From Mannesmann

to Mapress

Design Tables for Pipe Systems

Pressure drop

mapress STAINLESS STEEL

mapress CARBON STEEL

mapress COPPER

mapress

pressfitting system

Contents

1.0 General

1.1 Introduction

The *mapress* Pressfitting System is manufactured in 3 different materials: unalloyed steel, copper and stainless steel

		material number
-	unalloyed steel RSt 34-2	1.0004
	stainless Cr-Ni steel	1.4301
-	stainless Cr-Ni-Mo steel	1.4401 (BS 316 S 16)
-	DHP copper	CW 024 A

These materials cater for an extremely wide variety of building service applications.

The methods of designing pipe systems in this booklet cover the *mapress* pressfitting systems for installing water supply, heating, extra light fuel oil, gas and liquefied gas systems.

Each application has its own method, which reflects the different properties of the fluids carried.

1.2 Conversion of pressure and heat units

Decimal multiples and submultiples of base units

Prefix Symbol	Prefix Name	Factor	Meaning	Prefix Symbol	Prefix Name	Factor	Meaning
T	tera	10^{12}	1,000,000,000,000	**d**	deci	10^{-1}	0.1
G	giga	10^{9}	1,000,000,000	**c**	centi	10^{-2}	0.01
M	mega	10^{6}	1,000,000	**m**	milli	10^{-3}	0.001
k	kilo	10^{3}	1,000	**µ**	micro	10^{-6}	0.000001
h	hecto	10^{2}	100	**n**	nano	10^{-9}	0.000000001
da	deca	10^{1}	10	**p**	pico	10^{-12}	
				f	femto	10^{-15}	
				a	atto	10^{-18}	

Derived SI units

Physical quantity	Legal SI units		Relationship
Area	m²	square metre	
Volume	m³	cubic metre	1 m³ = 1000 dm³
Density	kg/m³		
Frequency	Hz	hertz	1 Hz = 1/s
Plane angle	rad;°	radian; degree	right angle = $^{\delta}/_{2}$ rad = 90°
Volumetric flow rate	m³/s		
Mass flow rate	kg/s		
Force	N	newton	1 N = 1 kg m/s²
Pressure, stress	Pa	pascal	1 Pa = 1 N/m² = 1 kg/(m · s²)
	bar	bar	1 bar = 0.1 Mpa
Dynamic viscosity	Pa · s =	pascal second	1 Pa · s = 1 kg/m · s
Kinematic viscosity	m²/s		
Energy, work, quantity of heat	J	joule	1 J = 1 Nm = 1 Ws = 1 kg m²/s²
Power, radiant flux, heat flow rate	W	watt	1 W = 1 J/s = 1 Nm/s

Force

SI unit: newton				
	kp	**J/cm**	**N**	**Kg · m/s**
kp	1	$9.81 \cdot 10^{-2}$	9.81	9.81
J/cm	10.2	1	100	100
N	0.102	0.01	1	1
kg · m/s	0.102	0.01	1	1

Pressure

SI unit: pascal						
	at	torr	mm WG	bar	N/mm²	Pa
at (1 at = 1 kp/cm²)	1	736	10^4	0.981	$9.81 \cdot 10^{-2}$	$9.81 \cdot 10^4$
torr (1 torr = 1 mm Hg)	$1.36 \cdot 10^{-3}$	1	13.6	$1.333 \cdot 10^{-3}$	$1.33 \cdot 10^{-4}$	1.33.3
mm WG (1 mm WG = 1 kp/m²)	10^{-4}	$7.36 \cdot 10^{-2}$	1	$9.81 \cdot 10^{-5}$	$9.81 \cdot 10^{-6}$	9.81
bar (1 bar = 0.1 Mpa)	1.02	750	$1.02 \cdot 10^4$	1	0.1	10^5
N/mm² (1 N/mm² = 10 bar)	10.2	7500	$1.02 \cdot 10^5$	10	1	10^5
Pa (1 Pa = 1 N/m²)	$1.02 \cdot 10^{-5}$	$7.5 \cdot 10^{-3}$	0.102	10^{-5}	10^{-6}	1

Power

SI unit: watt						
	kpm/s	PS	kcal/s	kcal/h	kW	W J/s Nm/s
kpm/s	1	$1.33 \cdot 10^{-2}$	$2.34 \cdot 10^{-3}$	8.43	$9.81 \cdot 10^{-3}$	9.81
PS	75	1	0.176	632	0.736	736
kcal/s	427	5.69	1	3600	4.19	$4.19 \cdot 10^{-3}$
kcal/h	0.119	$1.58 \cdot 10^{-2}$	$2.778 \cdot 10^{-4}$	1	$1.16 \cdot 10^{-3}$	1.16
kW	102	1.36	0.239	860	1	1000
W J/s Nm/s	0.102	$1.36 \cdot 10^{-3}$	$2.39 \cdot 10^{-4}$	0.860	0.001	1

Energy

SI unit: joule				
	kcal	kpm	kWh	J Nm Ws
Kcal	1	427	$1.16 \cdot 10^{-3}$	$4.19 \cdot 10^{3}$
Kpm	$2.34 \cdot 10^{-3}$	1	$2.72 \cdot 10^{-6}$	9.81
KWh	860	$3.67 \cdot 10^{5}$	1	$3.6 \cdot 10^{6}$
J Nm Ws	$2.39 \cdot 10^{-4}$	0.102	$2.78 \cdot 10^{-7}$	1

Thermal conductivity

SI unit: watt / metre · kelvin			
	$\frac{\text{cal}}{\text{cm} \cdot \text{s} \cdot °\text{C}}$	$\frac{\text{J}}{\text{cm} \cdot \text{s} \cdot °\text{C}}$ or $\frac{\text{W}}{\text{cm} \cdot \text{K}}$	$\frac{\text{W}}{\text{m} \cdot \text{K}}$
cal/cm · s · °C	1	4.1868	$4.1868 \cdot 10^{2}$
J/cm · s · °C = W/cm · K	0.2388	1	100
W/m · K	$2.383 \cdot 10^{-3}$	0.01	1

1.3 Formulae

Name	Symbol	Units	Water Supply	Heating	Gas
Mass density	r	kg/m³	$\rho = \frac{m}{V}$		
Viscosity	u	m²/s	$\upsilon = \frac{\eta}{\rho}$		
Mean flow velocity	v	m/s	$\bar{v} = \frac{\dot{V}}{A} = \frac{\dot{m}}{r \cdot A} = \frac{4 \cdot \dot{m}}{r \cdot D^2 \cdot p}$		
Mass flow rate	m	kg/s	$\dot{m} = \dot{V} \cdot r = A \cdot \bar{v} \cdot r$		
Volumetric flow rate	$\dot{V}$	m³/h	$\dot{V} = \frac{\dot{m}}{r} = A \cdot \bar{v}$		
Pressure drop in pipes	Δp_p	mbar	$\Delta p_p = f \cdot \frac{l}{D} \cdot \frac{r}{2} \cdot \bar{v}^2$		
Pipe pressure gradient due to friction	R	mbar	$R = \frac{\Delta p_p}{l}$		
Pressure drop due to geodetec height difference	Δp_{geo}	mbar	$\Delta p_{geo} = r \cdot h_{geo} \cdot g \cdot 10^{-2}$		
Pressure drop across equipment	Δp_{eq}	mbar	$\Delta p_{Z,eq} = \Delta p_{A,\max} \cdot \left(\frac{\dot{V}_{actual}}{\dot{V}_{eq,\max}} \right)^2$		
Pressure drop due to minor losses	Z	mbar	$Z = \sum C \cdot \frac{r}{2} \cdot \bar{v}^2$		
Total pressure drop at building service connection	Δp_b	mbar	$\Delta p_b = \Delta p_{wm} + \Delta p_{eq} + \Delta p_{geo} + \Delta p_{\min,fl} + \sum (R \cdot l + Z)$		
Reynolds number Re ≤ 2320 ⎩ laminar Re > 2320 ⎩ turbulent	Re		$\mathrm{Re} = \frac{\bar{v} \cdot D}{u}$		
Friction factor (laminar flow)	f		$f = \frac{64}{\mathrm{Re}}$		
Cross-sectional area of pipe	A	m²	$A = \frac{p}{4} \cdot D^2$		

Name	Symbol	Units	Water supply	Heating	Gas
Friction factor (turbulent flow) hydr. \ k = 0	f		$\frac{1}{\sqrt{f}} = 2 \cdot \log \frac{\mathrm{Re} \cdot \sqrt{f}}{2.51}$		
Friction factor (turbulent flow) hydr. rough \ k = ∞	f		$\frac{1}{\sqrt{f}} = 2 \cdot \lg \frac{3.71 \cdot D}{k}$		
Friction factor (turbulent flow) transitional range	f		$\frac{1}{\sqrt{f}} = -2 \cdot \lg\left(\frac{2.51}{\mathrm{Re} \cdot \sqrt{f}} + \frac{k}{3.71 \cdot D}\right)$		
Internal volume of pipe	*V*	m³	$V = A \cdot l = \frac{p}{4} \cdot D^2 \cdot l$		
Design flow rate	$\dot{V}_d$	l/s	$\dot{V}_d = \frac{\dot{V}_{\min} \cdot \dot{V}_{\max}}{2}$		
Peak flow rate	$\dot{V}_p$	l/s	See appendix: Water Supply table, peak flow rate		$\dot{V}_p = \Sigma\left(f_s \cdot \dot{V}_A\right)$
Heat capacity	$\dot{Q}$	W		$\dot{Q} = \dot{m}\, c\, \Delta T$	
Temperature differential	ΔT	k		$\Delta T = T_{flow} - T_{return}$	
Calorific value	CV	KWh/m³			$CV = \frac{\dot{Q}_{nl}}{\dot{V}_a}$
Dynamic viscosity	*h*	Kg/m*s			
Gas appliance consumption	$\dot{V}_a$	m³/h			
Simultaneity factor	f_s				
Nominal heat load	$\dot{Q}_{nl}$	kW			
Pipe length	*l*	m			
Pipe inside diameter	D	mm			
Specific heat capacity	*c*	Wh/kg*k			
Loss constant for minor losses	*C*				

1.4 Guide values for building services

1.4.1 Water supply systems

DIN 1988, Part 3, Table 5: Maximum calculated flow velocity at the related peak flow rate

Pipe run	Max calculated flow velocity for related flow duration	
	£ **15 min** **[m/s]**	> **15 min** **[m/s]**
Service pipe	2	2
Supply pipe: Sub-runs with low pressure drop, straight through valves (C < 2.5) *	5	2
Sub-runs with straight through valves with higher loss constant**	2.5	2

* Eg piston valve to DIN 3500, ball valve, angle seat valve to DIN 3502 (from DN20)
** Eg straight seat valve to DIN 3512

1.4.2 Heating systems

Pipe run	Calculated flow velocity [m/s]
Radiator connection pipe	~ 0.5
Mains	~ 1.0
Riser	~ 1.0
Mains and riser in exceptional cases	up to 1.5

1.4.3 Gas systems to TRGI (German Gas Installation Regulations)

Max flow velocity: v_{max} **= 6m/s**

Pipe run	Permissible pressure drop [mbar]
Distribution pipe	≤ 0.3
Supply pipe (including meter connection pipe if the gas meter is installed after the riser)	≤ 0.8
Branch and appliance connection pipe in the gas meter	≤ 0.5
	≤ 1.0

1.4.4 Gas systems to TRF (German Liquefied Gas Regulations)

Permissible pressure drop: $\Delta p_{perm} = 0.05 \cdot p_w$ [mbar]

Working pressure: $p_w = 50$ mbar

1.4.5 Extra light fuel oil systems

Laminar flow: $Re < 2320$

Pressure drop in suction pipe: $\Delta p_{s\ tot\ max} = 0.5$ bar

Pipe run	**Calculated flow velocity [m/s]**
Suction pipe	0.2 to 0.3
Delivery pipe	0.4 to 0.5

2.0 Water Supply Systems to DIN 1988 (Part 3)

2.1 Pressure drop tables for *mapress* EDELFLEX

Pipe pressure gradient due to friction R and calculated flow velocity v as a function of peak flow rate V_p at T = 10°C

mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541 (k = 0.0015mm)

Nominal size	**Outside diameter x wall thickness**	
OD x t [mm]	**12 x 0.1**	
ID [mm]	11.8	
Peak flow rate V_p $\frac{l}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$
0.05	3.3	0.5
0.06	4.7	0.6
0.08	7.5	0.7
0.10	11.2	0.9
0.12	15.5	1.1
0.14	20.5	1.2
0.16	26.3	1.4
0.18	32.5	1.6
0.20	39.2	1.8
0.22	45.7	2.0
0.24	53.2	2.2
0.26	60.3	2.4
0.28	67.2	2.6
0.30	75.5	2.7
0.32	83.8	2.9
0.34	93.6	3.1
0.36	100.7	3.3
0.38	115.0	3.5
0.40	127.0	3.6
0.42	139.0	3.8
0.44	152.3	4.0
0.46	166.0	4.2
0.48	180.0	4.4
0.50	192.0	4.6
0.52	206.0	4.7
0.54	221.0	4.9
0.56	235.2	5.1
0.58	249.6	5.4
0.60	264.0	5.5

2.2 Pressure drop tables for *mapress* STAINLESS STEEL

Pipe pressure gradient due to friction R and calculated flow velocity v as a function of peak flow rate V_p at T = 10°C

mapress STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541 (k = 0.0015mm)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**15 x 1.0**		**18 x 1.0**		**22 x 1.2**		**28 x 1.2**	
ID [mm]	13.0		16.0		19.5		25.6	
Nom dia	DN12		DN15		DN20		DN25	
Peak flow rate V_p l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0.05	2.2	0.4	0.8	0.2	0.3	0.2	0.1	0.1
0.10	7.3	0.8	2.7	0.5	1.1	0.3	0.3	0.2
0.15	14.8	1.1	5.5	0.7	2.1	0.5	0.6	0.3
0.20	24.5	1.5	9.1	1.0	3.5	0.7	1.0	0.4
0.25	36.2	1.9	13.5	1.2	5.1	0.8	1.4	0.5
0.30	50.0	2.3	18.6	1.5	7.1	1.0	2.0	0.6
0.35	65.6	2.6	24.3	1.7	9.3	1.2	2.6	0.7
0.40	83.2	3.0	30.8	2.0	11.7	1.3	3.3	0.8
0.45	102.5	3.4	38.0	2.2	14.4	1.5	4.0	0.9
0.50	123.7	3.8	45.7	2.5	17.3	1.7	4.9	1.0
0.55	146.6	4.1	54.2	2.7	20.5	1.8	5.7	1.1
0.60	171.3	4.5	63.2	3.0	23.9	2.0	6.7	1.2
0.65	197.5	4.9	72.9	3.3	27.6	2.2	7.7	1.3
0.70	225.5	5.3	83.2	3.5	31.5	2.3	8.8	1.4
0.75			94.2	3.8	35.6	2.5	10.0	1.5
0.80			105.6	4.0	39.9	2.7	11.1	1.6
0.85			117.8	4.3	44.5	2.9	12.4	1.7
0.90			130.4	4.5	49.2	3.0	13.7	1.8
0.95			143.7	4.8	54.2	3.2	15.1	1.9
1.00			157.6	5.0	59.4	3.3	16.5	1.9
1.05					64.8	3.5	18.0	2.1
1.10					70.4	3.7	19.6	2.1
1.15					76.3	3.8	21.2	2.3
1.20					82.3	4.0	22.9	2.3
1.25					88.6	4.2	23.9	2.4
1.30					95.0	4.3	26.4	2.5
1.35					101.7	4.5	28.2	2.6
1.40					108.6	4.6	30.1	2.7
1.45					115.6	4.8	32.0	2.8
1.50					122.9	5.0	34.0	2.9
1.55							36.1	3.0
1.60							38.2	3.1
1.65							40.4	3.2
1.70							42.6	3.3
1.75							44.9	3.4
1.80							47.2	3.5
1.85							49.6	3.6
1.90							52.0	3.7
1.95							54.5	3.8
2.00							57.0	3.9
2.05							59.6	4.0
2.10							62.2	4.1
2.15							64.3	4.2
2.20							67.7	4.3
2.25							70.5	4.4
2.30							73.3	4.5
2.35							82.8	4.8
2.40							86.0	4.9
2.45							89.2	5.0
2.50							92.5	5.1

Nominal size	Pipe outside diameter x wall thickness					
dxt [mm]	**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	32.0		39.0		51.0	
Nom dia	DN32		DN40		DN50	
Peak flow rate V_p l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0.2	0.3	0.2	0.1	0.2	0.0	0.1
0.4	1.1	0.5	0.4	0.3	0.1	0.2
0.6	2.3	0.7	0.9	0.5	0.3	0.3
0.8	3.8	1.0	1.5	0.7	0.4	0.4
1.0	5.7	1.2	2.2	0.8	0.6	0.5
1.2	7.9	1.5	3.1	1.0	0.8	0.6
1.4	10.3	1.7	4.0	1.2	1.1	0.7
1.6	13.1	2.0	5.1	1.3	1.4	0.8
1.8	16.2	2.2	6.3	1.5	1.7	0.9
2.0	19.5	2.5	7.6	1.7	2.1	1.0
2.2	23.1	2.7	9.0	1.8	2.5	1.1
2.4	27.1	3.0	10.5	2.0	2.9	1.2
2.6	31.2	3.2	12.1	2.2	3.3	1.3
2.8	35.7	3.5	13.8	2.3	3.8	1.4
3.0	40.4	3.7	15.6	2.5	4.3	1.5
3.2	45.4	4.0	17.5	2.7	4.8	1.6
3.4	50.6	4.2	19.5	2.9	5.4	1.7
3.6	56.1	4.5	21.7	3.0	6.0	1.8
3.8	61.9	4.7	23.9	3.2	6.6	1.9
4.0	67.9	5.0	26.2	3.4	7.2	2.0
4.2	74.1	5.2	28.6	3.5	7.9	2.1
4.4			31.1	3.7	8.6	2.2
4.6			33.7	3.9	9.3	2.3
4.8			36.3	4.0	10.0	2.4
5.0			39.1	4.2	10.8	2.5
5.2			42.1	4.4	11.6	2.6
5.4			45.0	4.5	12.4	2.7
5.6			48.0	4.7	13.2	2.7
5.8			51.1	4.9	14.1	2.8
6.0			54.4	5.0	14.9	2.9
6.2					15.9	3.0
6.4					16.9	3.1
6.6					17.8	3.2
6.8					18.7	3.3
7.0					19.7	3.4
7.2					20.7	3.5
7.4					21.8	3.6
7.6					22.9	3.7
7.8					24.0	3.8
8.0					25.1	3.9
8.2					26.3	4.0
8.4					27.4	4.1
8.6					28.6	4.2
8.8					29.9	4.3
9.0					31.1	4.4
9.2					32.4	4.5
9.4					33.7	4.6
9.6					35.0	4.7
9.8					36.3	4.8
10.0					37.6	4.9

2.2 Pressure drop tables for *mapress* STAINLESS STEEL [Continuation]

Pipe pressure gradient due to friction R and calculated flow velocity v as a function of peak flow rate V_p at T = 10°C

mapress STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541 (k = 0.0015mm)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**76.1 x 2.0**		**88.9 x 2.0**		**108 x 2.0**	
ID [mm]	72.1		84.9		104	
Nom dia	DN65		DN80		DN100	
Peak flow rate V_p $\frac{l}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$
1	0.1	0.2	0.1	0.2	0.0	0.1
2	0.4	0.5	0.2	0.4	0.1	0.2
3	0.8	0.7	0.4	0.5	0.1	0.4
4	1.4	1.0	0.6	0.7	0.2	0.5
5	2.0	1.2	0.9	0.9	0.4	0.6
6	2.8	1.5	1.3	1.1	0.5	0.7
7	3.7	1.7	1.7	1.2	0.6	0.8
8	4.7	2.0	2.2	1.4	0.8	0.9
9	5.9	2.2	2.7	1.6	1.0	1.1
10	7.1	2.5	3.2	1.8	1.2	1.2
11	8.4	2.7	3.8	1.9	1.4	1.3
12	9.9	2.9	4.5	2.1	1.7	1.4
13	11.4	3.2	5.2	2.3	2.0	1.5
14	13.0	3.4	5.9	2.5	2.2	1.7
15	14.8	3.7	6.7	2.7	2.5	1.8
16	16.6	3.9	7.5	2.8	2.8	1.9
17	18.5	4.2	8.4	3.0	3.2	2.0
18	20.6	4.4	9.3	3.2	3.5	2.1
19	22.7	4.7	10.3	3.4	3.9	2.2
20	24.9	4.9	11.3	3.5	4.3	2.4
21	27.2	5.1	12.4	3.7	4.6	2.5
22			13.4	3.9	5.1	2.6
23			14.6	4.1	5.5	2.7
24			15.7	4.2	5.9	2.8
25			17.0	4.4	6.4	3.0
26			18.2	4.6	6.8	3.1
27			19.6	4.8	7.3	3.2
28			20.9	5.0	7.8	3.3
29			22.2	5.1	8.4	3.4
30					8.9	3.5
31					9.5	3.7
32					10.0	3.8
33					10.6	3.9
34					11.1	4.0
35					12.3	4.2
36					12.9	4.3
37					13.6	4.4
38					14.3	4.6
39					15.0	4.7
40					15.7	4.8
41					16.4	4.9
42					17.1	5.0
43					17.9	5.2
44						
45						
46						
47						
48						
49						
50						

2.3 Pressure drop tables for *mapress* COPPER

Pipe pressure gradient due to friction R and calculated flow velocity v as a function of peak flow rate V_p at T = 10°C

Copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057 (k = 0.0015mm)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**15 x 1.0**		**18 x 1.0**		**22 x 1.0**		**28 x 1.5**	
ID [mm]	13		16		20		25	
Nom dia	DN12		DN15		DN20		DN25	
Peak flow rate V_p [l/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
0.05	2.2	0.38	0.8	0.25	0.3	0.16	0.1	0.10
0.06	3.0	0.45	1.1	0.30	0.4	0.19	0.1	0.12
0.07	4.0	0.53	1.5	0.35	0.5	0.22	0.2	0.14
0.08	5.0	0.60	1.9	0.40	0.7	0.25	0.2	0.16
0.09	6.1	0.68	2.3	0.45	0.8	0.29	0.3	0.18
0.10	7.3	0.8	2.7	0.5	1.0	0.3	0.3	0.2
0.15	14.8	1.1	5.5	0.7	1.9	0.5	0.7	0.3
0.20	24.5	1.5	9.1	1.0	3.2	0.6	1.1	0.4
0.25	36.2	1.9	13.5	1.2	4.7	0.8	1.6	0.5
0.30	49.9	2.3	18.5	1.5	6.4	1.0	2.2	0.6
0.35	65.6	2.6	24.3	1.7	8.4	1.1	2.9	0.7
0.40	83.1	3.0	30.8	2.0	10.6	1.3	3.7	0.8
0.45	102.4	3.4	37.9	2.2	13.1	1.4	4.5	0.9
0.50	123.6	3.8	45.7	2.5	15.7	1.6	5.4	1.0
0.55	146.5	4.1	54.1	2.7	18.6	1.8	6.4	1.1
0.60	171.1	4.5	63.2	3.0	21.7	1.9	7.5	1.2
0.65	197.5	4.9	72.9	3.2	25.0	2.1	8.6	1.3
0.70	225.5	5.3	83.2	3.5	28.5	2.2	9.8	1.4
0.75			94.1	3.7	32.3	2.4	11.1	1.5
0.80			105.6	4.0	36.2	2.5	12.4	1.6
0.85			117.6	4.2	40.3	2.7	13.9	1.7
0.90			130.3	4.5	44.6	2.9	15.3	1.8
0.95			143.6	4.7	49.2	3.0	16.9	1.9
1.00			157.4	5.0	53.9	3.2	18.5	2.0
1.05					58.8	3.3	20.2	2.1
1.10					63.9	3.5	21.9	2.2
1.15					69.2	3.7	23.7	2.3
1.20					74.7	3.8	25.6	2.4
1.25					80.3	4.0	27.5	2.5
1.30					86.2	4.1	29.5	2.6
1.35					92.2	4.3	31.6	2.8
1.40					98.4	4.5	33.7	2.9
1.45					104.8	4.6	35.9	3.0
1.50					111.4	4.8	38.1	3.1
1.55					118.2	4.9	40.4	3.2
1.60					125.1	5.1	42.8	3.3
1.65							45.2	3.4
1.70							47.7	3.5
1.75							50.2	3.6
1.80							52.8	3.7
1.85							55.5	3.8
1.90							58.2	3.9
1.95							61.0	4.0
2.00							63.9	4.1
2.05							66.8	4.2
2.10							69.7	4.3
2.15							72.7	4.4
2.20							75.8	4.5
2.25							78.9	4.6
2.30							82.1	4.7
2.35							85.4	4.8
2.40							88.7	4.9
2.45							92.0	5.0
2.50							95.4	5.1

2.3 Pressure drop tables for *mapress* COPPER **[Continuation]**

Pipe pressure gradient due to friction R and calculated flow velocity v as a function of peak flow rate V_p at T = 10°C

Copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057 (k = 0.0015mm)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**35 x 1.5**		**42 x 1.5**		**54 x 2.0**	
ID [mm]	32		39		50	
Nom dia	DN32		DN40		DN50	
Peak flow rate V_p [l/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
0.50	1.7	0.6				
0.75	3.4	0.9				
1.00	5.7	1.2	2.2	0.8	0.7	0.5
1.25	8.4	1.6	3.3	1.1	1.0	0.6
1.50	11.7	1.9	4.5	1.3	1.4	0.8
1.75	15.4	2.2	6.0	1.5	1.8	0.9
2.00	19.5	2.5	7.6	1.7	2.3	1.0
2.20	23.1	2.7	9.0	1.8	2.7	1.1
2.40	27.1	3.0	10.5	2.0	3.2	1.2
2.60	31.2	3.2	12.1	2.2	3.7	1.3
2.80	35.7	3.5	13.8	2.3	4.2	1.4
3.00	40.4	3.7	15.6	2.5	4.7	1.5
3.20	45.4	4.0	17.5	2.7	5.3	1.6
3.40	50.6	4.2	19.5	2.9	5.9	1.7
3.60	56.1	4.5	21.7	3.0	6.6	1.8
3.80	61.9	4.7	23.9	3.2	7.2	1.9
4.00	67.9	5.0	26.2	3.4	7.9	2.0
4.10	74.1	5.2	27.4	3.4	8.3	2.1
4.20			28.5	3.5	8.7	2.1
4.30			29.8	3.6	9.0	2.2
4.40			31.1	3.7	9.4	2.2
4.50			32.4	3.8	9.8	2.3
4.60			33.7	3.9	10.2	2.3
4.70			35.0	3.9	10.6	2.4
4.80			36.3	4.0	11.0	2.4
4.90			37.7	4.1	11.4	2.5
5.00			39.1	4.2	11.8	2.6
5.10			40.6	4.3	12.3	2.6
5.20			42.0	4.4	12.7	2.7
5.30			43.5	4.4	13.1	2.7
5.40			45.0	4.5	13.6	2.8
5.60			48.0	4.7	14.5	2.9
5.80			51.1	4.9	15.5	3.0
6.00			54.4	5.0	16.4	3.1
6.20					17.4	3.2
6.40					18.5	3.3
6.60					19.5	3.4
6.80					20.6	3.5
7.00					21.7	3.6
7.20					22.8	3.7
7.40					24.0	3.8
7.60					25.2	3.9
7.80					26.4	4.0
8.00					27.6	4.1
8.20					28.9	4.2
8.40					30.2	4.3
8.60					31.5	4.4
8.80					32.8	4.5
9.00					34.2	4.6
9.20					35.6	4.7
9.40					37.0	4.8
9.60					38.4	4.9
9.80					39.9	5.0
10.00					41.4	5.1

2.4 Tables of pressure drop due to minor losses

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants Ca at T = 10°C
(density = 985.2 kg/m³)

Pressure drop Z [mbar] due to minor losses													
Óc / v[m/s]	**0.2**	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.5**	**3.0**	**3.5**
0.1	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.15	0.17
0.2	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40	0.50	0.60	0.70
0.3	0.09	0.18	0.27	0.36	0.45	0.54	0.63	0.72	0.81	0.90	1.12	1.35	1.57
0.4	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28	1.44	1.60	2.00	2.40	2.80
0.5	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	3.12	3.75	4.37
0.6	0.36	0.72	1.08	1.44	1.80	2.16	2.52	2.88	3.24	3.60	4.50	5.40	6.30
0.7	0.49	0.98	1.47	1.96	2.45	2.94	3.43	3.92	4.41	4.90	6.12	7.35	8.57
0.8	0.64	1.28	1.92	2.56	3.20	3.84	4.48	5.12	5.76	6.40	8.00	9.60	11.20
0.9	0.81	1.62	2.43	3.24	4.05	4.86	5.67	6.48	7.29	8.10	10.12	12.15	14.17
1.0	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	12.50	15.00	17.49
1.1	1.21	2.42	3.63	4.84	6.05	7.26	8.47	9.68	10.89	12.10	15.12	18.14	21.17
1.2	1.44	2.88	4.32	5.76	7.20	8.64	10.08	11.52	12.96	14.40	17.99	21.59	0.00
1.3	1.69	3.38	5.07	6.76	8.45	10.14	11.83	13.52	15.21	16.89	21.12	25.34	29.57
1.4	1.96	3.92	5.88	7.84	9.80	11.76	13.72	15.68	17.63	19.59	24.49	29.39	34.29
1.5	2.25	4.50	6.75	9.00	11.25	13.50	15.75	17.99	20.24	22.49	28.12	33.74	39.36
1.6	2.56	5.12	7.68	10.24	12.80	15.36	17.91	20.47	23.03	25.59	31.99	38.39	44.79
1.7	2.89	5.78	8.67	11.56	14.45	17.33	20.22	23.11	26.00	28.89	36.11	43.34	50.56
1.8	3.24	6.48	9.72	12.96	16.20	19.43	22.67	25.91	29.15	32.39	40.49	48.59	56.68
1.9	3.61	7.22	10.83	14.44	18.04	21.65	25.26	28.87	32.48	36.09	45.11	54.13	63.16
2.0	4.00	8.00	12.00	16.00	19.99	23.99	27.99	31.99	35.99	39.99	49.99	59.98	69.98
2.1	4.41	8.82	13.23	17.63	22.04	26.45	30.86	35.27	39.68	44.09	55.11	66.13	77.15
2.2	4.84	9.68	14.52	19.35	24.19	29.09	33.87	38.71	43.55	48.39	60.48	72.58	84.67
2.3	5.29	10.58	15.87	21.15	26.44	31.73	37.02	42.31	47.60	52.88	66.11	79.33	92.55
2.4	5.76	11.52	17.27	23.03	28.79	34.55	40.31	46.07	51.82	57.58	71.98	86.37	100.77
2.5	6.25	12.50	18.74	24.99	31.24	37.49	43.74	49.99	56.23	62.48	78.10	93.72	109.34
2.6	6.76	13.52	20.27	27.03	33.79	40.55	47.31	54.06	60.82	67.58	84.47	101.37	118.26
2.7	7.29	14.58	21.86	29.15	36.44	43.73	51.01	58.30	65.59	72.88	91.10	109.32	127.54
2.8	7.84	15.68	23.51	31.35	39.19	47.03	54.86	62.70	70.54	78.38	97.97	117.56	137.16
2.9	8.41	16.81	25.22	33.63	42.04	50.44	58.85	67.26	75.67	84.7	105.09	126.11	147.13
3.0	9.00	17.99	26.99	35.99	44.99	53.98	62.98	71.98	80.98	89.97	112.47	134.96	157.45
3.1	9.61	19.21	28.82	38.43	48.04	57.64	67.25	76.86	86.46	96.07	120.09	144.11	168.12
3.2	10.24	20.47	30.71	40.95	51.18	61.42	71.66	81.90	92.13	102.37	127.96	153.55	179.15
3.4	11.56	23.11	34.67	46.23	57.78	69.34	80.90	92.45	104.01	115.57	144.46	173.35	202.24
3.6	12.96	25.91	38.87	51.82	64.78	77.74	90.69	103.65	116.61	129.56	161.95	194.34	226.73
3.8	14.44	28.87	43.31	57.74	72.18	86.61	101.05	115.49	129.92	144.36	180.45	216.54	252.62
4.0	16.00	31.99	47.99	63.98	79.98	95.97	111.97	127.96	143.96	159.95	199.94	239.93	279.92
4.2	17.63	35.27	52.90	70.54	88.17	105.81	123.44	141.08	158.71	176.35	220.43	264.52	308.61
4.4	19.35	38.71	58.06	77.42	96.77	116.13	135.48	154.83	174.19	193.54	241.93	290.31	338.70
4.6	21.15	42.31	63.46	84.61	105.77	126.92	148.08	169.23	190.38	211.54	264.42	317.30	370.19
4.8	23.03	46.07	69.10	92.13	115.17	138.20	161.23	184.26	207.30	230.33	287.91	345.50	403.08
5.0	24.99	49.99	74.98	99.97	124.96	149.96	174.95	199.94	224.93	249.93	312.41	374.89	437.37

2.4 Table of pressure drop due to minor losses [Continuation]

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants Ca T = 10°C
(density = 985.2kg/m³)

Pressure drop Z [mbar] due to minor losses													
Óc v[m/s]	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
0.1	0.20	0.22	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
0.2	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
0.3	1.80	2.02	2.25	2.47	2.70	2.92	3.15	3.37	3.60	3.82	4.05	4.27	4.50
0.4	3.20	3.60	4.00	4.40	4.80	5.20	5.60	6.00	6.40	6.80	7.20	7.60	8.00
0.5	5.00	5.62	6.25	6.87	7.50	8.12	8.75	9.37	10.00	10.62	11.25	11.87	12.50
0.6	7.20	8.10	9.00	9.90	10.80	11.70	12.60	13.50	14.40	15.30	16.20	17.09	17.99
0.7	9.80	11.02	12.25	13.47	14.70	15.92	17.14	18.37	19.59	20.82	22.04	23.27	24.49
0.8	12.80	14.40	16.00	17.59	19.19	20.79	22.39	23.99	25.59	27.19	28.79	30.39	31.99
0.9	16.20	18.22	20.24	22.27	24.29	26.32	28.34	30.37	32.39	34.41	36.44	38.46	40.49
1.0	19.99	22.49	24.99	27.49	29.99	32.49	34.99	37.49	39.99	42.49	44.99	47.49	49.99
1.1	24.19	27.22	30.24	33.27	36.29	39.31	42.34	45.36	48.39	51.41	54.43	57.46	60.48
1.2	28.79	32.39	35.99	39.59	43.19	46.79	50.38	53.98	57.58	61.18	64.78	68.38	71.98
1.3	33.79	38.01	42. 24	46.46	50.68	54.91	59 .13	63 . 36	67 .58	71.80	76.03	80.25	84.47
1.4	39.19	44.09	48.99	53.88	58.78	63.68	68.58	73.48	78.38	83.28	88.17	93.07	97.97
1.5	44.99	50.61	56.23	61.86	67.48	73.10	78.73	84.35	89.97	95.60	101.22	106.84	112.47
1.6	51.18	57.58	63.98	70.38	76.78	83.18	89.57	95.97	102.37	108.77	115.17	121.56	127.96
1.7	557.78	65.01	72.23	79.45	86.67	93.90	101.12	108.34	115.57	122.79	130.01	137.23	144.46
1.8	64.78	72.88	80.98	89.07	97.17	105.27	113.37	121.46	129.56	137.66	145.76	153.85	161.95
1.9	72.18	81.20	90.22	99.25	108.27	117.29	126.31	135.33	144.36	153.38	162.40	171.42	180.45
2.0	79.98	89.97	99.97	109.97	119.96	129.96	139.96	149.96	159.95	169.95	179.95	189.94	199.94
2.1	88.17	99.20	110.22	121.24	132.26	143.28	154.30	165.33	176.35	187.37	198.39	209.41	220.43
2.2	96.77	108.87	120.96	133.06	145.16	157.25	169.35	181.45	193.54	205.64	217.73	229.83	241.93
2.3	105.77	118.99	132.21	145.43	158.65	171.87	185.09	198.32	211.54	224.76	237.98	251.20	264.42
2.4	115.17	129.56	143.96	158.35	172.75	187.14	201.54	215.94	230.33	244.73	259.12	273.52	287.91
2.5	124.96	140.58	156.20	171.82	187.44	203.06	218.68	234.30	249.93	265.55	281.17	296.79	312.41
2.6	135.16	152.05	168.95	185.84	202.74	219.63	236.53	253.42	270.32	287.21	304.11	321.00	337.90
2.7	145.76	163.98	182.20	200.41	218.63	236.85	255.07	273.29	291.51	309.73	327.95	346.17	364.39
2.8	156.75	176.35	195.94	215.54	235.13	254.72	274.32	293.91	313.51	333.10	352.69	372.29	391.88
2.9	168.15	189.17	210.19	231.21	252.22	273.24	294.26	315.28	336.30	357.32	378.34	399.36	420.37
3.0	179.95	202.44	224.93	247.43	269.92	292.41	314.91	337.40	359.89	382.39	404.88	427.37	449.87
3.1	192.14	216.16	240.18	264.20	288.21	312.23	336.25	360.27	384.28	408.30	432.32	456.34	480.36
3.2	204.74	230.33	255.92	281.52	307.11	332.70	358.29	383.88	409.48	435.07	460.66	486.25	511.85
3.4	231.13	260.02	288.91	317.80	346.70	375.59	404.48	433.37	462.26	491.15	520.04	548.94	577.83
3.6	259.12	291.51	323.90	356.29	388.68	421.07	453.46	485.85	518.24	550.63	583.03	615.42	647.81
3.8	288.71	324.80	360.89	396.98	433.07	469.16	505.25	541.34	577.43	613.52	649.61	685.69	721.78
4.0	319.90	359.89	399.88	439.87	479.86	519.84	559.82	599.82	639.81	679.80	719.78	759.77	799.76
4.2	352.69	396.78	440.87	484.95	529.04	573.13	617.21	661.30	705.39	749.48	793.56	837.65	881.74
4.4	387.08	435.47	483.85	532.24	580.63	629.01	677.40	725.78	774.17	822.55	870.94	919.32	967.71
4.6	423.07	475.96	528.84	581.73	634.61	687.49	740.38	793.26	846.15	899.03	951.91	1004.80	1057.68
4.8	460.66	518.24	575.83	633.41	690.99	748.58	806.16	863.74	921.32	978.91	1036.49	1094.07	1151.65
5.0	499.85	562.33	624.81	687.29	749.78	812.26	874.74	937.22	999.70	1062.18	1124.66	1187.14	1249.63

3.0 Closed Hot Water Heating Systems to DIN 4751

3.1 Pressure drop tables for *mapress* EDELFLEX (for unit differential)

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 60°C

mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541 (k = 0.0015mm)

Nominal size	**Outside diameter x wall thickness**	
dxt [mm]	**12 x 0.1**	
ID [mm]	11.8	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]
1	5.01	0.043
5	25.06	0.055
10	32.84	0.073
15	42.14	0.094
20	49.21	0.108
25	55.80	0.122
30	62.40	0.137
35	68.14	0.150
40	73.88	0.163
45	78.95	0.174
50	84.13	0.186
55	88.83	0.195
60	93.53	0.206
65	97.98	0.216
70	102.44	0.226
75	106.71	0.235
80	110.97	0.244
85	114.77	0.252
90	118.57	0.261
95	122.36	0.269
100	126.16	0.277
110	132.83	0.293
120	139.48	0.308
130	146.12	0.322
140	152.75	0.337
150	159.37	0.351
160	165.09	0.364
170	170.79	0.376
180	176.48	0.389
190	182.17	0.401
200	187.86	0.414
210	193.08	0.425
220	198.30	0.436
230	203.05	0.448
240	207.80	0.459
250	213.30	0.470
260	218.20	0.481
270	222.60	0.492
280	227.70	0.501
290	232.00	0.511
300	236.30	0.521
320	245.13	0.540
340	253.96	0.560
360	262.80	0.579
380	270.90	0.596
400	279.00	0.614
425	288.50	0.636
450	298.00	0.657
475	307.05	0.678
500	316.10	0.698
750	397.70	0.878
1000	494.50	1.091

3.2 Pressure drop tables for *mapress* CARBON STEEL (for unit differential)

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 80°C

mapress CARBON STEEL pipes to DIN 2394 (k = 0.01 mm)

Nominal size	Pipe outside diameter x wall thickness											
d x t [mm]	**12 x 1.2**		**15 x 1.2**		**18 x 1.2**		**22 x 1.5**		**28 x 1.5**		**35 x 1.5**	
ID [mm]	9.6		12.6		15.6		19		25		32	
Nom dia	DN10		DN12		DN15		DN20		DN25		DN32	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]
29	29	0.11	61	0.14	109	0.16	187	0.19	393	0.23	766	0.27
32	30	0.12	64	0.15	115	0.17	197	0.20	414	0.24	807	0.29
35	32	0.13	67	0.15	121	0.18	207	0.21	435	0.25	847	0.30
39	34	0.13	72	0.16	128	0.19	219	0.22	461	0.27	898	0.32
44	36	0.14	77	0.17	137	0.21	234	0.24	493	0.29	958	0.34
49	39	0.15	81	0.19	146	0.22	249	0.25	522	0.30	1016	0.36
54	41	0.16	86	0.20	154	0.23	262	0.26	551	0.32	1070	0.38
59	43	0.17	90	0.20	161	0.24	275	0.28	578	0.34	1123	0.40
64	45	0.18	94	0.22	169	0.25	288	0.29	604	0.35	1173	0.42
69	47	0.18	98	0.23	176	0.26	300	0.30	629	0.37	1222	0.43
74	49	0.19	102	0.23	183	0.27	312	0.31	654	0.38	1269	0.46
78	50	0.20	106	0.24	189	0.28	323	0.33	678	0.40	1315	0.47
88	54	0.21	113	0.26	202	0.30	345	0.35	723	0.42	1402	0.50
98	57	0.23	120	0.28	215	0.32	366	0.37	766	0.45	1485	0.53
108	60	0.24	127	0.29	226	0.34	386	0.39	807	0.47	1565	0.56
118	63	0.25	133	0.31	238	0.36	405	0.41	846	0.49	1640	0.58
128	66	0.26	140	0.32	248	0.37	423	0.43	884	0.52	1713	0.61
137	69	0.27	145	0.33	259	0.39	440	0.44	921	0.54	1783	0.63
147	72	0.28	151	0.35	269	0.40	457	0.46	956	0.56	1851	0.66
157	75	0.29	156	0.36	279	0.42	474	0.48	990	0.58	1916	0.68
167	77	0.30	162	0.37	288	0.43	490	0.49	1023	0.60	1980	0.70
177	80	0.31	167	0.38	297	0.45	505	0.51	1056	0.62	2042	0.73
186	82	0.32	167	0.39	306	0.46	521	0.53	1087	0.63	2102	0.75
196	85	0.33	172	0.41	315	0.47	535	0.54	1118	0.66	2161	0.77
216	89	0.35	186	0.43	332	0.50	564	0.57	1177	0.69	2275	0.81
235	94	0.37	196	0.45	348	0.52	591	0.60	1234	0.72	2384	0.85
255	98	0.39	204	0.47	364	0.54	618	0.62	1288	0.75	2488	0.89
275	102	0.40	213	0.49	379	0.57	643	0.65	1341	0.78	2589	0.92
294	106	0.42	221	0.51	394	0.59	668	0.67	1391	0.81	2687	0.96
324	112	0.44	233	0.53	414	0.62	703	0.71	1464	0.85	2827	1.00
353	114	0.46	244	0.56	434	0.65	737	0.74	1534	0.89	2961	1.05
392	117	0.49	259	0.59	460	0.69	780	0.79	1624	0.95	3132	1.11
441	133	0.52	276	0.63	460	0.73	831	0.84	1729	1.00	3334	1.19
490	140	0.55	292	0.67	519	0.78	880	0.89	1829	1.07	3526	1.26
540	148	0.58	308	0.71	546	0.82	926	0.93	1924	1.12	3709	1.32
589	155	0.61	323	0.74	572	0.86	970	0.98	2016	1.17	3883	1.38
638	162	0.64	337	0.77	598	0.89	1012	1.02	2103	1.23	4051	1.44
687	169	0.66	351	0.80	622	0.93	1053	1.06	2188	1.27	4213	1.50
736	175	0.69	364	0.82	645	0.97	1093	1.10	2269	1.32	4369	1.55
785	182	0.72	377	0.87	668	1.00	1131	1.14	2348	1.37	4520	1.61
883	194	0.76	402	0.92	712	1.06	1204	1.21	2499	1.46	4808	1.71
981	205	0.81	425	0.98	753	1.13	1274	1.28	2642	1.54	5082	1.81
1079	216	0.85	448	1.03	792	1.19	1340	1.35	2778	1.61	5342	1.90
1177	226	0.89	469	1.08	829	1.24	1403	1.41	2908	1.69	5591	1.99
1275	236	0.93	489	1.12	866	1.30	1464	1.48	3303	1.77	5829	2.07
1373	246	0.97	509	1.17	900	1.35	1522	1.53	3153	1.84	6059	2.15
1471	255	1.00	528	1.21	934	1.40	1578	1.59	3269	1.90	6281	2.23
1570	264	1.04	547	1.25	966	1.45	1633	1.65	3381	1.97	6496	2.31
1669	273	1.07	564	1.29	998	1.50	1686	1.70	3490	2.03	6704	2.38
1766	281	1.11	582	1.33	1028	1.54	1737	1.75	3596	2.09	6907	2.46
1864	296	1.14	599	1.38	1058	1.59	1787	1.80	3699	2.15	7103	2.52
1962	297	1.17	615	1.41	1087	1.63	1836	1.85	3799	2.21	7295	2.59

3.2 Pressure drop tables for mapress CARBON STEEL (for unit differential) [Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 80°C
mapress CARBON STEEL pipes to DIN 2394
(k = 0.01mm)

Nominal size	Pipe outside diameter x wall thickness			
d x t [mm]	**42 x 1.5**		**54 x 1.5**	
ID [mm]	39.0		51.0	
Nom dia	DN40		DN50	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]
13	835	0.20	1640	0.23
22	1086	0.26	2210	0.31
29	1253	0.30	2570	0.36
32	1336	0.32	2712	0.38
39	1503	0.36	3000	0.42
47	1670	0.40	3285	0.46
53	1755	0.42	3570	0.50
63	1940	0.46	3880	0.54
72	2100	0.50	4150	0.58
78	2180	0.52	4310	0.60
89	2340	0.56	4600	0.64
98	2450	0.59	4850	0.68
103	2515	0.60	5000	0.70
108	2600	0.62	5280	0.73
118	2715	0.65	5430	0.76
130	2850	0.68	5710	0.80
137	2925	0.70	5855	0.82
151	3070	0.74	6160	0.86
157	3130	0.75	6270	0.88
164	3200	0.76	6420	0.90
180	3350	0.80	6720	0.94
196	3500	0.84	7000	0.98
201	3550	0.85	7170	1.00
207	3600	0.86	7380	1.03
216	3675	0.88	7550	1.06
225	3780	0.90	7700	1.08
235	3880	0.93	7870	1.10
255	4040	0.96	8200	1.15
270	4170	1.00	8440	1.18
279	4230	1.01	8570	1.20
283	4260	1.02	8740	1.22
294	4340	1.04	8920	1.25
309	4450	1.07	9140	1.28
319	4520	1.08	9280	1.30
329	4593	1.10	9425	1.32
353	4760	1.14	9775	1.37
368	4945	1.18	9975	1.40
374	5000	1.20	10060	1.41
392	5130	1.23	10300	1.44
407	5225	1.25	10495	1.47
441	5440	1.30	10920	1.53
452	5510	1.32	11060	1.5
471	5630	1.35	11440	1.60
490	5740	1.38	11670	1.63
509	5845	1.40	11900	1.67
540	6020	1.44	12250	1.72
589	6285	1.50	12800	1.79
595	6320	1.51	12860	1.80
638	6700	1.60	13320	1.86
663	6835	1.64	13570	1.90
736	7200	1.72	14300	2.00
805	7530	1.80	14950	2.10
1000	8490	2.00	16950	2.30

3.3 Pressure drop tables for *mapress* SUPER SIZE HEATING (for unit differential)

Pipe pressure gradient due to friction *R* as a function of mass flow *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 80 °C
mapress SUPER SIZE HEATING pipes to DIN EN ISO 1127
(k = 0.0015mm)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**76.1 x 1.5**		**88.9 x 1.5**		**108.0 x 2.0**	
ID [mm]	73.1		85.9		104.0	
Nom dia	DN65		DN80		DN100	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]
11	3950	0.28	6200	0.32	10500	0.36
13	4250	0.30	6650	0.34	11500	0.39
16	4900	0.35	7600	0.39	12750	0.44
21	5600	0.40	8800	0.45	14750	0.51
25	6200	0.44	9600	0.49	16250	0.56
30	6800	0.48	10750	0.54	18000	0.63
31	7000	0.50	10900	0.56	18500	0.64
35	7450	0.53	11700	0.59	19500	0.68
37	7700	0.55	12000	0.62	20000	0.69
40	8000	0.58	12500	0.64	21000	0.73
45	8450	0.61	13250	0.68	22500	0.78
50	9050	0.65	14000	0.72	23750	0.82
55	9600	0.68	15000	0.76	25000	0.86
58	9900	0.70	15250	0.78	25750	0.88
60	10000	0.72	15500	0.79	26000	0.91
65	10500	0.75	16250	0.83	27500	0.95
70	10800	0.78	17000	0.87	28500	0.99
74	11250	0.80	17750	0.90	29500	1.02
80	11800	0.84	18250	0.94	31000	1.08
85	12000	0.86	18750	0.97	31500	1.11
90	12400	0.89	19500	1.0	33000	1.14
95	12750	0.92	20000	1.04	33500	1.18
100	13250	0.95	20750	1.07	34500	1.20
105	13500	0.98	21500	1.09	35500	1.24
110	14000	1.00	22000	1.13	36500	1.27
120	14500	1.05	23000	1.18	38000	1.34
130	15250	1.10	24000	1.23	40000	1.39
140	16000	1.15	25000	1.29	41500	1.45
150	16500	1.18	26000	1.33	43000	1.52
155	17000	1.20	26500	1.36	44000	1.54
165	17500	1.25	27500	1.40	45500	1.59
175	18000	1.30	28000	1.45	46500	1.65
185	18500	1.35	29000	1.50	48000	1.69
200	19500	1.39	30000	1.57	51000	1.77
215	20250	1.45	31500	1.63	51500	1.84
225	21000	1.50	32000	1.67	54000	1.88
240	21500	1.55	33500	1.73	56000	1.96
250	22000	1.58	34000	1.76	56500	2.00
255	22500	1.60	34500	1.78	58000	2.02
270	23000	1.65	35500	1.84	60000	2.09
280	23750	1.70	36500	1.87	61000	2.13
300	24500	1.75	38000	1.94	63000	2.20
320	25000	1.80	39000	2.00	65000	2.28
350	26500	1.90	41000	2.11	69000	2.40
390	28000	2.00	44000	2.25	71000	2.56
400	28500	2.05	45500	2.28		
420	29500	2.10	46000	2.35		
460	31000	2.20	48000	2.46		
500	32000	2.30				
600	35500	2.56				

3.4 Pressure drop tables for *mapress* COPPER **(for unit differential)**

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 60°C

Copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057 (k = 0.0015 mm)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**12 x 1.0**		**15 x 1.0**		**18 x 1.0**		**22 x 1.0**	
ID [mm]	10		13		16		20	
Nom dia	DN10		DN12		DN15		DN20	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]
15	28.1	0.100	43.7	0.093	77.8	0.109	144	0.129
16	30.0	0.110	45.4	0.098	80.0	0.113	149	0.134
17	22.7	0.082	47.1	0.100	83.7	0.118	155	0.139
18	23.5	0.084	48.7	0.104	86.5	0.122	160	0.144
19	24.2	0.087	50.3	0.107	89.3	0.125	165	0.148
20	25.0	0.089	51.9	0.110	92.0	0.129	170	0.153
22	26.5	0.095	54.8	0.117	97.3	0.137	180	0.162
24	27.9	0.100	57.7	0.123	102	0.144	189	0.170
26	29.2	0.105	60.5	0.129	107	0.151	198	0.178
28	30.5	0.110	63.2	0.135	112	0.157	207	0.186
30	31.8	0.114	65.8	0.140	117	0.164	215	0.193
33	33.7	0.121	69.6	0.148	123	0.173	227	0.204
36	35.4	0.127	73.2	0.156	130	0.182	239	0.215
40	37.7	0.136	77.9	0.166	138	0.194	254	0.228
45	40.4	0.145	83.4	0.178	148	0.207	272	0.244
50	43.0	0.155	88.7	0.189	157	0.220	288	0.259
55	45.5	0.164	93.8	0.200	166	0.233	305	0.274
60	47.9	0.172	98.6	0.210	174	0.245	320	0.288
65	50.2	0.181	103	0.220	182	0.256	335	0.302
70	52.4	0.189	108	0.230	190	0.268	350	0.315
75	54.6	0.196	112	0.239	198	0.278	364	0.327
80	56.7	0.204	117	0.248	206	0.289	378	0.340
90	60.7	0.218	125	0.266	220	0.309	404	0.363
100	64.6	0.232	133	0.282	234	0.329	429	0.386
110	68.3	0.246	140	0.298	247	0.347	453	0.407
120	71.8	0.258	147	0.314	260	0.365	476	0.428
130	75.2	0.271	154	0.328	272	0.382	498	0.448
140	78.5	0.282	161	0.343	284	0.398	519	0.467
150	81.7	0.294	168	0.357	295	0.414	540	0.486
160	84.9	0.305	174	0.370	306	0.430	560	0.504
170	87.9	0.316	180	0.383	317	0.445	580	0.522
180	90.8	0.327	186	0.396	327	0.460	599	0.539
190	93.7	0.337	192	0.408	338	0.474	618	0.556
200	96.6	0.347	198	0.421	348	0.488	636	0.572
220	102	0.367	209	0.444	367	0.516	671	0.604
240	107	0.386	219	0.467	386	0.542	705	0.634
260	112	0.404	230	0.489	403	0.567	738	0.663
280	117	0.422	240	0.510	421	0.591	769	0.692
300	122	0.439	249	0.530	438	0.615	800	0.719
330	129	0.464	263	0.560	462	0.649	844	0.759
360	135	0.487	277	0.589	485	0.682	886	0.797
400	144	0.518	294	0.625	515	0.724	941	0.846
450	154	0.554	314	0.668	551	0.774	1005	0.904
500	164	0.588	333	0.710	584	0.821	1066	0.959
550	173	0.621	352	0.749	617	0.867	1125	1.01
600	181	0.653	370	0.787	648	0.910	1181	1.06
650	190	0.683	387	0.823	678	0.952	1235	1.11
700	198	0.713	403	0.859	706	0.993	1288	1.16
750	206	0.741	419	0.893	734	1.03	1338	1.20
800	214	0.769	435	0.926	762	1.07	1388	1.25
900	229	0.822	465	0.990	814	1.14	1482	1.33
1000	243	0.873	493	1.05	863	1.21	1572	1.41
1100	256	0.922	521	1.11	911	1.28	1658	1.49

3.4 Pressure drop tables for *mapress* COPPER (for unit differential)[Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* with temperature differential ΔT = 1K, heating water temperature T = 60°C

Copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057 (k = 0.0015 mm)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**28 x 1.5**		**35 x 1.5**		**42 x 1.5**		**54 x 2.0**	
ID [mm]	25		32		39		50	
Nom dia	DN25		DN32		DN40		DN50	
Pressure gradient *R* [Pa/m]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]	*m* [kg/h]	*v* [m/s]
15	265	0.153	520	0.183	890	0.210	1744	0.251
16	275	0.158	540	0.190	923	0.218	1809	0.260
17	285	0.164	559	0.196	956	0.226	1872	0.269
18	295	0.170	577	0.203	988	0.234	1934	0.278
19	304	0.175	595	0.209	1018	0.241	1994	0.287
20	313	0.180	613	0.215	1049	0.248	2052	0.295
22	331	0.190	647	0.227	1107	0.262	2166	0.312
24	348	0.200	680	0.239	1163	0.275	2275	0.327
26	364	0.209	712	0.250	1217	0.288	2380	0.342
28	380	0.219	743	0.261	1269	0.300	2482	0.357
30	395	0.227	773	0.271	1320	0.312	2580	0.371
33	417	0.240	816	0.287	1393	0.329	2722	0.392
36	439	0.252	857	0.301	1464	0.346	2859	0.411
40	466	0.268	910	0.320	1553	0.367	3034	0.436
45	498	0.287	973	0.342	1660	0.393	3241	0.466
50	529	0.350	1033	0.363	1762	0.417	3439	0.495
55	559	0.322	1090	0.383	1859	0.440	3627	0.522
60	587	0.338	1145	0.402	1953	0.462	3809	0.548
65	615	0.354	1198	0.421	2043	0.483	3983	0.573
70	641	0.369	1250	0.439	2130	0.504	4152	0.597
75	667	0.384	1299	0.456	2214	0.524	4315	0.621
80	692	0.398	1348	0.473	2296	0.543	4474	0.644
90	739	0.426	1440	0.506	2453	0.580	4778	0.688
100	785	0.452	1528	0.537	2602	0.615	5068	0.729
110	829	0.477	1613	0.567	2745	0.649	5345	0.769
120	870	0.501	1694	0.595	2882	0.682	5610	0.807
130	911	0.524	1772	0.622	3015	0.713	5866	0.844
140	950	0.547	1847	0.649	3142	0.743	6113	0.880
150	987	0.568	1920	0.674	3266	0.773	6352	0.914
160	1024	0.589	1991	0.699	3386	0.801	6585	0.947
170	1060	0.610	2060	0.724	3502	0.828	6810	0.980
180	1094	0.630	2127	0.747	3616	0.855	7030	1.01
190	1128	0.649	2192	0.770	3727	0.881	7244	1.04
200	1161	0.668	2256	0.793	3835	0.907	7454	1.07
220	1225	0.705	2380	0.836	4044	0.957	7858	1.13
240	1287	0.741	2499	0.878	4245	1.00	8247	1.19
260	1346	0.775	2613	0.918	4439	1.05	8621	1.24
280	1403	0.808	2723	0.957	4626	1.09	8982	1.29
300	1459	0.840	2830	0.994	4807	1.14	9331	1.34
330	1539	0.886	2985	1.05	5068	1.20	9837	1.42
360	1616	0.930	3133	1.10	5319	1.26	10321	1.49
400	1714	0.987	3323	1.17	5639	1.33	10940	1.57
450	1831	1.05	3548	1.25	6020	1.42	11674	1.68
500	1942	1.12	3762	1.32	6382	1.51	12372	1.78
550	2048	1.18	3967	1.39	6727	1.59	13039	1.88
600	2150	1.24	4163	1.46	7059	1.67	13679	1.97
650	2248	1.29	4352	1.53	7378	1.74	14295	2.06
700	2343	1.35	4534	1.59	7686	1.82	14889	2.14
750	2435	1.40	4711	1.65	7985	1.89	15464	2.23
800	2524	1.45	4883	1.72	8274	1.96	16022	2.31
900	2695	1.55	5211	1.83	8829	2.09	17092	2.46
1000	2857	1.64	5524	1.94	9356	2.21	18108	2.61
1100	3012	1.73	5822	2.05	9860	2.33	19079	2.75

3.5 Pressure drop due to minor losses

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants C
(density = 985.2kg/m³)

Pressure drop Z [mbar] due to minor losses													
Óc / v[m/s]	**0.2**	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.5**	**3.0**	**3.5**
0.10	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.15	0.17
0.15	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.18	0.20	0.22	0.28	0.33	0.39
0.20	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.31	0.35	0.39	0.49	0.59	0.69
0.25	0.06	0.12	0.18	0.25	0.31	0.37	0.43	0.49	0.55	0.61	0.77	0.92	1.08
0.30	0.09	0.18	0.27	0.35	0.44	0.53	0.62	0.71	0.80	0.88	1.11	1.33	1.55
0.35	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.20	1.51	1.81	2.11
0.40	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26	1.42	1.57	1.97	2.36	2.75
0.45	0.20	0.40	0.60	0.80	1.00	1.19	1.39	1.59	1.79	1.99	2.49	2.99	3.48
0.50	0.25	0.49	0.74	0.98	1.23	1.47	1.72	1.97	2.21	2.46	3.07	3.69	4.30
0.55	0.30	0.59	0.89	1.19	1.49	1.78	2.08	2.38	2.68	2.97	3.72	4.46	5.20
0.60	0.35	0.71	1.06	1.42	1.77	2.12	2.48	2. 83	3.19	3. 54	4. 42	5.31	6.19
0.65	0.42	0.83	1.25	1.66	2.08	2.49	2.91	3.32	3.74	4. 15	5.19	6.23	7.27
0.70	0.48	0.96	1.45	1.93	2.41	2.89	3.37	3.85	4.34	4.82	6.02	7.23	8.43
0.75	0.55	1.11	1.66	2.21	2.77	3.32	3.87	4.42	4.98	5.53	6.91	8.30	9.68
0.80	0.63	1.26	1.89	2.52	3.15	3.78	4.40	5.03	5.66	6.29	7.87	9.44	11.01
0.85	0.71	1.42	2.13	2.84	3.55	4.26	4.97	5.68	6.39	7.10	8.88	10.66	12.43
0.90	0.80	1.59	2.39	3.19	3.98	4.78	5.57	6.37	7.17	7.96	9.95	11.95	13.94
0.95	0.89	1.77	2.66	3.55	4.44	5.32	6.21	7.10	7.99	8.87	11.09	13.31	15.53
1.00	0.98	1.97	2.95	3.93	4.92	5.90	6.88	7.87	8.85	9.83	12.29	14.75	17.21
1.05	1.08	2.17	3.25	4.34	5.42	6.50	7.59	8.67	9.76	10.84	13.55	16.26	18.97
1.10	1.19	2.38	3.57	4.76	5.95	7.14	8.33	9.52	10.71	11.90	14.87	17.85	20.82
1.15	1.30	2.60	3.90	5.20	6.50	7.80	9.10	10.40	11.70	13.00	16.25	19.50	22.75
1.20	1.42	2.83	4.25	5.66	7.08	8.49	9.91	11.33	12.74	14.16	17.70	21.24	24.78
1.30	1.66	3.32	4.98	6.65	8.31	9.97	11.63	13.29	14.95	16.62	20.77	24.92	29.08
1.40	1.93	3.85	5.78	7.71	9.64	11.56	13.49	15.42	17.34	19.27	24.09	28.91	33.72
1.50	2.21	4.42	6.64	8.85	11.06	13.27	15.49	17.70	19.91	22.12	27.65	33.18	38.71
1.60	2.52	5.03	7.55	10.07	12.58	15.10	17.62	20.14	22.65	25.17	31.46	37.75	44.05
1.70	2.84	5.68	8.52	11.37	14.21	17.05	19.89	22.73	25.57	28.41	35.52	42.62	49.73
1.80	3.19	6.37	9.56	12.74	15.93	19.11	22.30	25.48	28.67	31.86	39.82	47.78	55.75
1.90	3.55	7.10	10.65	14.20	17.75	21.30	24.85	28.39	31.94	35.49	44.37	53.24	62.11
2.00	3.93	7.87	11.80	15.73	19.66	23.60	27.53	31.46	35.40	39.33	49.16	58.99	68.82
2.10	4.34	8.67	13.01	17.34	21.68	26.02	30.35	34.69	39.02	43.36	54.20	65.04	75.88
2.20	4.76	9.52	14.28	19.03	23.79	28.55	33.31	38.07	42.83	47.59	59.48	71.38	83.28
2.30	5.20	10.40	15.60	20.80	26.01	31.21	36.41	41.61	46.81	52.01	65.01	78.02	91.02
2.40	5.66	11.33	16.99	22.65	28.32	33.98	39.64	45.31	50.97	56.63	70.79	84.95	99.11
2.50	6.15	12.29	18.44	24.58	30.73	36.87	43.02	49.16	55.31	61.45	76.81	92.18	107.54
2.60	6.65	13.29	19.94	26.59	33.23	39.88	46.53	53.17	59.82	66.46	83.08	99.70	116.31
2.70	7.17	14.34	21.50	28.67	35.84	43.01	50.17	57.34	64.51	71.68	89.59	107.51	125.43
2.80	7.71	15.42	23.12	30.83	38.54	46.25	53.96	61.67	69.37	77.08	96.35	115.62	134.90
2.90	8.27	16.54	24.81	33.07	41.34	49.61	57.88	66.15	74.42	82.69	103.36	124.03	144.70

3.5 Pressure drop due to minor losses [Continuation]

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants C
(density = 985.2kg/m³)

Pressure drop Z [mbar] due to minor losses													
Óc / v[m/s]	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
0.10	0.20	0.22	0.25	0.27	0.29	0.32	0.34	0.37	0.39	0.42	0.44	0.47	0.49
0.15	0.44	0.50	0.55	0.61	0.66	0.72	0.77	0.83	0.88	0.94	1.00	1.05	1.11
0.20	0.79	0.88	0.98	1.08	1.18	1.28	1.38	1.47	1.57	1.67	1.77	1.87	1.97
0.25	1.23	1.38	1.54	1.69	1.84	2.00	2.15	2.30	2.46	2.61	2.77	2.92	3.07
0.30	1.77	1.99	2.21	2.43	2.65	2.88	3.10	3.32	3.54	3.76	3.98	4.20	4.42
0.35	2.41	2.71	3.01	3.31	3.61	3.91	4.22	4.52	4.82	5.12	5.42	5.72	6.02
0.40	3.15	3.54	3.93	4.33	4.72	5.11	5.51	5.90	6.29	6.69	7.08	7.47	7.87
0.45	3.98	4.48	4.98	5.48	5.97	6.47	6.97	7.47	7.96	8.46	8.96	9.46	9.95
0.50	4.92	5.53	6.15	6.76	7.37	7.99	8.60	9.22	9.83	10.45	11.06	11.68	12.29
0.55	5.95	6.69	7.44	8.18	8.92	9.67	10.41	11.15	11.90	12.64	13.38	14.13	14.87
0.60	7.08	7.96	8.85	9.73	10.62	11.50	12.39	13.27	14.16	15.04	15.93	16.81	17.70
0.65	8.31	9.35	10.39	11.42	12.46	13.50	14.54	15.58	16.62	17.65	18.69	19.73	20.77
0.70	9.64	10.84	12.04	13.25	14.45	15.66	16.86	18.07	19.27	20.48	21.68	22.88	24.09
0.75	11.06	12.44	13.83	15.21	16.59	17.97	19.36	20.74	22.12	23.50	24.89	26.27	27.65
0.80	12.58	14.16	15.73	17.30	18.88	20.45	22.02	23.60	25.17	26.74	28.32	29.89	31.46
0.85	14.21	15.98	17.76	19.53	21.31	23.09	24.86	26.64	28.41	30.19	31.97	33.74	35.52
0.90	15.93	17.92	19.91	21.90	23.89	25.88	27.87	29.86	31.86	33.85	35.84	37.83	39.82
0.95	17.75	19.97	22.18	24.40	26.62	28.84	31.06	33.28	35.49	37.71	39.93	42.15	44.37
1.00	19.66	22.12	24.58	27.04	29.50	31.95	34.41	36.87	39.33	41.79	44.24	46.70	49.16
1.05	21.68	24.39	27.10	29.81	32.52	35.23	37.94	40.65	43.36	46.07	48.78	51.49	54.20
1.10	23.79	26.77	29.74	32.72	35.69	38.66	41.64	44.61	47.59	50.56	53.54	56.51	59.48
1.15	26.01	29.26	32.51	35.76	39.01	42.26	45.51	48.76	52.01	55.26	58.51	61.76	65.01
1.20	28.32	31.86	35.40	38.93	42.47	46.01	49.55	53.09	56.63	60.17	63.71	67.25	70.79
1.30	33.23	37.39	41.54	45.69	49.85	54.00	58.16	62.31	66.46	70.62	74.77	78.93	83.08
1.40	38.54	43.36	48.18	52.99	57.81	62.63	67.45	72.27	77.08	81.90	86.72	91.54	96.35
1.50	44.24	49.77	55.31	60.84	66.37	71.90	77.43	82.96	88.49	94.02	99.55	105.08	110.61
1.60	50.34	56.63	62.92	69.22	75.51	81.80	88.09	94.39	100.68	106.97	113.26	119.56	125.85
1.70	56.83	63.93	71.04	78.14	85.24	92.35	99.45	106.55	113.66	120.76	127.87	134.97	142.07
1.80	63.71	71.68	79.64	87.60	95.57	103.53	111.49	119.46	127.42	135.39	143.35	151.31	159.28
1.90	70.99	79.86	88.73	97.61	106.48	115.35	124.23	133.10	141.97	150.85	159.72	168.59	177.47
2.00	78.66	88.49	98.32	108.15	117.98	127.82	137.65	147.48	157.31	167.14	176.98	186.81	196.64
2.10	86.72	97.56	108.40	119.24	130.08	140.92	151.76	162.60	173.44	184.28	195.12	205.96	216.80
2.20	95.17	107.07	118.97	130.86	142.76	154.66	166.55	178.45	190.35	202.24	214.14	226.04	237.93
2.30	104.02	117.03	130.03	143.03	156.03	169.04	182.04	195.04	208.05	221.05	234.05	247.05	260.06
2.40	113.26	127.42	141.58	155.74	169.90	184.06	198.21	212.37	226.53	240.69	254.85	269.00	283.16
2.50	122.90	138.26	153.63	168.99	184.35	199.71	215.08	230.44	245.80	261.16	276.53	291.89	307.25
2.60	132.93	149.54	166.16	182.78	199.39	216.01	232.63	249.24	265.86	282.47	299.09	315.71	332.32
2.70	143.35	161.27	179.19	197.11	215.03	232.94	250.86	268.78	286.70	304.62	322.54	340.46	358.38
2.80	154.17	173.44	192.71	211.98	231.25	250.52	269.79	289.06	308.33	327.60	346.87	366.14	385.41
2.90	165.37	186.05	206.72	227.39	248.06	268.73	289.40	310.08	330.75	351.42	372.09	392.76	413.44

4.0 Gas Systems to DBGW G 600 · TRGI 86/96

4.1 Pressure drop tables for 1st family of gases

4.1.1 Pressure drop tables for *mapress* EDELFLEX GAS

Pipe pressure gradient due to friction *R* as a function of peak flow rate *Vp* and flow velocity *v* for *mapress* EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

Nominal size	**Outside diameter x wall thickness**	
dxt [mm]	**12 x 0.1**	
ID [mm]	11.8	
Peak flow rate V_p $\frac{l}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$
1.0	0.0931	2.5
1.2	0.1237	3.1
1.4	0.1543	3.5
1.6	0.1848	4.1
1.8	0.2154	4.5
2.0	0.2460	5.1
2.2	0.3270	5.6
2.4	0.4081	6.1
2.6	0.4891	6.6
2.8	0.5702	7.1
3.0	0.6512	7.6
3.2	0.7391	8.2
3.4	0.8270	8.6
3.6	0.9150	9.2
3.8	1.0029	9.6
4.0	1.0908	10.2

4.1.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS

Pipe pressure gradient due to friction *R* as a function of peak flow rate *Vp* and flow velocity *v* for *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**15 x 1.0**		**18 x 1.0**		**22 x 1.2**		**28 x 1.2**	
ID [mm]	13.0		16.0		19.6		25.6	
Peak flow rate V_p [m^3/h]	*R* [mbar/m]	*v* [m/s]	*R* [mbar/m]	*v* [m/s]	*R* [mbar/m]	*v* [m/s]	*R* [mbar/m]	*v* [m/s]
1.0	0.0629	2.1	0.0274	1.4				
1.5	0.0943	3.1	0.0411	2.1	0.0168	1.3		
2.0	0.1257	4.2	0.0548	2.8	0.0224	1.8	0.0092	1.1
2.5	0.3032	5.2	0.0685	3.5	0.0281	2.2	0.0115	1.4
3.0	0.4137	6.3	0.1552	4.1	0.0337	2.7	0.0138	1.7
3.5	0.5386	7.3	0.2017	4.8	0.0705	3.1	0.0161	2.0
4.0	0.6777	8.3	0.2534	5.5	0.0883	3.5	0.0184	2.3
4.5					0.1079	4.0	0.0377	2.5
5.0					0.1292	4.4	0.0451	2.8
5.5					0.1520	4.9	0.0530	3.1
6.0					0.1764	5.3	0.0615	3.4
6.5					0.2024	5.7	0.0705	3.7
7.0					0.2300	6.2	0.0800	4.0
7.5					0.2593	6.6	0.0900	4.2
8.0							0.1006	4.5
8.5							0.1116	4.8
9.0							0.1231	5.1
9.5							0.1351	5.4
10.0							0.1476	5.7
10.5							0.1607	5.9
11.0							0.1740	6.2
11.5							0.1881	6.5
12.0							0.2024	6.8
12.5							0.2172	7.1
13.0							0.2328	7.4
13.5							0.2485	7.6
14.0							0.2647	7.9
14.5								
15.0								
15.5								
16.0								
16.5								
17.0								
17.5								
18.0								
18.5								
19.0								
19.5								
20.0								
21.0								
22.0								
23.0								
24.0								
25.0								
26.0								
27.0								
28.0								
29.0								
30.0								
31.0								

4.1.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS [Continuation]

Pipe pressure gradient due to friction *R* as a function of peak flow rate *Vp* and flow velocity *v* for *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	32.0		39.0		51.0	
Peak flow rate V_p [m^3/h]	*R* [mbar/m]	*v* [m/s]	*R* [mbar/m]	*v* [m/s]	*R* [mbar/m]	*v* [m/s]
1.0						
1.5						
2.0						
2.5						
3.0	0.0051	1.0				
3.5	0.0060	1.2				
4.0	0.0069	1.4				
4.5	0.0077	1.6	0.0035	1.0		
5.0	0.0086	1.7	0.0039	1.2		
5.5	0.0166	1.9	0.0043	1.3		
6.0	0.0192	2.1	0.0047	1.4		
6.5	0.0220	2.2	0.0050	1.5		
7.0	0.0250	2.4	0.0099	1.6	0.0020	1.0
7.5	0.0281	2.6	0.0111	1.7	0.0022	1.1
8.0	0.0313	2.8	0.0124	1.9	0.0023	1.1
8.5	0.0347	2.9	0.0137	2.0	0.0043	1.2
9.0	0.0383	3.1	0.0151	2.1	0.0047	1.3
9.5	0.0420	3.3	0.0165	2.2	0.0051	1.3
10.0	0.0459	3.5	0.0181	2.3	0.0056	1.4
10.5	0.0499	3.6	0.0196	2.4	0.0061	1.5
11.0	0.0540	3.8	0.0212	2.6	0.0066	1.6
11.5	0.0583	4.0	0.0229	2.7	0.0071	1.6
12.0	0.0628	4.1	0.0246	2.8	0.0076	1.7
12.5	0.0673	4.3	0.0264	2.9	0.0082	1.8
13.0	0.0720	4.5	0.0282	3.0	0.0088	1.8
13.5	0.0769	4.7	0.0301	3.1	0.0093	1.9
14.0	0.0818	4.8	0.0321	3.3	0.0099	2.0
14.5	0.0869	5.0	0.0341	3.4	0.0105	2.1
15.0	0.0923	5.2	0.0361	3.5	0.0112	2.1
15.5	0.0977	5.4	0.0382	3.6	0.0118	2.2
16.0	0.1032	5.5	0.0404	3.7	0.0125	2.3
16.5	0.1088	5.7	0.0426	3.8	0.0131	2.3
17.0	0.1146	5.9	0.0448	4.0	0.0138	2.4
17.5	0.1204	6.0	0.0471	4.1	0.0145	2.5
18.0	0.1265	6.2	0.0495	4.2	0.0153	2.5
18.5	0.1327	6.4	0.0519	4.3	0.0160	2.6
19.0	0.1390	6.6	0.0543	4.4	0.0167	2.7
19.5	0.1455	6.7	0.0568	4.5	0.0175	2.8
20.0	0.1519	6.9	0.0593	4.7	0.0183	2.8
21.0	0.1655	7.3	0.0646	4.9	0.0199	3.0
22.0			0.0700	5.1	0.0215	3.1
23.0			0.0757	5.3	0.0233	3.3
24.0			0.0814	5.6	0.0250	3.4
25.0			0.0874	5.8	0.0269	3.5
26.0			0.0936	6.0	0.0288	3.7
27.0			0.0999	6.3	0.0307	3.8
28.0			0.1065	6.5	0.0327	4.0
29.0			0.1132	6.7	0.0347	4.1
30.0			0.1201	7.0	0.0368	4.2
31.0			0.1273	7.2	0.0390	4.4

4.2 Tables of pressure drop due to minor losses

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants Ó (1st family of gases)

Pressure drop Z [mbar] due to minor losses													
Óc / v[m/s]	0.3	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
1.0	0.0009	0.002	0.003	0.005	0.006	0.008	0.009	0.011	0.012	0.014	0.015	0.017	0.018
1.1	0.0011	0.002	0.004	0.006	0.007	0.009	0.011	0.013	0.015	0.017	0.019	0.020	0.022
1.2	0.0013	0.002	0.004	0.007	0.009	0.011	0.013	0.015	0.018	0.020	0.022	0.024	0.026
1.3	0.0016	0.003	0.005	0.008	0.010	0.013	0.016	0.018	0.021	0.023	0.026	0.028	0.031
1.4	0.0018	0.003	0.006	0.009	0.012	0.015	0.018	0.021	0.024	0.027	0.030	0.033	0.036
1.5	0.0021	0.003	0.007	0.010	0.014	0.017	0.021	0.024	0.028	0.031	0.034	0.038	0.041
1.6	0.0024	0.004	0.008	0.012	0.016	0.020	0.024	0.027	0.031	0.035	0.039	0.043	0.047
1.7	0.0027	0.004	0.009	0.013	0.018	0.022	0.027	0.031	0.035	0.040	0.044	0.049	0.053
1.8	0.0030	0.005	0.010	0.015	0.020	0.025	0.030	0.035	0.040	0.045	0.050	0.055	0.059
1.9	0.0033	0.006	0.011	0.017	0.022	0.028	0.033	0.039	0.044	0.050	0.055	0.061	0.066
2.0	0.0037	0.006	0.012	0.018	0.024	0.031	0.037	0.043	0.049	0.055	0.061	0.067	0.073
2.1	0.0040	0.007	0.013	0.020	0.027	0.034	0.040	0.047	0.054	0.061	0.067	0.074	0.081
2.2	0.0044	0.007	0.015	0.022	0.030	0.037	0.044	0.052	0.059	0.067	0.074	0.081	0.089
2.3	0.0049	0.008	0.016	0.024	0.032	0.040	0.049	0.057	0.065	0.073	0.081	0.089	0.097
2.4	0.0053	0.009	0.018	0.026	0.035	0.044	0.053	0.062	0.071	0.079	0.088	0.097	0.106
2.5	0.0057	0.010	0.019	0.029	0.038	0.048	0.057	0.067	0.077	0.086	0.096	0.105	0.115
2.6	0.0062	0.010	0.021	0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
2.7	0.0067	0.011	0.022	0.033	0.045	0.056	0.067	0.078	0.089	0.100	0.112	0.123	0.134
2.8	0.0072	0.012	0.024	0.036	0.048	0.060	0.072	0.084	0.096	0.108	0.120	0.132	0.144
2.9	0.0077	0.013	0.026	0.039	0.051	0.064	0.077	0.090	0.103	0.116	0.129	0.142	0.154
3.0	0.083	0.014	0.028	0.041	0.055	0.069	0.083	0.096	0.110	0.124	0.138	0.151	0.165
3.1	0.0088	0.015	0.029	0.044	0.059	0.074	0.088	0.103	0.118	0.132	0.147	0.162	0.176
3.2	0.0094	0.016	0.031	0.047	0.063	0.078	0.094	0.110	0.125	0.141	0.157	0.172	0.188
3.3	0.0100	0.017	0.033	0.050	0.067	0.083	0.100	0.177	0.133	0.150	0.167	0.183	0.200
3.4	0.0106	0.018	0.035	0.053	0.071	0.088	0.106	0.124	0.141	0.159	0.177	0.195	0.212
3.5	0.0112	0.019	0.037	0.056	0.075	0.094	0.112	0.131	0.150	0.169	0.187	0.206	0.225
3.6	0.0119	0.020	0.040	0.059	0.079	0.099	0.119	0.139	0.159	0.178	0.198	0.218	0.238
3.7	0.0126	0.021	0.042	0.063	0.084	0.105	0.126	0.147	0.168	0.189	0.209	0.230	0.251
3.8	0.0133	0.022	0.044	0.066	0.088	0.110	0.133	0.155	0.177	0.199	0.221	0.243	0.265
3.9	0.0140	0.023	0.047	0.070	0.093	0.116	0.140	0.163	0.186	0.209	0.233	0.256	0.279
4.0	0.0147	0.024	0.049	0.073	0.098	0.122	0.147	0.171	0.196	0.220	0.245	0.269	0.294
4.1	0.0154	0.026	0.051	0.077	0.103	0.129	0.154	0.180	0.206	0.231	0.257	0.283	0.309
4.2	0.0162	0.027	0.054	0.081	0.108	0.135	0.162	0.189	0.216	0.243	0.270	0.297	0.324
4.3	0.0170	0.028	0.057	0.085	0.113	0.141	0.170	0.198	0.226	0.255	0.283	0.311	0.339
4.3	0.0178	0.030	0.059	0.089	0.118	0.148	0.178	0.207	0.237	0.267	0.296	0.326	0.355
4.5	0.0186	0.031	0.062	0.093	0.124	0.155	0.186	0.217	0.248	0.279	0.310	0.341	0.372
4.6	0.0194	0.032	0.065	0.097	0.129	0.162	0.194	0.227	0.259	0.291	0.324	0.356	0.388
4.7	0.0203	0.034	0.068	0.101	0.135	0.169	0.203	0.237	0.270	0.304	0.338	0.372	0.406
4.8	0.0212	0.035	0.071	0.106	0.141	0.176	0.212	0.247	0.282	0.317	0.353	0.288	0.423
4.9	0.0220	0.037	0.073	0.110	0.147	0.184	0.220	0.257	0.294	0.331	0.367	0.404	0.441
5.0	0.0230	0.038	0.077	0.115	0.153	0.191	0.230	0.268	0.306	0.344	0.383	0.421	0.459

4.2 Tables of pressure drop due to minor losses [Continuation]

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants ζ (1st family of gases)

Pressure drop Z [mbar] due to minor losses													
ζ / v[m/s]	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.00	13.00
1.0	0.020	0.021	0.023	0.024	0.026	0.028	0.029	0.031	0.032	0.034	0.035	0.037	0.040
1.1	0.024	0.026	0.028	0.030	0.031	0.033	0.035	0.037	0.039	0.041	0.043	0.044	0.048
1.2	0.029	0.031	0.033	0.035	0.037	0.040	0.042	0.044	0.046	0.048	0.051	0.053	0.057
1.3	0.034	0.036	0.039	0.041	0.044	0.047	0.049	0.052	0.054	0.057	0.059	0.062	0.067
1.4	0.039	0.042	0.045	0.048	0.051	0.054	0.057	0.060	0.063	0.066	0.069	0.072	0.078
1.5	0.045	0.048	0.052	0.055	0.059	0.062	0.065	0.069	0.072	0.076	0.079	0.083	0.090
1.6	0.051	0.055	0.059	0.063	0.067	0.071	0.074	0.078	0.082	0.086	0.090	0.094	0.102
1.7	0.057	0.062	0.066	0.071	0.075	0.080	0.084	0.088	0.093	0.097	0.102	0.106	0.115
1.8	0.064	0.069	0.074	0.079	0.084	0.089	0.094	0.099	0.104	0.109	0.114	0.119	0.129
1.9	0.072	0.077	0.083	0.088	0.094	0.099	0.105	0.110	0.116	0.122	0.127	0.133	0.144
2.0	0.080	0.086	0.092	0.098	0.104	0.110	0.116	0.122	0.129	0.135	0.141	0.147	0.159
2.1	0.088	0.094	0.101	0.108	0.115	0.121	0.128	0.135	0.142	0.148	0.155	0.162	0.175
2.2	0.096	0.104	0.111	0.118	0.126	0.133	0.141	0.148	0.156	0.163	0.170	0.178	0.193
2.3	0.105	0.113	0.121	0.129	0.138	0.146	0.154	0.162	0.170	0.178	0.186	0.194	0.210
2.4	0.115	0.123	0.132	0.141	0.150	0.159	0.167	0.176	0.185	0.194	0.203	0.212	0.229
2.5	0.124	0.134	0.143	0.153	0.163	0.172	0.182	0.191	0.201	0.210	0.220	0.230	0.249
2.6	0.134	0.145	0.155	0.165	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
2.7	0.145	0.156	0.167	0.178	0.190	0.201	0.212	0.223	0.234	0.245	0.257	0.268	0.290
2.8	0.156	0.168	0.180	0.192	0.204	0.216	0.228	0.240	0.525	0.264	0.276	0.288	0.312
2.9	0.167	0.180	0.193	0.206	0.219	0.232	0.244	0.257	0.270	0.283	0.296	0.309	0.335
3.0	0.179	0.193	0.207	0.220	0.234	0.248	0.262	0.275	0.289	0.303	0.317	0.330	0.358
3.1	0.191	0.206	0.221	0.235	0.250	0.265	0.279	0.294	0.309	0.323	0.338	0.353	0.382
3.2	0.204	0.219	0.235	0.251	0.266	0.282	0.298	0.313	0.329	0.345	0.360	0.376	0.407
3.3	0.217	0.233	0.250	0.267	0.283	0.300	0.317	0.333	0.350	0.367	0.383	0.400	0.433
3.4	0.230	0.248	0.265	0.283	0.301	0.318	0.336	0.354	0.371	0.389	0.407	0.424	0.460
3.5	0.244	0.262	0.281	0.300	0.319	0.337	0.356	0.375	0.394	0.412	0.431	0.450	0.487
3.6	0.258	0.278	0.297	0.317	0.337	0.357	0.377	0.397	0.416	0.436	0.456	0.476	0.516
3.7	0.272	0.293	0.314	0.335	0.356	0.377	0.398	0.419	0.440	0.461	0.482	0.503	0.545
3.8	0.287	0.309	0.331	0.353	0.376	0.398	0.420	0.442	0.464	0.486	0.508	0.530	0.574
3.9	0.303	0.326	0.349	0.372	0.396	0.419	0.442	0.465	0.489	0.512	0.535	0.559	0.605
4.0	0.318	0.343	0.367	0.392	0.416	0.441	0.465	0.490	0.514	0.539	0.563	0.588	0.636
4.1	0.334	0.360	0.386	0.412	0.437	0.463	0.489	0.512	0.540	0.566	0.592	0.617	0.669
4.2	0.351	0.378	0.405	0.432	0.459	0.486	0.513	0.540	0.567	0.594	0.621	0.648	0.702
4.3	0.368	0.396	0.424	0.453	0.481	0.509	0.538	0.566	0.594	0.622	0.651	0.679	0.736
4.4	0.385	0.415	0.444	0.474	0.504	0.533	0.563	0.592	0.622	0.652	0.681	0.711	0.770
4.5	0.403	0.434	0.465	0.496	0.527	0.558	0.589	0.620	0.651	0.682	0.713	0.744	0.806
4.6	0.421	0.453	0.486	0.518	0.550	0.583	0.615	0.647	0.680	0.712	0.745	0.777	0.842
4.7	0.439	0.473	0.507	0.541	0.575	0.608	0.642	0.676	0.710	0.744	0.777	0.811	0.879
4.8	0.458	0.494	0.529	0.564	0.599	0.635	0.670	0.705	0.740	0.776	0.811	0.846	0.917
4.9	0.478	0.514	0.551	0.588	0.625	0.661	0.698	0.735	0.771	0.808	0.845	0.882	0.955
5.0	0.497	0.536	0.574	0.612	0.650	0.689	0.727	0.765	0.803	0.842	0.880	0.918	0.995

4.3 Pressure drop tables for 2nd family of gases

4.3.1 Pressure drop tables for *mapress* EDELFLEX GAS

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

Nominal size (d)	**Outside diameter x wall thickness**	
d x t [mm]	**12 x 0.1**	
ID [mm]	11.8	
Peak flow rate V_p [m^3/h]	R mbar m	v m s
1.0	0.0848	2.5
1.2	0.1384	3.1
1.4	0.1921	3.5
1.6	0.2457	4.1
1.8	0.2994	4.5
2.0	0.3530	5.1
2.2	0.4261	5.6
2.4	0.4991	6.1
2.6	0.3722	6.6
2.8	0.6452	7.1
3.0	0.7183	7.6
3.2	0.8114	8.2
3.4	0.9044	8.6
3.6	0.9975	9.2
3.8	1.0905	9.6
4.0	1.1836	10.2

4.3.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**15 x 1.0**		**18 x 1.0**		**22 x 1.2**		**28 x 1.2**	
ID [mm]	13.0		16.0		19.6		25.6	
Peak flow rate V_p [m³/h]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
1.0	0.0438	2.1	0.0191	1.4	0.0078	0.9		
1.5	0.1369	3.1	0.0514	2.1	0.0117	1.3		
2.0	0.2242	4.2	0.0838	2.8	0.0293	1.8	0.0064	1.1
2.5	0.3295	5.2	0.1228	3.5	0.0427	2.2	0.0149	1.4
3.0	0.4524	6.3	0.1680	4.1	0.0583	2.7	0.0204	1.7
3.5	0.5916	7.8	0.2196	4.8	0.0760	3.1	0.0265	2.0
4.0	0.7479	8.4	0.2769	5.5	0.0957	3.5	0.0333	2.3
4.5			0.3402	6.2	0.1173	4.0	0.0407	2.5
5.0					0.1410	4.4	0.0488	2.8
5.5					0.1663	4.9	0.0575	3.1
6.0					0.1934	5.3	0.0669	3.4
6.5					0.2224	5.7	0.0768	3.7
7.0					0.2536	6.2	0.0874	4.0
7.5					0.2858	6.6	0.0985	4.2
8.0					0.3203	7.1	0.1103	4.5
8.5							0.1225	4.8
9.0							0.1354	5.1
9.5							0.1488	5.4
10.0							0.1629	5.7
10.5							0.1774	5.9
11.0							0.1925	6.2
11.5							0.2081	6.5
12.0							0.2243	6.8
12.5							0.2411	7.1
13.0								
13.5								
14.0								
14.5								
15.0								
15.5								
16.0								
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30.0								
31.0								

4.3.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS [Continuation]

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	32.0		39.0		51.0	
Peak flow rate V_p [m³/h]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
1.0						
1.5						
2.0						
2.5						
3.0	0.0064	1.0				
3.5	0.0083	1.2				
4.0	0.0104	1.4				
4.5	0.0127	1.6				
5.0	0.0152	1.7	0.0060	1.2		
5.5	0.0179	1.9	0.0070	1.3		
6.0	0.0207	2.1	0.0081	1.4		
6.5	0.0238	2.2	0.0093	1.5		
7.0	0.0271	2.4	0.0106	1.6	0.0033	1.0
7.5	0.0305	2.6	0.0119	1.7	0.0037	1.1
8.0	0.0341	2.8	0.0133	1.9	0.0041	1.1
8.5	0.0378	2.9	0.0148	2.0	0.0046	1.2
9.0	0.0418	3.1	0.0163	2.1	0.0051	1.3
9.5	0.0459	3.3	0.0179	2.2	0.0055	1.3
10.0	0.0501	3.5	0.0196	2.3	0.0060	1.4
10.5	0.0546	3.6	0.0213	2.4	0.0066	1.5
11.0	0.0592	3.8	0.0231	2.6	0.0071	1.6
11.5	0.0640	4.0	0.0250	2.7	0.0077	1.6
12.0	0.0689	4.1	0.0269	2.8	0.0083	1.7
12.5	0.0741	4.3	0.0289	2.9	0.0089	1.8
13.0	0.0793	4.5	0.0309	3.0	0.0095	1.8
13.5	0.0848	4.7	0.0330	3.1	0.0101	1.9
14.0	0.0904	4.8	0.0351	3.3	0.0108	2.0
14.5	0.0960	5.0	0.0374	3.4	0.0115	2.1
15.0	0.1019	5.2	0.0396	3.5	0.0122	2.1
15.5	0.1079	5.4	0.0420	3.6	0.0129	2.2
16.0	0.1142	5.5	0.0444	3.7	0.0136	2.3
16.5	0.1206	5.7	0.0469	3.8	0.0144	2.3
17.0	0.1270	5.9	0.0494	4.0	0.0151	2.4
17.5	0.1337	6.0	0.0519	4.1	0.0159	2.5
18.0	0.1406	6.2	0.0545	4.2	0.0167	2.5
18.5	0.1474	6.4	0.0573	4.3	0.0175	2.6
19.0	0.1546	6.6	0.0599	4.4	0.0184	2.7
19.5	0.1620	6.7	0.0628	4.5	0.0192	2.8
20.0	0.1693	6.9	0.0657	4.7	0.0201	2.8
21.0			0.0715	4.9	0.0219	3.0
22.0			0.0776	5.1	0.0237	3.1
23.0			0.0839	5.3	0.0256	3.3
24.0			0.0905	5.6	0.0276	3.4
25.0			0.0973	5.8	0.0296	3.5
26.0			0.1043	6.0	0.0317	3.7
27.0			0.1115	6.3	0.0339	3.8
28.0			0.1188	6.5	0.0362	4.0
29.0			0.1264	6.7	0.0385	4.1
30.0			0.1344	7.0	0.0409	4.2
31.0			0.1422	7.2	0.0432	4.4

4.4 Tables of pressure drop due to minor losses

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants Ó (2nd family of gases)

Pressure drop Z [mbar] due to minor losses													
Óc / v[m/s]	0.3	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
1.0	0.0012	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.016	0.018	0.020	0.022	0.024
1.1	0.0014	0.002	0.005	0.007	0.010	0.012	0.014	0.017	0.019	0.022	0.024	0.026	0.029
1.2	0.0017	0.003	0.006	0.009	0.011	0.014	0.017	0.020	0.023	0.026	0.029	0.031	0.034
1.3	0.0020	0.003	0.007	0.010	0.013	0.017	0.020	0.023	0.027	0.030	0.034	0.037	0.040
1.4	0.0023	0.004	0.008	0.012	0.016	0.019	0.023	0.027	0.031	0.035	0.039	0.043	0.047
1.5	0.0027	0.004	0.009	0.013	0.018	0.022	0.027	0.031	0.036	0.040	0.045	0.049	0.054
1.6	0.0030	0.005	0.010	0.015	0.020	0.025	0.030	0.036	0.041	0.046	0.051	0.056	0.061
1.7	0.0034	0.006	0.011	0.017	0.023	0.029	0.034	0.040	0.046	0.052	0.057	0.063	0.069
1.8	0.0039	0.006	0.013	0.019	0.026	0.032	0.039	0.045	0.051	0.058	0.064	0.071	0.077
1.9	0.0043	0.007	0.014	0.021	0.029	0.036	0.043	0.050	0.057	0.064	0.072	0.079	0.086
2.0	0.0048	0.008	0.016	0.024	0.032	0.040	0.048	0.056	0.064	0.071	0.079	0.087	0.095
2.1	0.0053	0.009	0.018	0.026	0.035	0.044	0.053	0.061	0.070	0.079	0.088	0.096	0.105
2.2	0.0058	0.010	0.019	0.029	0.038	0.048	0.058	0.067	0.077	0.086	0.096	0.106	0.115
2.3	0.0063	0.011	0.021	0.032	0.042	0.053	0.063	0.074	0.084	0.095	0.105	0.116	0.126
2.4	0.0069	0.011	0.023	0.034	0.046	0.057	0.069	0.080	0.091	0.103	0.114	0.126	0.137
2.5	0.0074	0.012	0.025	0.037	0.050	0.062	0.074	0.087	0.099	0.112	0.124	0.136	0.149
2.6	0.0081	0.013	0.027	0.040	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001
2.7	0.0087	0.014	0.029	0.043	0.058	0.072	0.087	0.101	0.116	0.130	0.145	0.159	0.174
2.8	0.0093	0.016	0.031	0.047	0.062	0.078	0.093	0.109	0.124	0.140	0.156	0.171	0.187
2.9	0.0100	0.017	0.033	0.050	0.067	0.083	0.100	0.117	0.134	0.150	0.167	0.184	0.200
3.0	0.0107	0.018	0.036	0.054	0.071	0.089	0.107	0.125	0.143	0.161	0.179	0.197	0.214
3.1	0.0114	0.019	0.038	0.057	0.076	0.095	0.114	0.134	0.153	0.172	0.191	0.210	0.229
3.2	0.0122	0.020	0.041	0.061	0.081	0.102	0.122	0.142	0.163	0.183	0.203	0.224	0.244
3.3	0.0130	0.022	0.043	0.065	0.086	0.108	0.130	0.151	0.173	0.195	0.216	0.238	0.259
3.4	0.0138	0.023	0.046	0.069	0.092	0.115	0.138	0.161	0.184	0.207	0.229	0.252	0.275
3.5	0.0146	0.024	0.049	0.073	0.097	0.122	0.146	0.170	0.195	0.219	0.243	0.267	0.292
3.6	0.0154	0.026	0.051	0.077	0.103	0.129	0.154	0.180	0.206	0.232	0.257	0.283	0.309
3.7	0.0163	0.027	0.054	0.082	0.109	0.136	0.163	0.190	0.217	0.245	0.272	0.299	0.326
3.8	0.0172	0.029	0.057	0.086	0.115	0.143	0.172	0.201	0.229	0.258	0.287	0.315	0.344
3.9	0.0181	0.030	0.060	0.091	0.121	0.151	0.181	0.211	0.242	0.272	0.302	0.332	0.362
4.0	0.0191	0.032	0.064	0.095	0.127	0.159	0.191	0.222	0.254	0.286	0.318	0.349	0.381
4.1	0.0200	0.033	0.067	0.100	0.133	0.167	0.200	0.234	0.267	0.300	0.334	0.367	0.400
4.2	0.210	0.035	0.070	0.105	0.140	0.175	0.210	0.245	0.280	0.315	0.350	0.385	0.420
4.3	0.0220	0.037	0.073	0.110	0.147	0.184	0.220	0.257	0.294	0.330	0.367	0.404	0.440
4.4	0.0231	0.038	0.077	0.115	0.154	0.192	0.231	0.269	0.307	0.346	0.384	0.423	0.461
4.5	0.0241	0.040	0.080	0.121	0.161	0.201	0.241	0.281	0.322	0.362	0.402	0.442	0.482
4.6	0.0252	0.042	0.084	0.126	0.168	0.210	0.252	0.294	0.336	0.378	0.420	0.462	0.504
4.7	0.0263	0.044	0.088	0.132	0.175	0.219	0.263	0.307	0.351	0.395	0.438	0.482	0.526
4.8	0.0274	0.046	0.091	0.137	0.183	0.229	0.274	0.320	0.366	0.412	0.457	0.503	0.549
4.9	0.0286	0.048	0.095	0.143	0.191	0.238	0.286	0.334	0.381	0.429	0.477	0.524	0.572
5.0	0.0298	0.050	0.099	0.149	0.199	0.248	0.298	0.347	0.397	0.447	0.496	0.546	0.596

4.4 Tables of pressure drop due to minor losses [Continuation]

Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants ζ (2nd family of gases)

Pressure drop Z [mbar] due to minor losses													
ζ / v[m/s]	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	13.0
1.0	0.026	0.028	0.030	0.032	0.034	0.036	0.038	0.040	0.042	0.044	0.046	0.048	0.052
1.1	0.031	0.034	0.036	0.038	0.041	0.043	0.046	0.048	0.050	0.053	0.055	0.058	0.062
1.2	0.037	0.040	0.043	0.046	0.049	0.051	0.054	0.057	0.060	0.063	0.066	0.069	0.074
1.3	0.044	0.047	0.050	0.054	0.057	0.060	0.064	0.067	0.070	0.074	0.077	0.081	0.087
1.4	0.051	0.054	0.058	0.062	0.066	0.070	0.074	0.078	0.082	0.086	0.089	0.093	0.101
1.5	0.058	0.063	0.067	0.071	0.076	0.080	0.085	0.089	0.094	0.098	0.103	0.107	0.116
1.6	0.066	0.071	0.076	0.81	0.086	0.091	0.097	0.102	0.107	0.112	0.117	0.122	0.132
1.7	0.075	0.080	0.086	0.092	0.098	0.103	0.109	0.115	0.120	0.126	0.132	0.138	0.149
1.8	0.084	0.090	0.096	0.103	0.109	0.116	0.122	0.129	0.135	0.141	0.148	0.154	0.167
1.9	0.093	0.100	0.107	0.115	0.122	0.129	0.,136	0.143	0.150	0.158	0.165	0.172	0.186
2.0	0.103	0.111	0.119	0.127	0.135	0.143	0.151	0.159	0.167	0.175	0.183	0.191	0.206
2.1	0.114	0.123	0.131	0.140	0.149	0.158	0.166	0.175	0.184	0.193	0.201	0.210	0.228
2.2	0.125	0.135	0.144	0.144	0.154	0.163	0.173	0.183	0.192	0.202	0.211	0.231	0.250
2.3	0.137	0.147	0.158	0.168	0.179	0.189	0.200	0.210	0.221	0.231	0.242	0.252	0.273
2.4	0.149	0.160	0.172	0.183	0.194	0.206	0.217	0.229	0.240	0.252	0.263	0.274	0.297
2.5	0.161	0.174	0.186	0.199	0.211	0.223	0.236	0.248	0.261	0.273	0.285	0.298	0.323
2.6	0.174	0.188	0.201	0.215	0.001	0.01	0.001	0.001	0.001	0.001	0.002	0.002	0.002
2.7	0.188	0.203	0.217	0.232	0.246	0.260	0.275	0.289	0.304	0.318	0.333	0.347	0.376
2.8	0.202	0.218	0.233	0.249	0.265	0.280	0.296	0.311	0.327	0.342	0.358	0.373	0.405
2.9	0.217	0.234	0.250	0.267	0.284	0.300	0.317	0.334	0.351	0.367	0.684	0.401	0.434
3.0	0.232	0.250	0.268	0.286	0.304	0.322	0.339	0.357	0.375	0.393	0.411	0.429	0.464
3.1	0.248	0.267	0.286	0.305	0.324	0.343	0.362	0.382	0.401	0.420	0.439	0.458	0.496
3.2	0.264	0.285	0.305	0.325	0.346	0.366	0.386	0.407	0.427	0.447	0.468	0.488	0.528
3.3	0.281	0.303	0.324	0.346	0.367	0.389	0.411	0.432	0.454	0.476	0.497	0.519	0.562
3.4	0.298	0.321	0.344	0.367	0.390	0.413	0.436	0.459	0.482	0.505	0.528	0.551	0.597
3.5	0.316	0.340	0.365	0.389	0.413	0.438	0.462	0.486	0.511	0.535	0.559	0.584	0.632
3.5	0.316	0.340	0.365	0.389	0.413	0.438	0.462	0.486	0.511	0.535	0.559	0.584	0.632
3.6	0.334	0.360	0.386	0.412	0.437	0.463	0.489	0.515	0.540	0.566	0.592	0.617	0.669
3.7	0.353	0.380	0.408	0.435	0.462	0.489	0.516	0.543	0.571	0.598	0.625	0.652	0.707
3.8	0.373	0.401	0.430	0.459	0.487	0.516	0.545	0.573	0.602	0.631	0.659	0.688	0.745
3.9	0.392	0.423	0.453	0.483	0.513	0.543	0.574	0.604	0.634	0.664	0.694	0.725	0.785
4.0	0.413	0.445	0.476	0.508	0.540	0.572	0.603	0.635	0.667	0.699	0.730	0.762	0.826
4.1	0.434	0.467	0.501	0.534	0.567	0.601	0.634	0.667	0.701	0.734	0.767	0.801	0.868
4.2	0.455	0.490	0.525	0.560	0.595	0.630	0.665	0.700	0.735	0.770	0.805	0.840	0.910
4.3	0.477	0.514	0.551	0.587	0.624	0.661	0.697	0.734	0.771	0.807	0.844	0.881	0.954
4.4	0.500	0.538	0.576	0.615	0.653	0.692	0.730	0.769	0.807	0.845	0.884	0.922	0.999
4.5	0.523	0.563	0.603	0.643	0.683	0.724	0.764	0.804	0.844	0.884	0.925	0.965	1.045
4.6	0.546	0.588	0.630	0.672	0.714	0.756	0.798	0.840	0.882	0.924	0.966	1.008	1.092
4.7	0.570	0.614	0.658	0.702	0.745	0.789	0.833	0.877	0.921	0.965	1.009	1.052	1.140
4.8	0.595	0.640	0.686	0.732	0.777	0.823	0.869	0.915	0.960	1.006	1.052	1.098	1.189
4.9	0.620	0.667	0.715	0.763	0.810	0.858	0.906	0.953	1.001	1.049	0.096	1.144	1.239
5.0	0.645	0.695	0.744	0.794	0.844	0.893	0.943	0.993	1.042	1.092	1.141	1.191	1.290

4.5 Pressure drop tables for 4th family of gases

4.5.1 Pressure drop tables for *mapress* EDELFLEX GAS

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

Nominal size	**Outside diameter x wall thickness**	
d x t [mm]	**12 x 0.1**	
ID [mm]	11.8	
Peak flow rate V_p $\frac{l}{s}$	R $\frac{mbar}{m}$	v $\frac{m}{s}$
1.0	0.1703	2.5
1.2	0.2487	3.1
1.4	0.8761	3.5
1.6	0.4055	4.1
1.8	0.4839	4.5
2.0	0.5623	5.1
2.2	0.6810	5.6
2.4	0.7998	6.1
2.6	0.9185	6.6
2.8	1.0372	7.1
3.0	1.1560	7.6
3.2	1.3095	8.2
3.4	1.4630	8.6
3.6	1.6165	9.2
3.8	1.7700	9.6
4.0	1.9235	10.2

4.5.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* STAINLESS STEEL pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**15 x 1.0**		**18 x 1.0**		**22 x 1.2**		**28 x 1.2**	
ID [mm]	13.0		16.0		19.6		25.6	
Peak flow rate V_p [m³/h]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
1.0	0.1069	2.1	0.0401	1.4	0.0086	0.9		
1.5	0.2149	3.1	0.0801	2.1	0.0279	1.3		
2.0	0.3548	4.2	0.1317	2.8	0.0456	1.8	0.0159	1.1
2.5	0.5244	5.2	0.1940	3.5	0.0670	2.2	0.0233	1.4
3.0	0.7239	6.3	0.2667	4.1	0.0919	2.7	0.0318	1.7
3.5	0.9507	7.3	0.3495	4.8	0.1202	3.1	0.0416	2.0
4.0	1.2063	8.4	0.4428	5.5	0.1518	3.5	0.0524	2.3
4.5			0.5457	6.2	0.1866	4.0	0.0643	2.5
5.0			0.6577	6.9	0.2247	4.4	0.0773	2.8
5.5					0.2657	4.9	0.0912	3.1
6.0					0.3098	5.3	0.1064	3.4
6.5					0.3572	5.7	0.1224	3.7
7.0					0.4078	6.2	0.1393	4.0
7.5					0.4607	6.6	0.1574	4.2
8.0					0.5167	7.1	0.1765	4.5
8.5							0.1964	4.8
9.0							0.2172	5.1
9.5							0.2391	5.4
10.0							0.2619	5.7
10.5							0.2856	5.9
11.0							0.3103	6.2
11.5							0.3361	6.5
12.0							0.3627	6.8
12.5								
13.0								
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14.0								
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4.5.2 Pressure drop tables for *mapress* STAINLESS STEEL GAS [Continuation]

Pipe pressure gradient due to friction R as a function of the peak flow rate V_p and flow velocity v for *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541. (k = 0.0015mm)

(The tabulated values also apply to copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057)

Nominal size	Pipe outside diameter x wall thickness					
d x t [mm]	**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	32.0		39.0		51.0	
Peak flow rate V_p [m³/h]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]	R [mbar/m]	v [m/s]
1.0						
1.5						
2.0						
2.5						
3.0	0.0099	1.0				
3.5	0.0129	1.2				
4.0	0.0162	1.4				
4.5	0.0199	1.6	0.0078	1.0		
5.0	0.0238	1.7	0.0093	1.2		
5.5	0.0281	1.9	0.0110	1.3		
6.0	0.0327	2.1	0.0128	1.4		
6.5	0.0376	2.2	0.0147	1.5		
7.0	0.0429	2.4	0.0167	1.6	0.0051	1.0
7.5	0.0483	2.6	0.0188	1.7	0.0058	1.1
8.0	0.0541	2.8	0.0211	1.9	0.0065	1.1
8.5	0.0602	2.9	0.0234	2.0	0.0072	1.2
9.0	0.0665	3.1	0.0259	2.1	0.0080	1.3
9.5	0.0732	3.3	0.0284	2.2	0.0087	1.3
10.0	0.0801	3.5	0.0311	2.3	0.0095	1.4
10.5	0.0873	3.6	0.0339	2.4	0.0104	1.5
11.0	0.0947	3.8	0.0367	2.6	0.0113	1.6
11.5	0.1025	4.0	0.0397	2.7	0.0122	1.6
12.0	0.1105	4.1	0.0429	2.8	0.0131	1.7
12.5	0.1188	4.3	0.0461	2.9	0.0141	1.8
13.0	0.1274	4.5	0.0493	3.0	0.0151	1.8
13.5	0.1360	4.7	0.0527	3.1	0.0161	1.9
14.0	0.1451	4.8	0.0562	3.3	0.0171	2.0
14.5	0.1546	5.0	0.0598	3.4	0.0182	2.1
15.0	0.1643	5.2	0.0635	3.5	0.0193	2.1
15.5	0.1739	5.4	0.0672	3.6	0.0205	2.2
16.0	0.1842	5.5	0.0711	3.7	0.0217	2.3
16.5	0.1944	5.7	0.0751	3.8	0.0229	2.3
17.0	0.2052	5.9	0.0791	4.0	0.0241	2.4
17.5	0.2159	6.0	0.0834	4.1	0.0254	2.5
18.0	0.2272	6.2	0.0877	4.2	0.0267	2.5
18.5	0.2384	6.4	0.0920	4.3	0.0280	2.6
19.0	0.2503	6.6	0.0965	4.4	0.0293	2.7
19.5	0.2620	6.7	0.1010	4.5	0.0307	2.8
20.0	0.2745	6.9	0.1057	4.7	0.0321	2.8
21.0			0.1153	4.9	0.0350	3.0
22.0			0.1253	5.1	0.0380	3.1
23.0			0.1355	5.3	0.0411	3.3
24.0			0.1462	5.6	0.0443	3.4
25.0			0.1574	5.8	0.0476	3.5
26.0			0.1690	6.0	0.0511	3.7
27.0			0.1805	6.3	0.0545	3.8
28.0			0.1929	6.5	0.0582	4.0
29.0			0.2052	6.7	0.0620	4.1
30.0			0.2183	7.0	0.0658	4.2
31.0			0.2313	7.2	0.0698	4.4

5.0 GAS Systems to TRF 1996

5.1 Pressure drop tables for 3rd family of gases

Pressure drops in liquefied gas pipes in mbar/m at a working pressure of 50 mbar.
mapress STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and coppper pipes to DVGW Code of Practice GW 392 / DIN-EN 1057.
OD = 15 – 35mm

Pipe outside dia OD [mm]	ID of pipe to TRF [mm]	Liquefied gas mass flow rate *n* [kg/h] (appliance consumption or load)													
		0.5	0.8	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	8.0	10.0	12.0	14.0
		Pressure drop (gradient) R in [mbar/m]													
	11.8	0.015	0.038	0.060	0.139	0.241	0.379	0.543	0.957	1.5	2.18	3.8			
15	12	0.013	0.033	0.052	0.12	0.21	0.33	0.47	0.83	1.3	1.9	3.3	5.2		
18	15		0.011	0.017	0.038	0.068	0.11	0.15	0.27	0.43	0.61	1.1	1.7		
22	20					0.016	0.025	0.036	0.064	0.10	0.14	0.26	0.40		
28	25							0.012	0.021	0.033	0.048	0.085	0.13	0.19	0.25
35	32									0.010	0.014	0.025	0.040	0.058	0.078

5.2 Length additions for pressure drop due to minor losses in liquefied gas systems

Minor loss:	Abbreviation	Length addition im [m]
Shutoff valve	SV	2.0
Elbow	E	0.5
Tee with elbow flow pattern	T	0.5

5.3 Example consumption values of appliances in liquefied gas systems

The values are calculated for simple systems with a pressure drop of 2.5 mbar and a working pressure of 50 mbar, for the specified nominal diameters DN and DIN connection sizes.

Type of appliance	Consumption [kg/h]	Nom dia DN	Connection size to DIN [mm]	Pipe outside diameter [mm]
Gas boiler	2.0	12	15	15
Gas instantaneous water heater	2.0	12	15	15
Gas combination water heater	2.5	12	15	15

6.0 Appendix - GAS

6.1 Consumption of gas appliances to TRGI

Gas appliance		Nominal heat capacity Q_{nc} [kW]	Gas appliance consumption V_a [m³/h] as a function of the calorific value CV [kwh/m³]			
			1st family of gases	2nd family of gases		4th family of gases
				Group L	GroupH	
			CV = 4.2kwh/m³	CV = 8.6kwh/m³	CV = 10.6kwh/m³	CV = 6.3kwh/m³
Gas cooker		4 burner	3.0	1.5	1.2	2.0
Gas instantaneous water heater		8.7	2.5	1.2	1.0	1.6
		17.5	5.0	2.4	2.0	3.3
		22.7	6.5	3.2	2.6	4.3
		27.9	8.0	3.9	3.2	5.3
Gas storage water heater Water capacity	80 l	6.9	1.9	0.9	0.7	1,3
	120 l	7.6	2.1	1.0	0.8	1,5
	150 l	8.3	2.3	1.1	0.9	1,6
	190 l	8.7	2.4	1.2	1.0	1,7
	200 l	10.5	2.9	1.4	1.2	1,9
Gas space heater		3.5	1.0	0.5	0.4	0.7
		4.7	1.3	0.6	0.5	0.9
		7.0	2.0	1.0	0.8	1.3
		9.3	2.7	1.3	1.1	1.8
		11.6	3.3	1.6	1.3	2.2
Gas circulating water heater		5.0	1.4	0.7	0.6	1.0
		6.0	1.7	0.8	0.7	1.1
Gas combination water heater		7.0	2.0	1.0	0.8	1.3
		8.0	2.3	1.1	0.9	1.5
		9.0	2.6	1.3	1.0	1.7
Gas boiler		9.3	2.7	1.3	1.1	1.8
		10.0	2.9	1.4	1.1	1.9
		11.0	3.1	1.5	1.2	2.1
		14.0	4.0	1.9	1.6	2.6
		17.5	5.0	2.4	2.0	3.3
		18.6	5.3	2.6	2.1	3.5
		20.9	6.0	2.9	2.4	4.0
		23.3	6.7	3.2	2.6	4.4
		30.0	8.6	4.2	3.4	5.7

6.2 Appliance related simultaneity factors to TRGI

Number of gas appliances	Appliance related simultaneity factors			
	f_{gc}	f_{giwh}	f_{gsh}	f_{gcwh}
1	0.621	1.000	1.000	1.000
2	0.448	0.607	0.800	0.883
3	0.371	0.456	0.703	0.822
4	0.325	0.373	0.641	0.782
5	0.294	0.320	0.597	0.752
6	0.271	0.283	0.564	0.729
7	0.253	0.255	0.537	0.710
8	0.239	0.234	0.515	0.694
9	0.227	0.217	0.496	0.680
10	0.217	0.202	0.480	0.668
11	0.208	0.191	0.466	0.657
12	0.201	0.180	0.454	0.648
13	0.194	0.172	0.443	0.639
14	0.188	0.164	0.432	0.631
15	0.183	0.157	0.423	0.624
16	0.178	0.151	0.415	0.617
17	0.173	0.146	0.407	0.611
18	0.169	0.141	0.400	0.605
19	0.166	0.137	0.394	0.599
20	0.162	0.133	0.387	0.594
21	0.159	0.129	0.382	0.590
22	0.156	0.125	0.376	0.585
23	0.153	0.122	0.371	0.581
24	0.151	0.119	0.366	0.577
25	0.148	0.117	0.362	0.573
26	0.146	0.114	0.357	0.569
27	0.144	0.112	0.353	0.566
28	0.142	0.110	0.349	0.562
29	0.140	0.108	0.346	0.559
30	0.138	0.106	0.342	0.556
31	0.136	0.104	0.339	0.553
32	0.134	0.102	0.336	0.550
33	0.133	0.100	0.332	0.547
34	0.131	0.099	0.329	0.545
35	0.130	0.097	0.327	0.542
36	0.128	0.096	0.324	0.540
37	0.127	0.095	0.321	0.537
38	0.126	0.093	0.319	0.535
39	0.125	0.092	0.316	0.533
40	0.123	0.091	0.314	0.530
41	0.122	0.090	0.311	0.528
42	0.121	0.089	0.309	0.526
43	0.120	0.088	0.307	0.524
44	0.119	0.087	0.305	0.522
45	0.118	0.086	0.303	0.520
46	0.117	0.085	0.301	0.518
47	0.116	0.084	0.299	0.517
48	0.115	0.083	0.297	0.515
49	0.114	0.082	0.295	0.513
50	0.114	0.082	0.293	0.512

7.0 EXTRA LIGHT FUEL OIL

7.1 Pressure drop tables for *mapress* EDELFLEX

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density *r* = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 1.

mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541

Nominal size	**Outside diameter x wall thickness**	
dxt [mm]	**12 x 0.1**	
ID [mm]	11.8	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.0292	0.01
10	0.0584	0.03
15	0.0876	0.04
20	0.1168	0.06
25	0.1460	0.07
30	0.1752	0.09
35	0.2044	0.10
40	0.2336	0.12
45	0.2628	0.13
50	0.2920	0.15
55	0.3212	0.16
60	0.3504	0.18
65	0.3796	0.19
70	0.4088	0.21
75	0.4380	0.22
80	0.4672	0.24
85	0.4964	0.25
90	0.5256	0.27
95	0.5548	0.28
100	0.5840	0.30
125	0.7301	0.37
150	0.8761	0.44
175	1.0221	0.52
200	1.1681	0.59
250	1.4601	0.74
300	1.7521	0.89

7.1 Pressure drop tables for *mapress* EDELFLEX

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 2.

mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541

Nominal size	**Outside diameter x wall thickness**	
d x t [mm]	**12 x 0.1**	
ID [mm]	11.8	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.0584	0.01
10	0.1168	0.03
15	0.1752	0.04
20	0.2336	0.06
25	0.2920	0.07
30	0.3504	0.09
35	0.4088	0.10
40	0.4672	0.12
45	0.5256	0.13
50	0.5840	0.15
55	0.6425	0.16
60	0.7009	0.18
65	0.7593	0.19
70	0.8177	0.21
75	0.8761	0.22
80	0.9345	0.24
85	0.9929	0.25
90	1.0513	0.27
95	1.1097	0.28
100	1.1681	0.30
125	1.4601	0.37
150	1.7521	0.44
175	2.0442	0.52
200	2.3362	0.59
250	2.9202	0.74
300	3.5043	0.89

7.1 Pressure drop tables for *mapress* EDELFLEX
[Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 4.

mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541

Nominal size	**Outside diameter x wall thickness**	
d x t [mm]	**12 x 0.1**	
ID [mm]	11.8	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0,1168	0,01
10	0.2336	0.03
15	0.3504	0.04
20	0.4672	0.06
25	0.5840	0.07
30	0.7009	0.09
35	0.8177	0.10
40	0.9345	0.12
45	1.0513	0.13
50	1.1681	0.15
55	1.2849	0.16
60	1.4017	0.18
65	1.5185	0.19
70	1.6353	0.21
75	1.7521	0.22
80	1.8690	0.24
85	1.9858	0.25
90	2.1026	0.27
95	2.2194	0.28
100	2.3362	0.30
125	2.9202	0.37
150	3.5043	0.44
175	4.0883	0.52
200	4.6724	0.59
250	5.8405	0.74
300	7.0086	0.89

7.1 Pressure drop tables for *mapress* EDELFLEX
[Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 6.
mapress EDELFLEX pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541

Nominal size	**Outside diameter x wall thickness**	
dxt [mm]	**12 x 0.1**	
ID [mm]	11.8	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.1752	0.01
10	0.3504	0.03
15	0.5256	0.04
20	0.7009	0.06
25	0.8761	0.07
30	1.0513	0.09
35	1.2265	0.10
40	1.4017	0.12
45	1.5769	0.13
50	1.7521	0.15
55	1.9274	0.16
60	2.1026	0.18
65	2.2778	0.19
70	2.4530	0.21
75	2.6282	0.22
80	2.8034	0.24
85	2.9787	0.25
90	3.1539	0.27
95	3.3291	0.28
100	3.5043	0.30
125	4.3804	0.37
150	5.2564	0.44
175	6.1325	0.52
200	7.0086	0.59
250	8.7607	0.74
300	10.5129	0.89

7.2 Pressure drop tables for various pipes

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density ρ = 860kg/m³, temperature T = 10°C and kinematic viscosity ν = 1.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**12 x 1.2**		**15 x 1.2**		**18 x 1.2**		**22 x 1.5**	
ID [mm]	9.6		12.6		15.6		19	
Nom dia	DN10		DN12		DN15		DN20	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.0667	0.02	0.0225	0.01	0.0096	0.01	0.0043	0.01
10	0.1333	0.04	0.0449	0.03	0.0191	0.02	0.0087	0.01
15	0.2000	0.07	0.0674	0.04	0.0287	0.03	0.0130	0.02
20	0.2666	0.09	0.0899	0.05	0.0382	0.03	0.0174	0.02
25	0.3333	0.11	0.1123	0.06	0.0478	0.04	0.0217	0.03
30	0.4000	0.13	0.1348	0.08	0.0574	0.05	0.0261	0.03
35	0.4666	0.16	0.1572	0.09	0.0669	0.06	0.0304	0.04
40	0.5333	0.18	0.1795	0.10	0.0765	0.07	0.0348	0.05
45	0.5999	0.20	0.2022	0.12	0.0860	0.08	0.0391	0.05
50	0.6666	0.22	0.2246	0.13	0.0956	0.08	0.0434	0.06
55	0.7333	0.25	0.2471	0.14	0.1052	0.09	0.0478	0.06
60	0.7999	0.27	0.2696	0.16	0.1147	0.10	0.0521	0.07
65	0.8666	0.29	0.2920	0.17	0.1243	0.11	0.0565	0.07
70	0.9332	0.31	0.3145	0.18	0.1338	0.12	0.0608	0.08
75	0.9999	0.33	0.3369	0.19	0.1434	0.13	0.0652	0.09
80	1.0666	0.36	0.3594	0.21	0.1530	0.14	0.0695	0.09
85	1.1332	0.38	0.3819	0.22	0.1625	0.14	0.0739	0.10
90	1.1999	0.40	0.4043	0.23	0.1721	0.15	0.0782	0.10
95	1.2665	0.42	0.4265	0.25	0.1816	0.16	0.0825	0.11
100	1.3332	0.45	0.4493	0.26	0.1912	0.17	0.0869	0.11
125	1.6665	0.56	0.5616	0.32	0.2390	0.21	0.1086	0.14
150	1.9998	0.67	0.6739	0.39	0.2868	0.25	0.1303	0.17
175	2.3331	0.78	0.7862	0.45	0.3346	0.30	0.1521	0.20
200			0.8985	0.52	0.3824	0.34	0.1738	0.23
250			1.1231	0.65	0.4780	0.42	0.2172	0.28
300			1.3478	0.78	0.5736	0.51	0.2607	0.34
350					0.6692	0.59	0.3041	0.40
400					0.7648	0.68	0.3476	0.46
450					0.8604	0.76	0.3910	0.51
500							0.4344	0.57
550							0.4779	0.63
600							0.5213	0.68
650							0.5648	0.74
700								
750								
800								
850								
900								
950								
1000								

7.2 Pressure drop tables for various pipes [Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density ρ = 860kg/m³, temperature T = 10°C and kinematic viscosity ν = 1.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**28 x 1.5**		**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	25		32		39		51	
Nom dia	DN25		DN32		DN40		DN50	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
50	0.0145	0.03						
55	0.0159	0.04						
60	0.0174	0.04						
65	0.0188	0.04						
70	0.0203	0.05						
75	0.0217	0.05						
80	0.0232	0.05	0.0086	0.03				
85	0.0246	0.06	0.0092	0.03				
90	0.0261	0.06	0.0097	0.04				
95	0.0275	0.06	0.0103	0.04				
100	0.0290	0.07	0.0108	0.04				
125	0.0362	0.08	0.0135	0.05				
150	0.0435	0.10	0.0162	0.06	0.0073	0.04		
175	0.0507	0.12	0.0189	0.07	0.0086	0.05		
200	0.0580	0.13	0.0216	0.08	0.0098	0.05		
250	0.0725	0.16	0.0270	0.10	0.0122	0.07		
300	0.0870	0.20	0.0324	0.12	0.0147	0.08		
350	0.1015	0.23	0.0378	0.14	0.0171	0.09		
400	0.1160	0.26	0.0432	0.16	0.0196	0.11		
450	0.1304	0.30	0.0486	0.18	0.0220	0.12		
500	0.1449	0.33	0.0540	0.20	0.0245	0.14	0.0084	0.08
550	0.1594	0.36	0.0594	0.22	0.0269	0.15	0.0092	0.09
600	0.1739	0.40	0.0648	0.24	0.0294	0.16	0.0100	0.09
650	0.1884	0.43	0.0702	0.26	0.0318	0.18	0.0109	0.10
700	0.2029	0.46	0.0756	0.28	0.0343	0.19	0.0117	0.11
750	0.2174	0.49	0.0810	0.30	0.0367	0.20	0.0126	0.12
800	0.2319	0.53	0.0864	0.32	0.0392	0.22	0.0134	0.13
850	0.2464	0.56	0.0918	0.34	0.0416	0.23	0.0142	0.13
900	0.2609	0.59	0.0972	0.36	0.0441	0.24	0.0151	0.14
950	0.2754	0.63	0.1026	0.38	0.0465	0.26	0.0159	0.15
1000			0.1080	0.40	0.0489	0.27	0.0167	0.16
1250			0.1350	0.50	0.0612	0.34	0.0209	0.20
1500			0.1620	0.60	0.0734	0.41	0.0251	0.24
1750			0.1890	0.70	0.0857	0.47	0.0293	0.28
2000			0.2160	0.80	0.0979	0.54	0.0335	0.32
2250					0.1101	0.61	0.0377	0.36
2500					0.1224	0.68	0.0418	0.40
2750							0.0460	0.44
3000							0.0502	0.47
3500							0.0586	0.55
4000							0.0670	0.63

7.2 Pressure drop tables for various pipes

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 2.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**12 x 1.2**		**15 x 1.2**		**18 x 1.2**		**22 x 1.5**	
ID [mm]	9.6		12.6		15.6		19	
Nom dia	DN10		DN12		DN15		DN20	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.1333	0.02	0.0449	0.01	0.0191	0.01	0.0087	0.01
10	0.2666	0.04	0.0899	0.03	0.0382	0.02	0.0174	0.01
15	0.4000	0.07	0.1348	0.04	0.0574	0.03	0.0261	0.02
20	0.5333	0.09	0.1797	0.05	0.0765	0.03	0.0348	0.02
25	0.6666	0.11	0.2246	0.06	0.0956	0.04	0.0434	0.03
30	0.7999	0.13	0.2696	0.08	0.1147	0.05	0.0521	0.03
35	0.9332	0.16	0.3145	0.09	0.1338	0.06	0.0608	0.04
40	1.0666	0.18	0.3594	0.10	0.1530	0.07	0.0695	0.05
45	1.1999	0.20	0.4043	0.12	0.1721	0.08	0.0782	0.05
50	1.3332	0.22	0.4493	0.13	0.1912	0.08	0.0869	0.06
55	1.4665	0.25	0.4942	0.14	0.2103	0.09	0.0956	0.06
60	1.5998	0.27	0.5391	0.16	0.2294	0.10	0.1043	0.07
65	1.7332	0.29	0.5840	0.17	0.2486	0.11	0.1130	0.07
70	1.8665	0.31	0.6290	0.18	0.2677	0.12	0.1216	0.08
75	1.9998	0.33	0.6739	0.19	0.2868	0.13	0.1303	0.09
80	2.1331	0.36	0.7188	0.21	0.3059	0.14	0.1390	0.09
85	2.2664	0.38	0.7637	0.22	0.3250	0.14	0.1477	0.10
90	2.3997	0.40	0.8087	0.23	0.3442	0.15	0.1564	0.10
95	2.5331	0.42	0.8536	0.25	0.3633	0.16	0.1651	0.11
100	2.6664	0.45	0.8985	0.26	0.3824	0.17	0.1738	0.11
125	3.3330	0.56	1.1231	0.32	0.4780	0.21	0.2172	0.14
150	3.9996	0.67	1.3478	0.39	0.5736	0.25	0.2607	0.17
175	4.6662	0.78	1.5724	0.45	0.6692	0.30	0.3041	0.20
200			1.7970	0.52	0.7648	0.34	0.3476	0.23
250			2.2463	0.65	0.9560	0.42	0.4344	0.28
300			2.6955	0.78	1.1472	0.51	0.5213	0.34
350					1.3384	0.59	0.6082	0.40
400					1.5296	0.68	0.6951	0.46
450					1.7208	0.76	0.7820	0.51
500							0.8689	0.57
550							0.9558	0.63
600							1.0427	0.68
650							1.1296	0.74
700								
750								
800								
850								
900								
950								
1000								

7.2 Pressure drop tables for various pipes [Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate ***m*** and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 2.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**28 x 1.5**		**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	25		32		39		51	
Nom dia	DN25		DN32		DN40		DN50	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
50	0.0290	0.03						
55	0.0319	0.04						
60	0.0348	0.04						
65	0.0377	0.04						
70	0.0406	0.05						
75	0.0435	0.05						
80	0.0464	0.05	0.0173	0.03				
85	0.0493	0.06	0.0184	0.03				
90	0.0522	0.06	0.0194	0.04				
95	0.0551	0.06	0.0205	0.04				
100	0.0580	0.07	0.0216	0.04				
125	0.0725	0.08	0.0270	0.05				
150	0.0870	0.10	0.0324	0.06	0.0147	0.04		
175	0.1015	0.12	0.0378	0.07	0.0171	0.05		
200	0.1160	0.13	0.0432	0.08	0.0196	0.05		
250	0.1449	0.16	0.0540	0.10	0.0245	0.07		
300	0.1739	0.20	0.0648	0.12	0.0294	0.08		
350	0.2029	0.23	0.0756	0.14	0.0343	0.09		
400	0.2319	0.26	0.0864	0.16	0.0392	0.11		
450	0.2609	0.30	0.0972	0.18	0.0441	0.12		
500	0.2899	0.33	0.1080	0.20	0.0489	0.14	0.0167	0.08
550	0.3189	0.36	0.1188	0.22	0.0538	0.15	0.0184	0.09
600	0.3479	0.40	0.1296	0.24	0.0587	0.16	0.0201	0.09
650	0.3768	0.43	0.1404	0.26	0.0636	0.18	0.0218	0.10
700	0.4058	0.46	0.1512	0.28	0.0685	0.19	0.0234	0.11
750	0.4348	0.49	0.1620	0.30	0.0734	0.20	0.0251	0.12
800	0.4638	0.53	0.1728	0.32	0.0783	0.22	0.0268	0.13
850	0.4928	0.56	0.1836	0.34	0.0832	0.23	0.0285	0.13
900	0.5218	0.59	0.1944	0.36	0.0881	0.24	0.0301	0.14
950	0.5508	0.63	0.2052	0.38	0.0930	0.26	0.0318	0.15
1000			0.2160	0.40	0.0979	0.27	0.0335	0.16
1250			0.2700	0.50	0.1224	0.34	0.0418	0.20
1500			0.3240	0.60	0.1468	0.41	0.0502	0.24
1750			0.3780	0.70	0.1713	0.47	0.0586	0.28
2000			0.4320	0.80	0.1958	0.54	0.0670	0.32
2250					0.2203	0.61	0.0753	0.36
2500					0.2447	0.68	0.0837	0.40
2750							0.0921	0.44
3000							0.1004	0.47
3500							0.1172	0.55
4000							0.1339	0.63

7.2 Pressure drop tables for various pipes

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 4.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**12 x 1.2**		**15 x 1.2**		**18 x 1.2**		**22 x 1.5**	
ID [mm]	9.6		12.6		15.6		19	
Nom dia	DN10		DN12		DN15		DN20	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.2666	0.02	0.0899	0.01	0.0382	0.01		
10	0.5333	0.04	0.1797	0.03	0.0765	0.02	0.0348	0.01
15	0.7999	0.07	0.2696	0.04	0.1147	0.03	0.0521	0.02
20	1.0666	0.09	0.3495	0.05	0.1530	0.03	0.0695	0.02
25	1.3332	0.11	0.4493	0.06	0.1912	0.04	0.0869	0.03
30	1.5998	0.13	0.5391	0.08	0.2294	0.05	0.1043	0.03
35	1.8665	0.16	0.6290	0.09	0.2677	0.06	0.1216	0.04
40	2.1331	0.18	0.7188	0.10	0.3059	0.07	0.1390	0.05
45	2.3997	0.20	0.8087	0.12	0.3442	0.08	0.1564	0.05
50	2.6664	0.22	0.8985	0.13	0.3824	0.08	0.1738	0.06
55	2.9330	0.25	0.9884	0.14	0.4206	0.09	0.1912	0.06
60	3.1997	0.27	1.0782	0.16	0.4589	0.10	0.2085	0.07
65	3.4663	0.29	1.1681	0.17	0.4971	0.11	0.2259	0.07
70	3.7329	0.31	1.2579	0.18	0.5353	0.12	0.2433	0.08
75	3.9996	0.33	1.3478	0.19	0.5736	0.13	0.2607	0.09
80	4.2662	0.36	1.4376	0.21	0.6118	0.14	0.2780	0.09
85	4.5329	0.38	1.5275	0.22	0.6501	0.14	0.2954	0.10
90	4.7995	0.40	1.6173	0.23	0.6883	0.15	0.3128	0.10
95	5.0661	0.42	1.7072	0.25	0.7265	0.16	0.3302	0.11
100	5.3328	0.45	1.7970	0.26	0.7648	0.17	0.3476	0.11
125	6.6660	0.56	2.2463	0.32	0.9560	0.21	0.4344	0.14
150	7.9992	0.67	2.6955	0.39	1.1472	0.25	0.5213	0.17
175	9.3323	0.78	3.1448	0.45	1.3384	0.30	0.6082	0.20
200	10.6655	0.89	3.5941	0.52	1.5296	0.34	0.6951	0.23
250			4.4926	0.65	1.9120	0.42	0.8689	0.28
300			5.3911	0.78	2.2944	0.51	1.0427	0.34
350					2.6767	0.59	1.2164	0.40
400					3.0591	0.68	1.3902	0.46
450					3.4415	0.76	1.5640	0.51
500					3.8239	0.85	1.7378	0.57
550							1.9116	0.63
600							2.0853	0.68
650							2.2591	0.74
700							2.4329	0.80
750								
800								
850								
900								
950								
1000								

7.2 Pressure drop tables for various pipes [Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 4.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**28 x 1.5**		**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	25		32		39		51	
Nom dia	DN25		DN32		DN40		DN50	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
50	0.0580	0.03						
55	0.0638	0.04						
60	0.0696	0.04						
65	0.0754	0.04						
70	0.0812	0.05						
75	0.0870	0.05						
80	0.0928	0.05	0.0346	0.03				
85	0.0986	0.06	0.0367	0.03				
90	0.1044	0.06	0.0389	0.04				
95	0.1102	0.06	0.0410	0.04				
100	0.1160	0.07	0.0432	0.04				
125	0.1449	0.08	0.0540	0.05				
150	0.1739	0.10	0.0648	0.06	0.0294	0.04		
175	0.2029	0.12	0.0756	0.07	0.0343	0.05		
200	0.2319	0.13	0.0864	0.08	0.0392	0.05		
250	0.2899	0.16	0.1080	0.10	0.0489	0.07		
300	0.3479	0.20	0.1296	0.12	0.0587	0.08		
350	0.4058	0.23	0.1512	0.14	0.0685	0.09		
400	0.4638	0.26	0.1728	0.16	0.0783	0.11		
450	0.5218	0.30	0.1944	0.18	0.0881	0.12		
500	0.5798	0.33	0.2160	0.20	0.0979	0.14	0.0335	0.08
550	0.6377	0.36	0.2376	0.22	0.1077	0.15	0.0368	0.09
600	0.6957	0.40	0.2592	0.24	0.1175	0.16	0.0402	0.09
650	0.7537	0.43	0.2808	0.26	0.1273	0.18	0.0435	0.10
700	0.8117	0.46	0.3024	0.28	0.1370	0.19	0.0469	0.11
750	0.8696	0.49	0.3240	0.30	0.1468	0.20	0.0502	0.12
800	0.9276	0.53	0.3456	0.32	0.1566	0.22	0.0536	0.13
850	0.9856	0.56	0.3672	0.34	0.1664	0.23	0.0569	0.13
900	1.0436	0.59	0.3888	0.36	0.1762	0.24	0.0603	0.14
950	1.1015	0.63	0.4104	0.38	0.1860	0.26	0.0636	0.15
1000			0.4320	0.40	0.1958	0.27	0.0670	0.16
1250			0.5399	0.50	0.2447	0.34	0.0837	0.20
1500			0.6479	0.60	0.2937	0.41	0.1004	0.24
1750			0.7559	0.70	0.3426	0.47	0.1172	0.28
2000			0.8639	0.80	0.3916	0.54	0.1339	0.32
2250					0.4405	0.61	0.1506	0.36
2500					0.4895	0.68	0.1674	0.40
2750							0.1841	0.44
3000							0.2009	0.47
3500							0.2343	0.55
4000							0.2678	0.63

7.2 Pressure drop tables for various pipes

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density r = 860kg/m³, temperature T = 10°C and kinematic viscosity n = 6.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from stainless Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**12 x 1.2**		**15 x 1.2**		**18 x 1.2**		**22 x 1.5**	
ID [mm]	9.6		12.6		15.6		19	
Nom dia	DN10		DN12		DN15		DN20	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
5	0.4000	0.02	0.1348	0.01	0.0574	0.01		
10	0.7999	0.04	0.2696	0.03	0.1147	0.02	0.0521	0.01
15	1.1999	0.07	0.4043	0.04	0.1721	0.03	0.0782	0.02
20	1.5998	0.09	0.5391	0.05	0.2294	0.03	0.1043	0.02
25	1.9998	0.11	0.6739	0.06	0.2868	0.04	0.1303	0.03
30	2.3997	0.13	0.8087	0.08	0.3442	0.05	0.1564	0.03
35	2.7997	0.16	0.9434	0.09	0.4015	0.06	0.1825	0.04
40	3.1997	0.18	1.0782	0.10	0.4589	0.07	0.2085	0.05
45	3.5996	0.20	1.2130	0.12	0.5162	0.08	0.2346	0.05
50	3.9996	0.22	1.3478	0.13	0.5736	0.08	0.2607	0.06
55	4.3995	0.25	1.4826	0.14	0.6309	0.09	0.2867	0.06
60	4.7995	0.27	1.6173	0.16	0.6883	0.10	0.3128	0.07
65	5.1995	0.29	1.7521	0.17	0.7457	0.11	0.3389	0.07
70	5.5994	0.31	1.8869	0.18	0.8030	0.12	0.3649	0.08
75	5.9994	0.33	2.0217	0.19	0.8604	0.13	0.3910	0.09
80	6.3993	0.36	2.1564	0.21	0.9177	0.14	0.4171	0.09
85	6.7993	0.38	2.2912	0.22	0.9751	0.14	0.4431	0.10
90	7.1992	0.40	2.4260	0.23	1.0325	0.15	0.4692	0.10
95	7.5992	0.42	2.5608	0.25	1.0898	0.16	0.4953	0.11
100	7.9992	0.45	2.6955	0.26	1.1472	0.17	0.5213	0.11
125	9.9989	0.56	3.3694	0.32	1.4340	0.21	0.6517	0.14
150	11.9987	0.67	4.0433	0.39	1.7208	0.25	0.7820	0.15
175	13.9985	0.78	4.7172	0.45	2.0076	0.30	0.9123	0.20
200	15.9983	0.89	5.3911	0.52	2.2944	0.34	1.0427	0.23
250			6.7389	0.65	2.8679	0.42	1.3033	0.28
300			808066	0.78	3.4415	0.51	1.5640	0.34
350			9.4344	0.91	4.0151	0.59	1.8247	0.40
400					4.5887	0.68	2.0853	0.46
450					5.1623	0.76	2.3460	0.51
500					5.7359	0.85	2.6067	0.57
550					6.3095	0.93	2.8673	0.63
600							3.1280	0.68
650							3.3887	0.74
700							3.6493	0.80
750								
800								
850								
900								
950								
1000								

7.2 Pressure drop tables for various pipes [Continuation]

Pipe pressure gradient due to friction *R* as a function of mass flow rate *m* and flow velocity *v* at a density ρ = 860kg/m³, temperature T = 10°C and kinematic viscosity ν = 6.

The values are tabulated for mapress CARBON STEEL pipes to DIN 2394, *mapress* STAINLESS STEEL pipes manufactured from Cr-Ni-Mo steel to DVGW Code of Practice W 541, and copper pipes to DVGW Code of Practice GW 392 / DIN EN 1057.

Nominal size	Pipe outside diameter x wall thickness							
d x t [mm]	**28 x 1.5**		**35 x 1.5**		**42 x 1.5**		**54 x 1.5**	
ID [mm]	25		32		39		51	
Nom dia	DN25		DN32		DN40		DN50	
m [kg/h]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]	Pressure gradient *R* [mbar/m]	*v* [m/s]
50	0.0870	0.03						
55	0.0957	0.04						
60	0.1044	0.04						
65	0.1131	0.04						
70	0.1217	0.05						
75	0.1304	0.05						
80	0.1391	0.05	0.0518	0.03				
85	0.1478	0.06	0.0551	0.03				
90	0.1565	0.06	0.0583	0.04				
95	0.1652	0.06	0.0616	0.04				
100	0.1739	0.07	0.0648	0.04				
125	0.2174	0.08	0.0810	0.05				
150	0.2609	0.10	0.0972	0.06	0.0441	0.04		
175	0.3044	0.12	0.1134	0.07	0.0514	0.05		
200	0.3479	0.13	0.1296	0.08	0.0587	0.05		
250	0.4348	0.16	0.1620	0.10	0.0734	0.07		
300	0.5218	0.20	0.1944	0.12	0.0881	0.08		
350	0.6087	0.23	0.2268	0.14	0.1028	0.09		
400	0.6957	0.26	0.2592	0.16	0.1175	0.11		
450	0.7827	0.30	0.2916	0.18	0.1322	0.12		
500	0.8696	0.33	0.3420	0.20	0.1468	0.14	0.0502	0.08
550	0.9566	0.36	0.3564	0.22	0.1615	0.15	0.0552	0.09
600	1.0436	0.40	0.3888	0.24	0.1762	0.16	0.0603	0.09
650	1.1305	0.43	0.4212	0.26	0.1909	0.18	0.0653	0.10
700	1.2175	0.46	0.4536	0.28	0.2056	0.19	0.0703	0.11
750	1.3045	0.49	0.4859	0.30	0.2203	0.20	0.0753	0.12
800	1.3914	0.53	0.5183	0.32	0.2349	0.22	0.0803	0.13
850	1.4784	0.56	0.5507	0.34	0.2496	0.23	0.0854	0.13
900	1.5654	0.59	0.5831	0.36	0.2643	0.24	0.0904	0.14
950	1.6523	0.63	0.6155	0.38	0.2790	0.26	0.0954	0.15
1000			0.6479	0.40	0.2937	0.27	0.1004	0.16
1250			0.8099	0.50	0.3671	0.34	0.1255	0.20
1500			0.9719	0.60	0.4405	0.41	0.1506	0.24
1750			1.1339	0.70	0.5139	0.47	0.1757	0.28
2000			1.2959	0.80	0.5874	0.54	0.2009	0.34
2250					0.6608	0.61	0.2260	0.36
2500					0.7342	0.68	0.2511	0.40
2750							0.2762	0.44
3000							0.3013	0.47
3500							0.3515	0.55
4000							0.4017	0.63

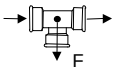
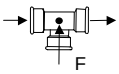
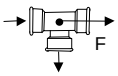
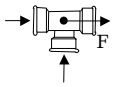
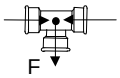
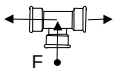
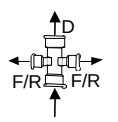
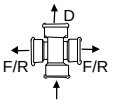
7.3 Table of pressure drop due to minor losses

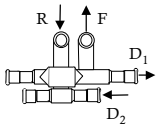
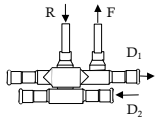
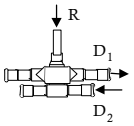
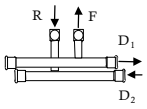
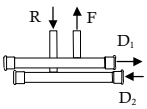
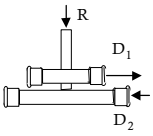
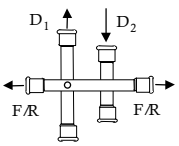
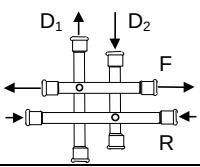
Pressure drop *Z* as a function of flow velocity *v* and sum of the loss constants Öc at T = 10°C
(density = 860kg/m³)

Pressure drop Z [mbar] due to minor losses													
Öc / v[m/s]	**0.02**	**0.04**	**0.06**	**0.08**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**1.0**
0.1	0.0002	0.0007	0.0015	0.0028	0.0043	0.0172	0.0387	0.0688	0.1075	0.1548	0.2107	0.2752	0.4300
0.2	0.0003	0.0014	0.0031	0.0055	0.0086	0.0344	0.0774	0.1376	0.2150	0.3096	0.4214	0.5504	0.8600
0.3	0.0005	0.0021	0.0046	0.0083	0.0129	0.0516	0.1161	0.2064	0.3225	0.4644	0.6321	0.8256	1.2900
0.4	0.0007	0.0028	0.0062	0.0110	0.0172	0.0688	0.1548	0.2752	0.4300	0.6192	0.8428	1.1008	1.7200
0.5	0.0009	0.0034	0.0077	0.0138	0.0215	0.0860	0.1935	0.3440	0.5375	0.7740	1.0535	1.3760	2.1500
0.6	0.0010	0.0041	0.0093	0.0165	0.0258	0.1032	0.2322	0.4128	0.6450	0.9288	1.2642	1.6512	2.5800
0.7	0.0012	0.0048	0.0108	0.0193	0.0301	0.1204	0.2709	0.4816	0.7525	1.0836	1.4749	1.9264	3.0100
0.8	0.0014	0.0055	0.0124	0.0220	0.0344	0.1376	0.3096	0.5504	0.8600	1.2384	1.6856	2.2016	3.4400
0.9	0.0015	0.0062	0.0139	0.0248	0.0387	0.1548	0.3483	0.6192	0.9675	1.3932	1.8963	2.4768	3.8700
1.0	0.0017	0.0069	0.0155	0.0275	0.0430	0.1720	0.3870	0.6880	1.0750	1.5480	2.1070	2.7520	4.3000
1.5	0.0026	0.0103	0.0232	0.0413	0.0645	0.2580	0.5805	1.0320	1.6125	2.3220	3.1605	4.1280	6.4500
2.0	0.0034	0.0138	0.0310	0.0550	0.0860	0.3440	0.7740	1.3760	2.1500	3.0960	4.2140	5.5040	8.6000
2.5	0.0043	0.0172	0.0387	0.0688	0.1075	0.4300	0.9675	1.7200	2.6875	3.8700	5.2675	6.8800	10.750
3.0	0.0052	0.0206	0.0464	0.0826	0.1290	0.5160	1.1610	2.0640	3.2250	4.6440	6.3210	8.2560	12.900
4.0	0.0069	0.0275	0.0619	0.1101	0.1720	0.6880	1.5480	2.7520	4.3000	6.1920	8.4280	11.008	17.200
5.0	0.0086	0.0344	0.0774	0.1376	0.2150	0.8600	1.9350	3.4400	5.3750	7.7400	10.535	13.760	21.500
6.0	0.0103	0.0413	0.0929	0.1651	0.2580	1.0320	2.3220	4.1280	6.4500	9.2880	12.642	16.512	25.800
7.0	0.0120	0.0482	0.1084	0.1926	0.3010	1.2040	2.7090	4.8160	7.5250	10.836	14.749	19.264	30.100
8.0	0.0138	0.0550	0.1238	0.2202	0.3440	1.3760	3.0960	5.5040	8.6000	12.386	16.856	22.016	34.400
9.0	0.0155	0.0619	0.1393	0.2477	0.3870	1.5480	3.4830	6.1920	9.6750	13.932	18.963	24.768	38.700
10.0	0.0172	0.0688	0.1548	0.2752	0.4300	1.7200	3.8700	6.8800	10.750	15.480	21.070	27.520	43.000
12.0	0.0206	0.0826	0.1858	0.3302	0.5160	2.0640	4.6440	8.2560	12.900	18.576	25.284	33.024	51.600
15.0	0.0258	0.1032	0.2322	0.4128	0.6450	2.5800	5.8050	10.320	16.125	23.220	31.605	41.280	64.500
20.0	0.0344	0.1376	0.3096	0.5504	0.8600	3.4400	7.7400	13.760	21.500	30.960	42.140	55.040	86.000
25.0	0.0430	0.1720	0.3870	0.6880	1.0750	4.3000	9.6750	17.200	26.875	38.700	52.675	68.800	107.50
30.0	0.0516	0.2064	0.4644	0.8256	1.2900	5.1600	11.610	20.640	32.250	46.440	63.210	82.560	129.00
40.0	0.0688	0.2752	0.6192	1.1008	1.7200	6.880	15.480	27.520	43.000	61.920	84.280	110.08	172.00
50.0	0.0860	0.3440	0.7740	1.3760	2.1500	8.600	19.350	34.400	53.750	77.400	105.35	137.60	215.00
60.0	0.1032	0.4128	0.9288	1.6512	2.5800	10.320	23.220	41.280	64.500	92.880	126.42	165.12	258.00
70.0	0.1204	0.4816	1.0836	1.9264	3.0100	12.040	27.090	48.160	75.250	108.36	147.49	192.64	301.00
80.0	0.1376	0.5504	1.2384	2.2016	3.4400	13.760	30.960	55.040	86.000	123.84	168.56	220.16	344.00
90.0	0.1548	0.6192	1.3932	2.4768	3.8700	15.480	34.830	61.920	96.750	139.32	189.63	247.68	387.00
100.0	0.1720	0.6880	1.5480	2.7520	4.3000	17.200	38.700	68.800	107.50	154.80	210.70	275.20	430.00

8.0 Pressure Drop Due to Minor Losses: Loss Constants

Guide values of *mapress* pressfitting loss constants

Name	Press-fitting	Loss constant C	WS	H	G
Elbow or bend		0.7	X	X	X
Angle adapter		1.5		X	
Preformed pipe bridge		0.5	X	X	X
45° elbow		0.5	X	X	X
Reducer		0.2	X	X	X
Coupling, male adapter **Combination pipe**		0.1	X	X	X
Tee, main flow from line into branch		1.3	X	X	X
Tee, main flow from branch into line		0.9	X	X	X
Tee, mainly through, some line into branch		0.3	X	X	X
Tee, mainly through, some branch into line		0.2	X	X	X
Tee, counterflow from line into branch		1.5	X	X	X
Tee, counterflow from branch into line		3.0	X	X	X
30° crossover **through flow** **flow splitting** **flow combination**		0.3 1.3 0.9		X	
90° crossover **through flow** **flow splitting** **flow combination**		0.2 1.7 1.3		X	

Name Pressfitting	d [mm]	Loss constant D_1 - C	D_2 - C	F - C	R - C
Twin pipe crossovers **Type: RP – KG (Cu)** 	15 – 15 18 – 15 22 – 15	3.0	1.0	1.8	2.3
Type: RP – K (Cu) 	15 – 15 18 – 15 22 – 15	3.0	1.0	1.5	2.0
Type: RP – KE (Cu) 	15 – 15 18 – 15 22 – 15	3.0	1.0	-	1.5
Twin pipe crossovers **Type: RP – KG (St)** 	15 – 15 18 – 15 22 – 15	5.0	3.0	8.0	10.0
Type: RP – K (St) 	15 – 15 18 – 15 22 – 15	5.0	3.0	6.0	8.0
Double pipe crossovers **Type: R – HE (St)** 	15 – 15 18 – 15 22 – 15	2.0	2.5	-	8.0
Type: ST – HD (St) 	15 – 15 18 – 15 22 – 15 28 – 15	4.0	2.0	10.0	8.0
Type: ST – RD (St) 	15 – 15 18 – 15 22 – 15 28 - 15	5.0	3.0	10.0	8.0

WS = Water supply system
H = Heating system
G = Gas system

mapress

pressfitting system

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