall thickness, s	3.2	mm
Casing diameter D	280	mm

Dist. to virtual anchor, L_1	13.6	m
Dist. to virtual anchor, L_2	1.5	m



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	
1	50	100	DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
2			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
3			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
4			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
5			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
6			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
7			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
8			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
9			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1
10			DN 65	76.1	250	13	2.2	2.5			13	2.2	2.5			19	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1.7	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

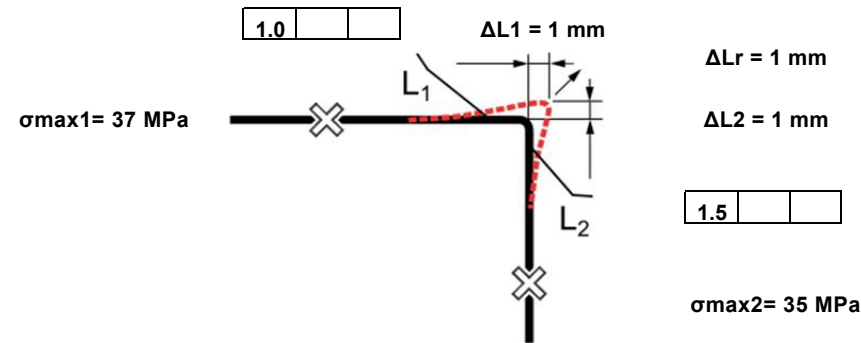
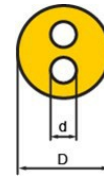
Soil parameters

Soil density, ρ	19	kN/m³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 50	
Steel pipe diameter, d	60.3	mm
Wall thickness, s	2.9	mm
Casing diameter D	225	mm

Dist. to virtual anchor, L_1	1.8	m
Dist. to virtual anchor, L_2	1.5	m



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	
1	50	100	DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
2			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
3			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
4			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
5			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
6			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
7			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
8			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
9			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1
10			DN 65	76.1	250	8	2.0	2.0			8	2.0	2.0			11	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T _f	75	°C
Return temperature, T _r	55	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H =	3	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

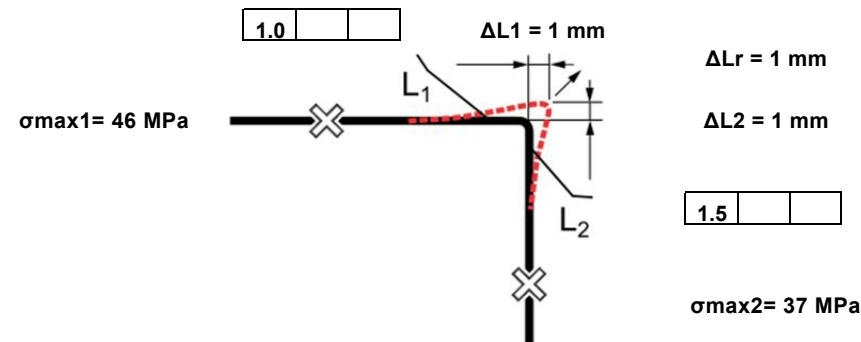
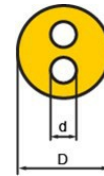
Soil parameters

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

Example

Nominal size	DN 50	
Steel pipe diameter, d	60.3	mm
Wall thickness, s	2.9	mm
Casing diameter D	225	mm

Dist. to virtual anchor, L ₁	1.8	m
Dist. to virtual anchor, L ₂	1	m



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	
1	50	100	DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
2			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
3			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
4			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
5			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
6			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
7			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
8			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
9			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1
10			DN 65	76.1	250	5	1.7	2.0			5	1.7	2.0			6	1

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f °C
 Return temperature, T_r °C
 Installation temperature, T_{ins} °C
 Soil cover, H = m

Insulation class

Steel material properties

Expansion coefficient, α °K⁻¹
 Modulus of elasticity MPa

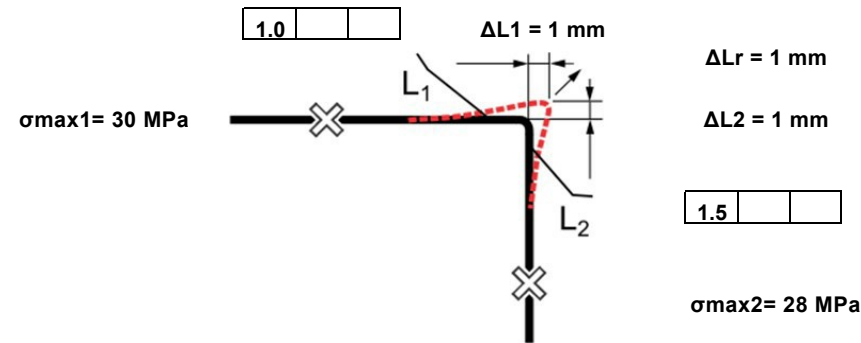
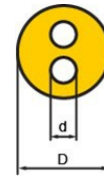
Soil parameters

Soil density, ρ kN/m³
 Soil friction angle, ϕ °
 Friction coefficient, μ :

Example

Nominal size
 Steel pipe diameter, d mm
 Wall thickness, s mm
 Casing diameter D mm

Dist. to virtual anchor, L_1 m
 Dist. to virtual anchor, L_2 m



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	
1	50	100	DN 65	76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2
2			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
3			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
4			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
5			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
6			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
7			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
8			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
9			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	
10			76.1	250	20	2.4	2.5	1.5		21	2.5	2.5	1.5		29	2	

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - 10-80° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.5

LOGSTOR

Version: 1.0.0

Date: 6/4/2025

Conditions

Flow temperature, T _f	75	°C
Return temperature, T _r	55	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H =	1.9	m

Insulation class **Series 2**

Soil parameters

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

Important

The calculation only apply when L₂ ≥ 0,2*L₁

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

i.e.

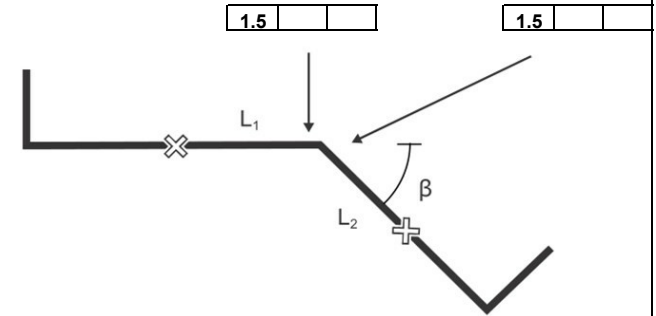
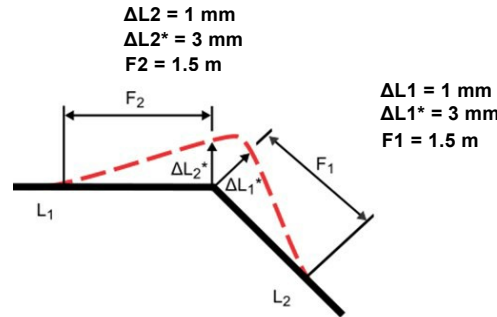
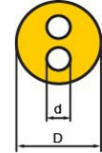
T_{ins} = the installation temperature before preheating

T_f = the max operating temperature

Example

Nominal size	DN 40	
Steel pipe diameter, d	48.3	mm
Wall thickness, s	2.6	mm
Casing diameter D	180	mm

Dist. to virtual anchor, L ₁	1.8	m
Dist. to virtual anchor, L ₂	1.8	m
Bend angle, β	38	°
Max allowed ΔL ₁ +ΔL ₂	37	mm



Multiple calculations

Input					Output														
Node no.	β	L1 m	L2	Nominal size	d	D	Max allowed ΔL1+ΔL2	ΔL1	ΔL1*	ΔL2	ΔL2*	F1 min	Foam pads for ΔL1			F2 min	Foam pads for ΔL2		
	Degrees	m	m		mm	mm	mm	mm	mm	mm	mm	m	1	2	3	m	1	2	3
1	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
2	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
3	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
4	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
5	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
6	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
7	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
8	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
9	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		
10	50	100	20	DN 65	76.1	250	58	7	15	7	15	2.3	2.5			2.3	2.5		

See LOGSTOR design manual for TwinPipes: <https://www.logstor.com/documentation>

TwinPipes - 80-90° L-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 6/26/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.8	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

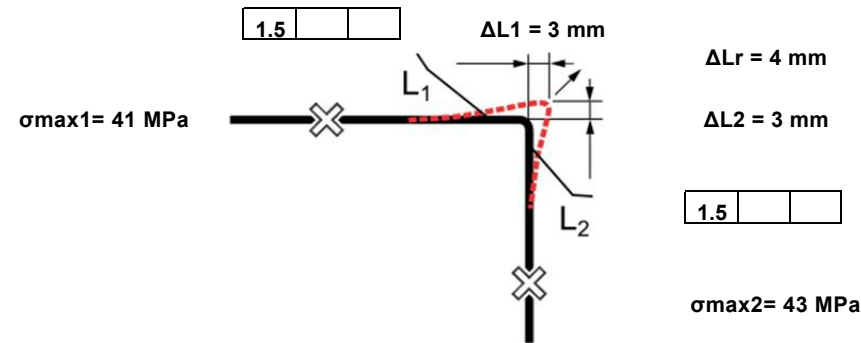
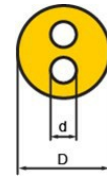
Soil parameters

Soil density, ρ	19	kN/m³
Soil friction angle, ϕ	32.5	°
Friction coefficient, μ	0.40	

Example

Nominal size	DN 40	
Steel pipe diameter, d	48.3	mm
Wall thickness, s	2.6	mm
Casing diameter D	180	mm

Dist. to virtual anchor, L_1	4.6	m
Dist. to virtual anchor, L_2	5	m



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	
1	50	100	DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
2			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
3			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
4			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
5			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
6			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
7			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
8			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
9			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1
10			DN 65	76.1	250	16	2.3	2.5			16	2.3	2.5			23	1

See LOGSTOR design manual for TwinPipes:

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

Bonded system - Z-bends with foam pads

calculations according to Design Manual chapter 4

LOGSTOR

Version: 1.0.4

25/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.9	m
Insulation class	Series 2	

Steel

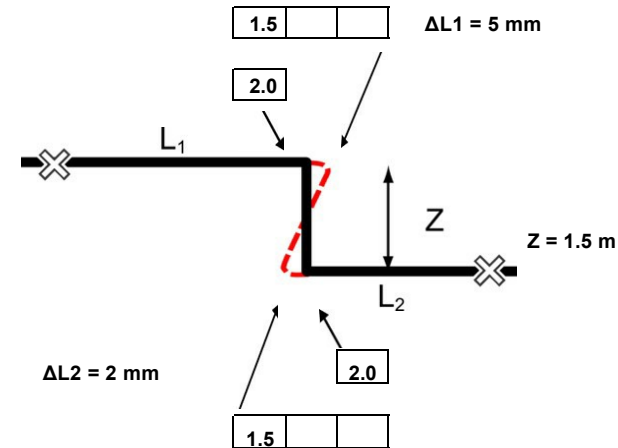
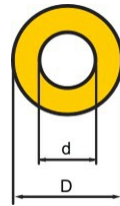
Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

Soil parameters

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

Example

Nominal size	DN 100		Dist. to anchor point, L_1	7	m
Steel pipe diameter, d	114.3	mm	Dist. to anchor point, L_2	2.4	m
Wall thickness, s	3.6	mm			
Casing diameter, D	225	mm			



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
1	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
2	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
3	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
4	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
5	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
6	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
7	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
8	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
9	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		
10	50	100	DN 65	76.1	160	16	16	2.1	1	2.1			1	2.1		

See LOGSTOR Design Manual:

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

TwinPipes - Z-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 6/26/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.6	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

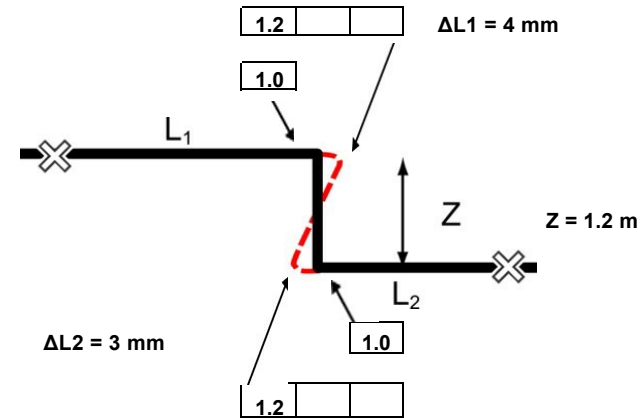
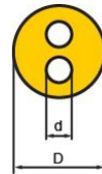
Soil parameters

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

Example

Nominal size	DN 50
Steel pipe diameter, d	60.3 mm
Wall thickness, s	2.9 mm
Casing diameter D	225 mm

Dist. to virtual anchor, L_1	7	m
Dist. to virtual anchor, L_2	4.25	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
1	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
2	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
3	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
4	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
5	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
6	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
7	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
8	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
9	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		
10	50	100	DN 65	76.1	250	20	21	2.2	1	2.2			1	2.2		

See LOGSTOR design manual for TwinPipes:

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

TwinPipes - Z-bends with foam pads

calculation according to "Design with TwinPipes" chapter 4.4

LOGSTOR

Version: 1.0.0

Date: 6/4/2025

Conditions

Flow temperature, T _f	75	°C
Return temperature, T _r	55	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	1.46	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	MPa

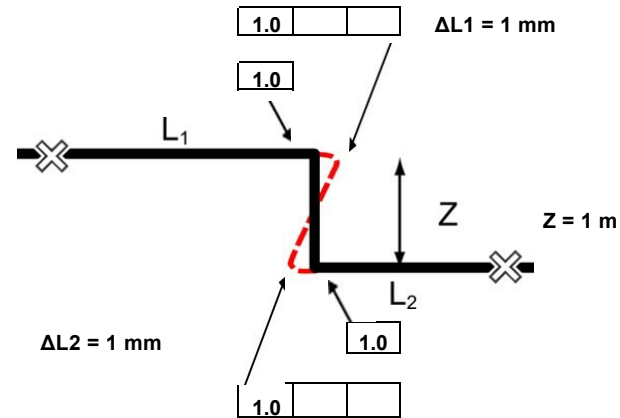
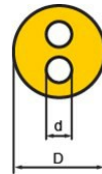
Soil parameters

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

Example

Nominal size	DN 40
Steel pipe diameter, d	48.3 mm
Wall thickness, s	2.6 mm
Casing diameter D	180 mm

Dist. to virtual anchor, L ₁	1.9	m
Dist. to virtual anchor, L ₂	1.8	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
1	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
2	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
3	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
4	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
5	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
6	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
7	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
8	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
9	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		
10	50	100	DN 65	76.1	250	9	9	1.8	1	1.8			1	1.8		

See LOGSTOR design manual for TwinPipes:

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

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

25/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 100
Steel pipe diameter, d_1	114.3 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	225 mm

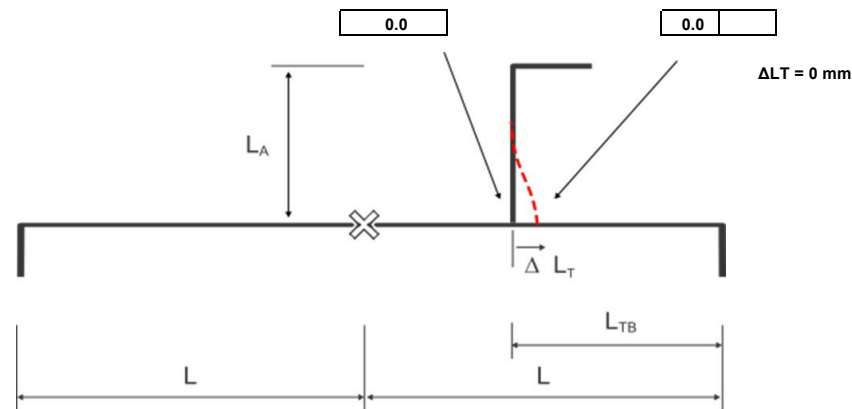
Pipe length, L	5 m
Dist. branch to bend, L_{TB}	4.4 m

Axial stress at branch, σ_{aT} 15 Mpa

Branch pipe

Nominal size	DN 50
Steel pipe diameter, d_2	60.3 mm
Wall thickness, s_2	2.9 mm
Casing diameter, D_2	140 mm

$L_{A,max}$	20 m
Branch length, L_A	8.3 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	ΔL_T mm	F_{min} m	Foam pads for ΔL_T		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	LA m	Main Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.6	m

Insulation class	Series 2
------------------	----------

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity, E	209,714 Mpa

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

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:

Main pipe: $0.6 \leq H \leq 1.0$ m

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

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

i.e.

Tins = installation temperature before preheating

T_f = max operating temperature

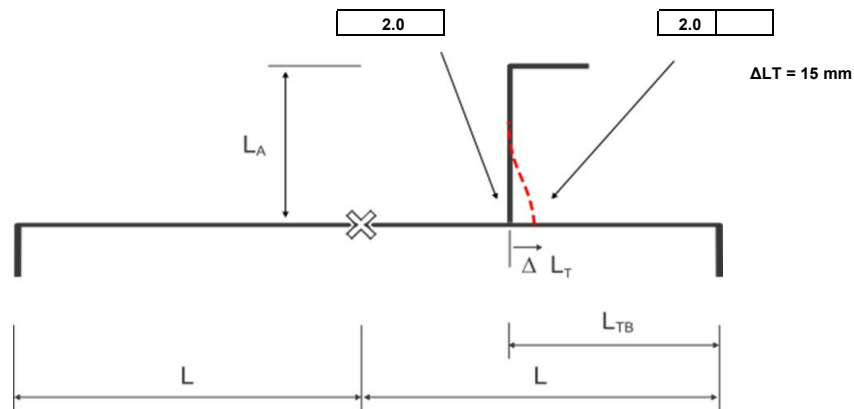
Nominal size	DN 100	
Steel pipe diameter, d1	114.3	mm
Wall thickness, s1	3.6	mm
Casing diameter, D1	225	mm

Pipe length, L	30.4	m
Dist. branch to bend, LTB	5.3	m

Axial stress at branch, σ_{aT}	11	Mpa
---------------------------------------	----	-----

Nominal size	DN 50	
Steel pipe diameter, d2	60.3	mm
Wall thickness, s2	2.9	mm
Casing diameter, D2	140	mm

LA,max	20	m
Branch length, LA	8.5	m



Multiple calculations

Input						Output											
Node no.			Branch length	Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee			Foam pads for ΔLT		Max branch length	Warnings	
	L	LTB		Main	Branch	d1	D1	d2	D2		σaT	ΔLT	Fmin			La,max	Main
	m	m	m			mm	mm	mm	mm	Mpa	mm	m	1	2	m		
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0		20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

26/6-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1.1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 100
Steel pipe diameter, d_1	114.3 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	225 mm

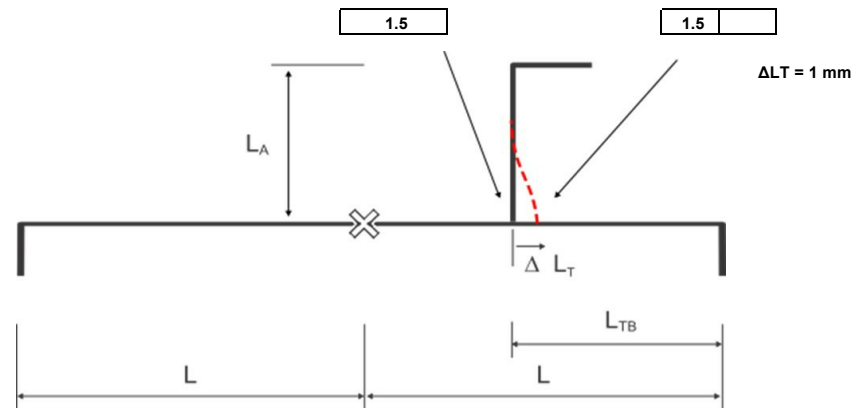
Pipe length, L	31.2 m
Dist. branch to bend, L_{TB}	27.4 m

Axial stress at branch, σ_{aT} 99 Mpa

Branch pipe

Nominal size	DN 80
Steel pipe diameter, d_2	88.9 mm
Wall thickness, s_2	3.2 mm
Casing diameter, D_2	180 mm

$L_{A,max}$	12 m
Branch length, L_A	6.1 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT}	ΔL_T	F_{min}	Foam pads for ΔL_T		Max branch length $L_{a,max}$	Warnings	
	L	LTB	Main	Branch	d1	D1	d2	D2				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	104	2	1.2	1.5	20		

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1.1	m

Insulation class	Series 2
------------------	----------

Steel material properties

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity	209,714 Mpa

Soil parameters

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

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 80	
Steel pipe diameter, d1	88.9	mm
Wall thickness, s1	3.2	mm
Casing diameter D1	280	mm

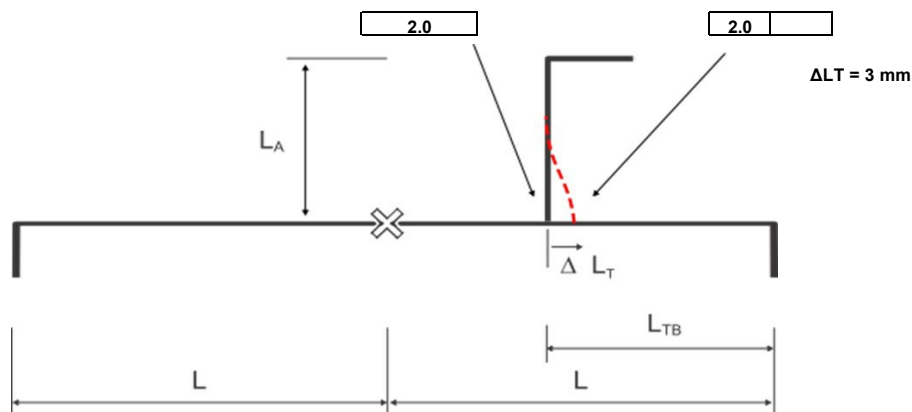
Pipe length, L	23.55	m
Dist. branch to bend, LTB	15.4	m

Axial stress at branch, σ_{aT}	76	Mpa
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Branch pipe

Nominal size	DN 80	
Steel pipe diameter, d2	88.9	mm
Wall thickness, s2	3.2	mm
Casing diameter D2	280	mm

LA,max	33	m
Branch length, LA	7.2	m



Multiple calculations

Input						Output											
Node no.	L m	LTB m	Branch length LA m	Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee $\sigma_a T$ Mpa	ΔT mm	Fmin m	Foam pads for ΔT		Max branch length La,max m	Warnings	
				Main	Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main pipe	Branch
1	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
2	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
3	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
4	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
5	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
6	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
7	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
8	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
9	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		
10	100	25	20	DN 80	DN 50	88.9	280	60.3	225	107	2	1.2	1.5		26		

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.9	m

Insulation class	Series 2
------------------	----------

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity, E	209,714 Mpa

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

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

Main pipe: $0.6 \leq H \leq 1.0$ m
Branch: $H \geq 0.5$ m

T_{ins} = installation temperature before preheating
 T_f = max operating temperature

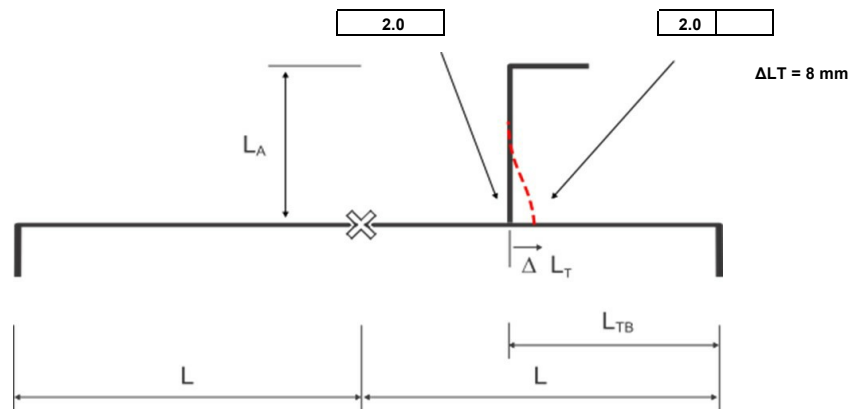
Nominal size	DN 125	
Steel pipe diameter, d1	139.7	mm
Wall thickness, s1	3.6	mm
Casing diameter, D1	250	mm

Pipe length, L	31.8	m
Dist. branch to bend, LTB	14.8	m

Axial stress at branch, σ_{aT} 40 Mpa

Nominal size	DN 40	
Steel pipe diameter, d2	48.3	mm
Wall thickness, s2	2.6	mm
Casing diameter, D2	125	mm

LA,max	20	m
Branch length, LA	9.2	m



Multiple calculations

Input						Output											
Node no.			Branch length	Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee			Foam pads for ΔLT		Max branch length	Warnings	
	L	LTB		Main	Branch	d1	D1	d2	D2		σaT	ΔLT	Fmin				La,max
	m	m	m			mm	mm	mm	mm	Mpa	mm	m	1	2	m		
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	86	4	1.4	1.5		20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

28/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.6	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 125
Steel pipe diameter, d_1	139.7 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	250 mm

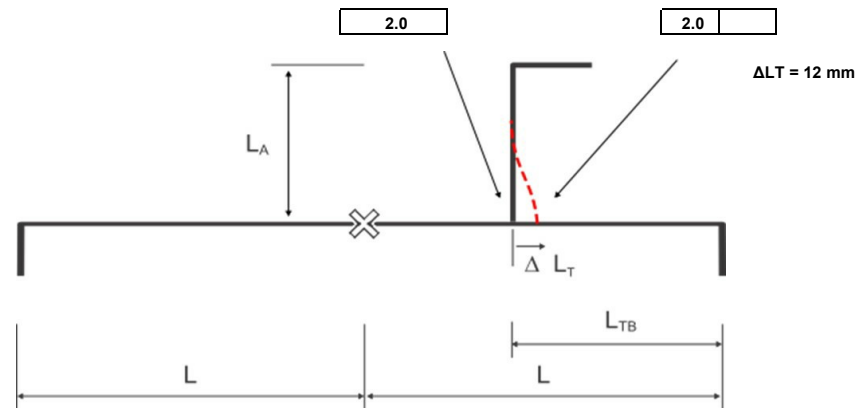
Pipe length, L	31.75 m
Dist. branch to bend, L_{TB}	11.1 m

Axial stress at branch, σ_{aT} 21 Mpa

Branch pipe

Nominal size	DN 50
Steel pipe diameter, d_2	60.3 mm
Wall thickness, s_2	2.9 mm
Casing diameter, D_2	140 mm

$L_{A,max}$	20 m
Branch length, L_A	5.7 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	ΔT mm	F_{min} m	Foam pads for ΔT		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	LA m	Main Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	59	11	1.8	2.0	20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

28/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.8	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 125
Steel pipe diameter, d_1	139.7 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	250 mm

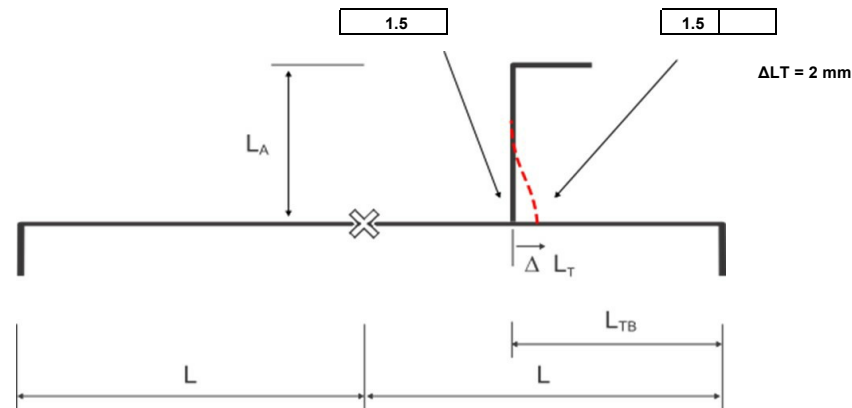
Pipe length, L	9.3 m
Dist. branch to bend, L_{TB}	6.9 m

Axial stress at branch, σ_{aT} 17 Mpa

Branch pipe

Nominal size	DN 40
Steel pipe diameter, d_2	48.3 mm
Wall thickness, s_2	2.6 mm
Casing diameter, D_2	125 mm

$L_{A,max}$	20 m
Branch length, L_A	11.5 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	ΔT mm	F_{min} m	Foam pads for ΔT		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	LA m	Main Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

28/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.8	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 125
Steel pipe diameter, d_1	139.7 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	250 mm

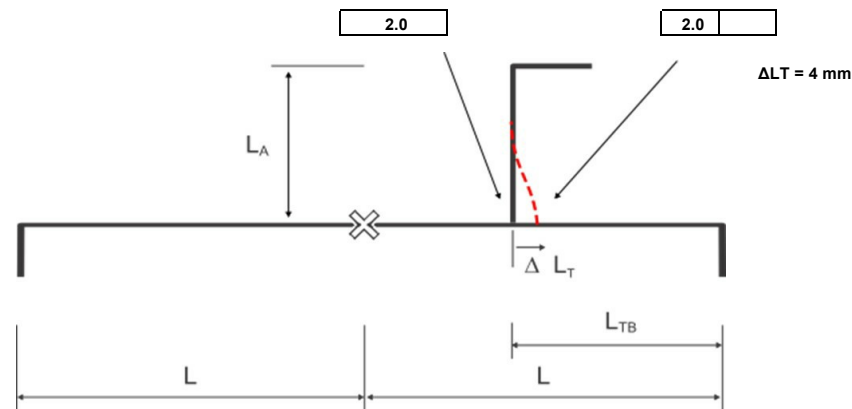
Pipe length, L	50.4 m
Dist. branch to bend, L_{TB}	34.7 m

Axial stress at branch, σ_{aT} 85 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	225 mm

$L_{A,max}$	12 m
Branch length, L_A	7.8 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	$\Delta L T$ mm	F_{min} m	Foam pads for $\Delta L T$		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	LA m	Main Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	77	6	1.5	1.5	20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

30/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.7	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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:

Main pipe:	$0.6 \leq H \leq 1.0$ m
Branch:	$H \geq 0.5$ m

Important

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

i.e.

T_{ins}	= installation temperature before preheating
T_f	= max operating temperature

Example

Main pipe

Nominal size	DN 100
Steel pipe diameter, d_1	114.3 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	225 mm

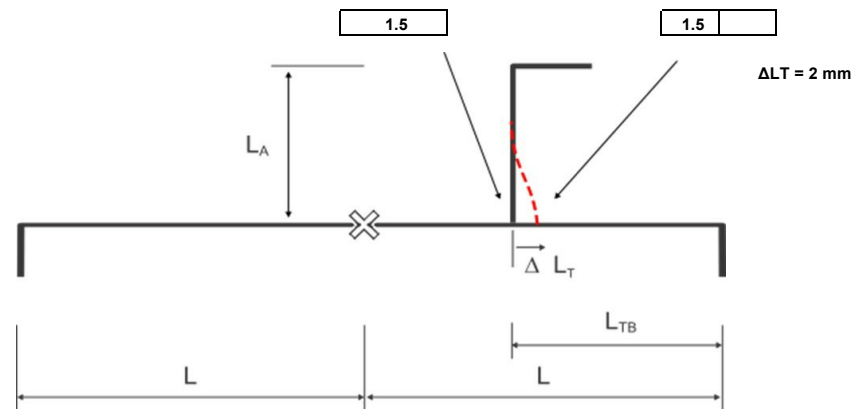
Pipe length, L	6.75 m
Dist. branch to bend, L_{TB}	3.6 m

Axial stress at branch, σ_{aT} 9 Mpa

Branch pipe

Nominal size	DN 50
Steel pipe diameter, d_2	60.3 mm
Wall thickness, s_2	2.9 mm
Casing diameter, D_2	140 mm

$L_{A,max}$	20 m
Branch length, L_A	3.7 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	$\Delta L T$ mm	F_{min} m	Foam pads for $\Delta L T$		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	Main	Branch	d_1 mm	D_1 mm	d_2 mm	D_2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	68	8	1.7	2.0	20		

Bonded system - Perpendicular branches with foam pads

calculations according to Design Manual chapter 5

LOGSTOR

Version: 1.0.4

28/4-2025

Conditions

Flow temperature, T_f	75	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	Mpa

Soil parameters

Soil density, ρ	19	kN/m ³
Soil friction angle, φ	32.5	°
Friction coefficient, μ	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} = installation temperature before preheating

T_f = max operating temperature

Example

Main pipe

Nominal size	DN 100
Steel pipe diameter, d_1	114.3 mm
Wall thickness, s_1	3.6 mm
Casing diameter, D_1	225 mm

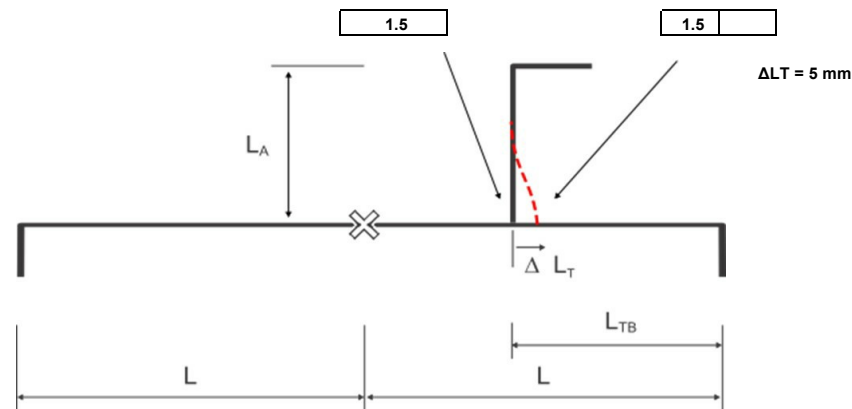
Pipe length, L	17.7 m
Dist. branch to bend, L_{TB}	8.8 m

Axial stress at branch, σ_{aT} 29 Mpa

Branch pipe

Nominal size	DN 50
Steel pipe diameter, d_2	60.3 mm
Wall thickness, s_2	2.9 mm
Casing diameter, D_2	140 mm

$L_{A,max}$	20 m
Branch length, L_A	5.7 m



Multiple calculations

Input

Output

Node no.	Branch length		Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa	$\Delta L T$ mm	F_{min} m	Foam pads for $\Delta L T$		Max branch length $L_{a,max}$ m	Warnings	
	L m	LTB m	LA m	Main Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main	Branch
1	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
2	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
3	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
4	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
5	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
6	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
7	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
8	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
9	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		
10	100	25	20	DN 80	DN 50	88.9	180	60.3	140	95	3	1.3	1.5	20		

TwinPipes - Branches with foam pads

calculation according to "Design with TwinPipes" chapter 5.3

LOGSTOR

Version: 1.0.0

Date: 4/30/2025

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	0.6	m

Insulation class

Series 2

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity	209,714	Mpa

Soil parameters

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

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 50	
Steel pipe diameter, d1	60.3	mm
Wall thickness, s1	2.9	mm
Casing diameter D1	225	mm

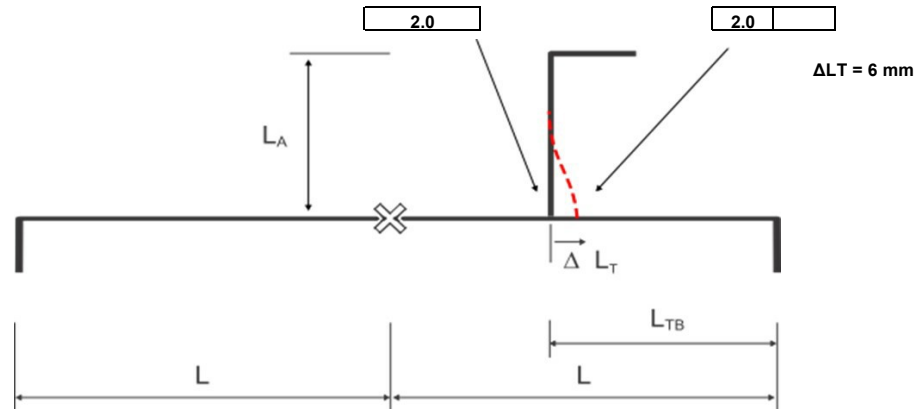
Pipe length, L	29.1	m
Dist. branch to bend, L_{TB}	14	m

Axial stress at branch, σ_{aT} 59 Mpa

Branch pipe

Nominal size	DN 50	
Steel pipe diameter, d2	60.3	mm
Wall thickness, s2	2.9	mm
Casing diameter D2	225	mm

$L_{A,max}$	45	m
Branch length, L_A	13	m



Multiple calculations

Input

Output

Node no.				Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee	ΔLT	F_{min}	Foam pads for ΔLT		Max branch length	Warnings	
	L	LTB	LA	Main	Branch	d1	D1	d2	D2				1	2	$L_{a,max}$	Main pipe	Branch
	m	m	m			mm	mm	mm	mm	Mpa	mm	m			m		
1	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
2	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
3	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
4	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
5	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
6	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
7	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
8	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
9	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		
10	100	25	20	DN 80	DN 50	88.9	280	60.3	225	72	11	1.8	2.0		45		

Conditions

Flow temperature, T_f	75	°C
Return temperature, T_r	55	°C
Installation temperature, T_{ins}	10	°C
Soil cover, H	1	m

Insulation class	Series 2
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Steel material properties

Expansion coefficient, α	0.0000120 °K ⁻¹
Modulus of elasticity	209,714 Mpa

Soil parameters

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

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

Tf = the max operating temperature

Example

Main pipe

Nominal size	DN 65	
Steel pipe diameter, d1	76.1	mm
Wall thickness, s1	2.9	mm
Casing diameter D1	250	mm

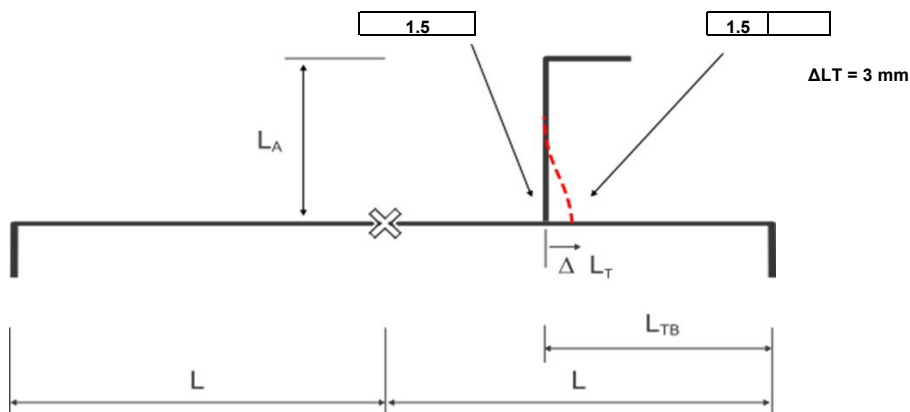
Pipe length, L	13.6	m
Dist. branch to bend, LTB	6.6	m

Axial stress at branch, σ_{aT}	48	Mpa
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Branch pipe

Nominal size	DN 40	
Steel pipe diameter, d2	48.3	mm
Wall thickness, s2	2.6	mm
Casing diameter D2	180	mm

LA,max	25	m
Branch length, LA	3.7	m



Multiple calculations

Input						Output											
Node no.			Branch length LA m	Nominal size		Main pipe		Branch pipe		Main pipe stress at Tee σ_{aT} Mpa		Fmin m	Foam pads for ΔT		Max branch length La,max m	Warnings	
	L m	LTB m		Main	Branch	d1 mm	D1 mm	d2 mm	D2 mm				1	2		Main pipe	Branch
1	100	25	20	DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
2	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
3	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
4	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
5	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
6	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
7	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
8	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
9	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		
10	100	25		DN 80	DN 50	88.9	280	60.3	225	100	3	1.3	1.5		28		

Bonded system - U-bends with foam pads

calculations according to Design Manual chapter 4

Version: 1.0.4

26/6-2025

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	55	°C
Soil cover, H	1	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

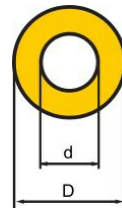
Soil parameters

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

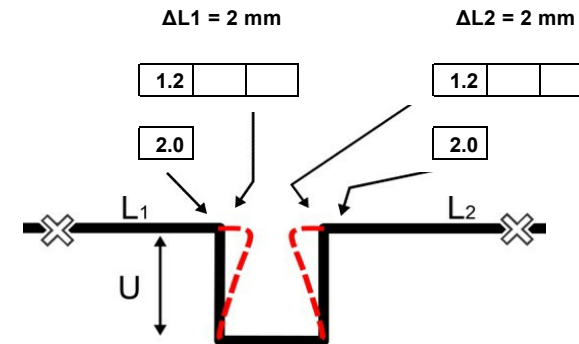
Example

Nominal size	DN 80	
Steel pipe diameter, d	88.9	mm
Wall thickness, s	3.2	mm
Casing diameter, D	180	mm

Dist. to anchor point, L1	31.2	m
Dist. to anchor point, L2	27.7	m



U = 1.2 m



Multiple calculations

Input					Output											
Node no.	L1	L2	Nominal size	d	D	ΔL1	ΔL2	U	Foam pads for L1				Foam pads for L2			
	m	m		Layers					Layer length			Layers	Layer length			
									1	2	3		1	2	3	
1	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
2	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
3	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
4	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
5	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
6	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
7	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
8	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
9	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		
10	10	50	DN 65	76.1	160	1	1	1.1	1	1.1			1	1.1		

See LOGSTOR Design Manual:

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

Bonded system - U-bends with foam pads

calculations according to Design Manual chapter 4

Conditions

Flow temperature, T _f	75	°C
Installation temperature, T _{ins}	10	°C
Soil cover, H	0.8	m

Insulation class **Series 2**

Steel material properties

Expansion coefficient, α	0.0000120	°K ⁻¹
Modulus of elasticity, E	209,714	MPa

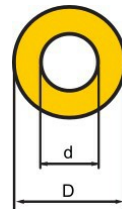
Soil parameters

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

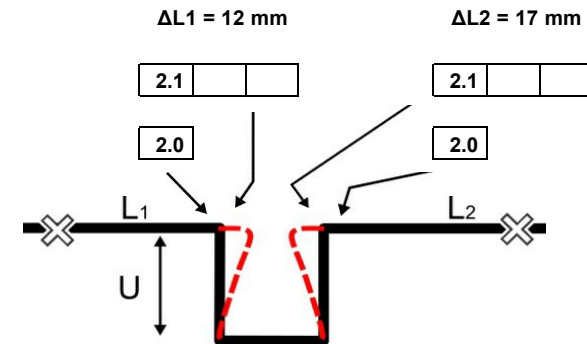
Example

Nominal size	DN 100	
Steel pipe diameter, d	114.3	mm
Wall thickness, s	3.6	mm
Casing diameter, D	225	mm

Dist. to anchor point, L1	17.7	m
Dist. to anchor point, L2	27.6	m



U = 2.1 m



Multiple calculations

Input					Output												
Node no.	L1	L2	Nominal size	d	D	ΔL1	ΔL2	U	Foam pads for L1			Foam pads for L2					
	m	m		mm					mm	mm	mm	mm	Layers	Layer length			Layers
											1	2	3		1	2	3
1	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
2	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
3	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
4	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
5	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
6	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
7	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
8	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
9	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		
10	10	50	DN 65	76.1	160	7	18	1.9	1	1.9				1	1.9		