



**NET4GAS, s.r.o**

# **HP PIPELINE DN1400, NODE KATEŘINSKÝ POTOK – NODE PŘIMDA**

## **Station Piping – Wall Thickness Calculation**

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## TABLE OF CONTENTS

1	SCOPE OF THE DOCUMENT	4
1.1	List of Stations	4
2	CODES, STANDARDS AND REFERENCE DOCUMENTS	4
2.1	Codes and Standards	4
2.2	Reference Documents	5
3	GENERAL	5
3.1	Definitions	5
3.2	Symbols	5
3.3	Units	6
3.4	Abbreviations	6
4	PIPE WALL THICKNESS CALCULATION	6
4.1	General	6
4.2	Pipe Wall Thickness Calculation	7
APPENDIX 1:	Station Process Piping – Wall Thickness Calculations	8

## 1 SCOPE OF THE DOCUMENT

The scope of this document is to specify the wall thickness calculation and selection method for station piping which have been carried out within the the HP Pipeline DN 1400, Distribution Node Kateřinský potok – Distribution Node Přimda project.

### 1.1 List of Stations

The wall thickness calculation for station piping is performed for the following stations:

Station	Type	Code
Jirkov	Line Valve Station (Note)	TU33S
Vrskmaň	Line Valve Station (Note)	KS007
Hrušovany	Line Valve Station	TU51S
Sýrovice	Line Valve Station	TU52S
Malmerice	Line Valve Station	TU53S
Mladotice	Line Valve Station	TU40S
Hubenov	Line Valve Station	TU41S
Svinomazy	Line Valve Station	TU42S
Bor	Line Valve Station	TU48S
Přimda	Distribution Node	RU005

Note: The line valve shall be installed only at one location, either at LVS Jirkov (TU33S) or at LVS Vrskmaň (KS007).

## 2 CODES, STANDARDS AND REFERENCE DOCUMENTS

The latest edition of applicable reference codes, standards and specifications stated hereinafter is the basis for the station piping wall thickness calculation.

### 2.1 Codes and Standards

ČSN EN 1594	Gas supply systems – Pipelines for maximum operating pressure over 16 bar – Functional requirements
ČSN EN ISO 3183	Petroleum and natural gas industries – Steel pipe for pipeline transportation systems

ČSN EN 10220	Seamless and welded steel tubes - Dimensions and masses per unit length
TPG 702 04	Gas mains and service pipelines for maximum operating pressure up to 100 bar included
TP_T01_01_01_03	Principles for design, constructions, reconstructions and repairs of high pressure pipelines and connections up to 100 bar.

## 2.2 Reference Documents

C4G-HPPL-ILF-GENER-STR-SPC-818	Pipes DN 300 - DN 1400 - Specification
C4G-HPPL-ILF-GENER-STR-SPC-813	Line Pipes DN1400 - Specification
C4G-HPPL-ILF-GENER-STR-SPC-800	Piping Classes - Specification

## 3 GENERAL

### 3.1 Definitions

Employer	NET4GAS, s.r.o. (Client)
Consultant	ILF Consulting Engineers

### 3.2 Symbols

Specific symbols are defined in the following table:

Symbol	Description	Unit
$c_1$	fabrication tolerance	mm
$c_1$ [%]	absolute value of the negative tolerance	%
$c_2$	corrosion / erosion allowance	mm
D	outside diameter of the pipe	mm
DN	nominal diameter	mm
DP	design pressure	barg
E	weld joint factor	-
$f_0$	design factor	-

Symbol	Description	Unit
K	Strengthening factor	-
NPS	nominal pipe size	inch
$R_{t0,5}$	specified minimum yield strength at the ambient temperature	N/mm <sup>2</sup>
T	minimum required wall thickness with allowances and tolerances	mm
$T_{min}$	calculated minimum wall thickness	mm

### 3.3 Units

Nominal diameters are shown in DN [mm] and NPS [inch].

Pressure classes are shown in DP [barg].

All other units are expressed in SI units.

### 3.4 Abbreviations

EN European Standard

ISO International Organization for Standardization

SI International System of Units

TPG Technical Regulation for Gas (Technická pravidla - Gas)

## 4 PIPE WALL THICKNESS CALCULATION

### 4.1 General

The calculation is performed on the basis of ČSN EN 1594, TPG 702 04 and NET4GAS Company Regulation TP\_T01\_01\_01\_03 considering also minimum corrosion allowance requirement and standard wall thickness tolerances.

For a table with the design parameters of each pipe class reference shall be made to the Piping Class Specification (C4G-HPPL-ILF-GENER-STR-SPC-800).

## 4.2 Pipe Wall Thickness Calculation

For normal load conditions the minimum wall thickness of straight pipe is calculated with the following formula, as stipulated in ČSN EN 1594:

$$T_{\min} = \frac{DP * D}{20 * f_o * R_{t0,5}}$$

According to N4G standard TP\_T01\_01\_01\_03, the design pressure for station piping system with nominal size smaller than DN 300 (< DN 300) inside the station shall be 100 barg.

According to TPG 702 04 and N4G standard TP\_T01\_01\_01\_03 the minimum wall thickness calculated by formula above has to be increased by the Strengthening Factor depending on safety requirements.

The stations included in the HP Pipeline DN 1400, Distribution Node Kateřinský potok – Distribution Node Přimda project belong to category B, so the Strengthening Factor K of 1.2 is applied.

As the result of above stated requirements design factor  $f_o$  is calculated by the following formula, with S = 1.4 according to EN 1594:

$$f_o = \frac{1}{S * K} = \frac{1}{1.4 * 1.2}$$

The minimum required wall thickness with allowances and tolerances T is calculated with the following formulas:

$$T = T_{\min} + c_1 + c_2, \quad \text{where } c_1 = T_{\min} * \frac{c_1 \%}{100}$$

$T_{\min}$  is the calculated minimum wall thickness by increased value.

Piping wall thickness is determined in accordance with the applicable codes and standards, where fabrication tolerances and minimum corrosion allowances are met.

The selected wall thickness is in accordance with ČSN EN ISO 3183 and EN 10220.

According to the N4G requirement, the minimum selected piping wall thickness is 4.0 mm.

The results and selection of the pipe wall thickness calculation are presented in the Appendix 1.

## **APPENDIX 1: Station Process Piping – Wall Thickness Calculations**

## General Notes

Design Conditions	Unit / Abbreviation	Description or Value
Service	-	Natural Gas
Design Temperature (CSXX-0)	° C	- 20 to + 50
Corrosion Allowance	mm	0
Piping Material Group	-	Carbon Steel
Pipe Standard	-	ISO 3183 Attachment M
Design Code	-	EN 1594 / TPG 702 04

Nominal Diameter		Outside Diameter	Internal Design Pressure	Material	Min. Yield Strength	Design Factor	Hoop Stress	Pipe Type	Weld Joint Factor	Calc. WT (note 1)	Corrosion/ Erosion Allowance (note 2)	Allowable Minus Tolerance (note 2)	Fabrication Tolerance (note 2)	Calc. WT	Selected WT acc. EN10220 (note 3)
[DN]	[ " ]	D <sub>0</sub> [mm]	DP [bar]		R <sub>10,5</sub> [N/mm <sup>2</sup> ]	f <sub>0</sub>	Re <sub>0,2p</sub> [N/mm <sup>2</sup> ]	-	E	T <sub>min</sub> [mm]	c <sub>2</sub> [mm]	c <sub>1</sub> [%]	c <sub>1</sub> [mm]	T [mm]	T <sub>ord</sub> [mm]
25	1	33.4	100	L290NE	245	0.600	147	SMLS	-	1.136	0	-	0.500	1.64	4
32	1 1/4	42.2	100	L290NE	245	0.600	147	SMLS	-	1.435	0	-	0.500	1.94	4
40	1 1/2	48.3	100	L290NE	245	0.600	147	SMLS	-	1.643	0	-	0.500	2.14	4
50	2	60.3	100	L290NE	245	0.600	147	SMLS	-	2.051	0	-	0.500	2.55	4
65	2 1/2	73.0	100	L290NE	245	0.600	147	SMLS	-	2.483	0	-	0.500	2.98	4
80	3	88.9	100	L290NE	245	0.600	147	SMLS	-	3.024	0	-	0.500	3.52	4
100	4	114.3	100	L290NE	245	0.600	147	SMLS	-	3.888	0	12.5	0.555	4.44	4.5
125	5	141.3	100	L290NE	245	0.600	147	SMLS	-	4.806	0	12.5	0.687	5.49	5.6
150	6	168.3	100	L290NE	245	0.600	147	SMLS	-	5.724	0	12.5	0.818	6.54	7.1
200	8	219.1	100	L290NE	245	0.600	147	SMLS	-	7.452	0	12.5	1.065	8.52	8.8
250	10	273.0	100	L290NE	245	0.600	147	SMLS	-	9.286	0	12.5	1.327	10.61	11.0
300	12	323.8	100	L360NE	360	0.600	216	LWLD	1	7.495	0	10	0.833	8.33	8.8
350	14	355.6	100	L360NE	360	0.600	216	LWLD	1	8.231	0	10	0.915	9.15	10.0
400	16	406.4	100	L360NE	360	0.600	216	LWLD	1	9.407	0	10	1.045	10.45	11.0
450	18	457.0	100	L360NE	360	0.600	216	LWLD	1	10.579	0	5	0.557	11.14	12.5
500	20	508.0	100	L360NE	360	0.600	216	LWLD	1	11.759	0	5	0.619	12.38	12.5
600	24	610.0	100	L360NE	360	0.600	216	LWLD	1	14.120	0	5	0.743	14.86	16.0
700	28	711.0	100	L360NE	360	0.600	216	LWLD	1	16.458	0	5	0.866	17.32	17.5
800	32	813.0	100	L415NE	415	0.600	249	LWLD	1	16.325	0	5	0.859	17.18	17.5
900	36	914.0	100	L415NE	415	0.600	249	LWLD	1	18.353	0	5	0.966	19.32	20.0
1000	40	1016.0	100	L485ME	485	0.600	291	LWLD	1	17.457	0	5	0.919	18.38	20.0
1100	44	1118.0	100	L485ME	485	0.600	291	LWLD	1	19.210	0	-	1.000	20.21	22.2
1200	48	1219.0	100	L485ME	485	0.600	291	LWLD	1	20.945	0	-	1.000	21.95	22.2
1400	56	1422.0	100	L485ME	485	0.600	291	LWLD	1	24.433	0	-	1.000	25.43	28.0

Notes: 1. Wall Thickness Calculation according to DIN EN 1594 (with  $f_0 = 1/S$  and  $S = 1,4*1,2$ ).

$$T_{\min} = DP \cdot D_0 / (20 \cdot Re_{0,2p}) \quad (\text{where } Re_{0,2p} = R_{10,5} \cdot f_0)$$

2. Tolerances acc. with ISO 3183 Attachment M
3. Selected minimum WT acc. with EN 10220

Nominal Diameter		Outside Diameter	Internal Design Pressure	Material	Min. Yield Strength	Design Factor	Hoop Stress	Pipe Type	Weld Joint Factor	Calc. WT (note 1)	Corrosion/ Erosion Allowance (note 2)	Allowable Minus Tolerance (note 2)	Fabrication Tolerance (note 2)	Calc. WT	Selected WT acc. EN10220 (note 3)
[DN]	[ " ]	D <sub>0</sub> [mm]	DP [bar]		R <sub>10,5</sub> [N/mm <sup>2</sup> ]	f <sub>0</sub>	Re <sub>0,2p</sub> [N/mm <sup>2</sup> ]	-	E	T <sub>min</sub> [mm]	c <sub>2</sub> [mm]	c <sub>1</sub> [%]	c <sub>1'</sub> [mm]	T [mm]	T <sub>ord</sub> [mm]
25	1	33.4	Refer to CS100-0												4
32	1 1/4	42.2													4
40	1 1/2	48.3													4
50	2	60.3													4
65	2 1/2	73.0													4
80	3	88.9													4
100	4	114.3													4.5
125	5	141.3													5.6
150	6	168.3													7.1
200	8	219.1													8.8
250	10	273.0													11
300	12	323.8	85	L360NE	360	0.600	216	LWLD	1	6.371	0	10	0.708	7.08	7.1
350	14	355.6	85	L360NE	360	0.600	216	LWLD	1	6.997	0	10	0.777	7.77	8.0
400	16	406.4	85	L360NE	360	0.600	216	LWLD	1	7.996	0	10	0.888	8.88	10.0
450	18	457.0	85	L360NE	360	0.600	216	LWLD	1	8.992	0	10	0.999	9.99	11.0
500	20	508.0	85	L360NE	360	0.600	216	LWLD	1	9.995	0	5	0.526	10.52	11.0
600	24	610.0	85	L360NE	360	0.600	216	LWLD	1	12.002	0	5	0.632	12.63	14.2
700	28	711.0	85	L360NE	360	0.600	216	LWLD	1	13.990	0	5	0.736	14.73	16.0
800	32	813.0	85	L415NE	415	0.600	249	LWLD	1	13.877	0	5	0.730	14.61	16.0
900	36	914.0	85	L415NE	415	0.600	249	LWLD	1	15.600	0	5	0.821	16.42	17.5
1000	40	1016.0	85	L485ME	485	0.600	291	LWLD	1	14.838	0	5	0.781	15.62	16.0
1100	44	1118.0	85	L485ME	485	0.600	291	LWLD	1	16.328	0	5	0.859	17.19	17.5
1200	48	1219.0	85	L485ME	485	0.600	291	LWLD	1	17.803	0	5	0.937	18.74	20.0
1400	56	1422.0	85	L485ME	485	0.600	291	LWLD	1	20.768	0	-	1.000	21.77	22.2

Notes: 1. Wall Thickness Calculation according to DIN EN 1594 (with  $f_0 = 1/S$  and  $S = 1,4 \cdot 1,2$ ).

$$T_{\min} = DP \cdot D_0 / (20 \cdot Re_{0,2p}) \quad (\text{where } Re_{0,2p} = R_{10,5} \cdot f_0)$$

2. Tolerances acc. with ISO 3183 Attachment M

3. Selected minimum WT acc. with EN 10220

## Summary Table

DN	Selected Wall Thickness [mm]	
	-25°C to 50°C	
	CS100-0	CS85-0
25	4.0	4.0
32	4.0	4.0
40	4.0	4.0
50	4.0	4.0
65	4.0	4.0
80	4.0	4.0
100	4.5	4.5
125	5.6	5.6
150	7.1	7.1
200	8.8	8.8
250	11.0	11.0
300	8.8	7.1
350	10.0	8.0
400	11.0	10.0
450	12.5	11.0
500	12.5	11.0
600	16.0	14.2
700	17.5	16.0
800	17.5	16.0
900	20.0	17.5
1000	20.0	16.0
1100	22.2	17.5
1200	22.2	20.0
1400	28.0	22.2