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NIBCO®

AHEAD OF THE FLOW®

PVC-C and PVC-U systems

Design and Installation Manual

with catalog

DM-IM-C/PVC-EN042018

NIBCO world headquarters, Elkhart, Indiana, USA

Manufacturing plant and logistic centre in Łódź, Poland

NIBCO is a global company established in 1904 in Elkhart, Indiana, USA, it has 11 manufacturing centres, one of which is in Poland. The manufacturing plant and logistic centre located in Łódź have been looking after the distribution network in Europe for 20 years. The quality of our products, manufacturing and distribution methods conform with DIN EN ISO 9001:2000 requirements. Our product range conforms with European certificates and approvals, both in relation to process and hygiene, in all countries of operation.

The basic product of the Polish plant are complete PVC-C (1/2" to 4") and PVC-U (1/2" to 8") installations for use in cooling, air conditioning, swimming pool systems, water treatment systems, sewage treatment plants and in residential applications. Our product range also includes: soldered copper fittings with diameters of 8 mm to 108 mm, press fittings for water and gas (from 12 mm to 54 mm), threaded and soldered brass fittings (from 12 mm to 54 mm), as well as brass and bronze industrial valves.

Our basic product range also includes Fire Protection Valves made in USA in our own foundries. Our high quality NIBCO Fire Protection Valves have been approved by American fire security testing bodies UL (Underwriters Laboratories) and FM (Factory Mutual), and have been issued various European certificates and approvals.

NIBCO is not only about product quality but also tight-knit teams of employees who are passionate about completing their tasks. Our employees are people with many years of experience on Polish and foreign markets. We work hard to meet the requirements of our customers. Further services include: training, presentations and demonstrations at the locations selected by the customer. We also offer project consultation and assistance in commissioning, which involves checking the correct assembly of installations made from NIBCO products.

CONTENTS

I. GENERAL

Installations made of plastics, such as polyvinyl chloride and chlorinated polyvinyl chloride, have now been enjoying immense popularity for several dozen years. Thanks to parameters of these materials, such as low specific gravity, corrosion resistance, and resistance to various chemicals, PVC-C and PVC-U pipes are widely used in many industries: in cooling, air conditioning, swimming pool systems, water treatment systems, sewage treatment plants, industrial installations and in residential applications.

PVC-C and PVC-U installations were first introduced in the USA in the 1950s. It was the American Society of Testing Materials that first developed ASTM standards concerning these materials in construction installations. For example, ASTM D-1785 applies to cold water, while ASTM D-2846 and ASTM F-441 relate to hot water. Such installations also have approvals for use with potable water issued by NSF (National Sanitation Foundation). PVC-C and PVC-U piping systems have been in use in Europe since the 1970s, from the moment they were certified by the most important European test organizations from England, Germany and others. In Europe, the requirements for PVC-U installations are regulated by EN 1452, and for PVC-C – by EN 15877. PVC-C and PVC-U systems by NIBCO meet the requirements of both American and European standards. The systems have technical approvals issued by the Building Research Institute (in Poland: ITB) as well as hygienic approvals by PZH as safe for use in plumbing applications with potable water.

Our piping products are manufactured in four plants: Łódź in Poland, as well as Goshen, Greensboro, and Charlestown in the USA. All NIBCO manufacturing plants meet the requirements of quality maintenance systems in accordance with ISO 9001:2008.

II. PVC-U & PVC-C AS INTALLATION MATERIALS

1 PHYSICAL PARAMETERS

Table 1

Parameters	PVC-U	PVC-C	Unit
Mechanical at 23°C			
1 Density	1.41	1.57	g/cm^3
2 Tensile strength	48.3	57.9	MPa
3. Bend strength	100	107.7	MPa
4. Compressive strength	62.0	62.0	MPa
5. Young's modulus	2758	2898	MPa
6. Hardness Rockwell R	110-120	120	
Thermal			
1 Coefficient of linear expansion	5.2	6.2	x10^{-5} 1/K
2 Thermal transmittance coefficient	0.22	0.16	W/mK

Conditions for use of PVC-C and PVC-U pipes and fittings, including temperature and working time distribution during a 50-year period of use of the installation are included in technical approvals issued by the Polish Building Research Institute (for PVC-C: ITB AT-15-8695/2016, for PVC-U: ITB AT-15-8179/2014).

2 CHEMICAL PARAMETERS

PVC-C and PVC-U pipes and fittings feature excellent chemical resistance. It was tested using PVC-C and PVC-U samples submerged in different chemicals for 90 days and recording changes in mass and tension at different temperatures. These test results served as the basis for the development of a table with PVC-C and PVC-U resistance to different chemicals. This table can be found in the NIBCO Chemical Guide.

For industrial uses of PVC-C and PVC-U valves, NIBCO has data on chemical resistance of different types of materials used as sealants for such products.

3 FIRE RESISTANCE PROPERTIES

Both PVC-C and PVC-U show great fire performance. The ignition temperature for PVC-U is higher than 388°C, and PVC-C is higher than 433°C. The Limiting Oxygen Index (LOI) for PVC-U is 40, and for PVC-C it is 60. This means that for burning these materials require 40% oxygen (PVC-U) and 60% oxygen (PVC-C FlowGuard®). The Earth atmosphere contains 21% oxygen, so both PVC-U and PVC-C do not sustain combustion process and self-extinguish after the removal of the ignition source.
LOI for PP is 17, for polybutylene – 18, PEX – 7, PERT – 7, cotton – 15, nylon – 20.

Another parameter used for describing fire resistance is FLAME SPREAD. Flame spread value for asbestos is 0, for PVC-C is 15, PVC-U 15-20, PP 250, nylon 60, acrylic 90 and for wood: 100. The lower the flame spread, the less absorption of oxygen, less heat production and less production of substances dangerous to human life, such as CO.

The burning of PVC-U, and PVC-C produces a small amount of smoke. The smoke-developed index for PVC-C is under 50, and for PP it is approx 500. Scientists from University of Pittsburgh have found that the toxicity level of the combustion by-products of PVC-U and PVC-C is not higher than with that of burning wood, and lower than when burning cotton or wool. These characteristics were decisive for the popularity of PVC-U and PVC-C in the construction industry.

4 BASIC ADVANTAGES OF PVC-U & PVC-C AS INTALLATION MATERIALS

- Resistant to scaling and dirt.
- Resistant to corrosion.
- Resistant to several hundred chemical compounds, including aggressive media. Thanks to the above, PVC-C and PVC-U systems may be used in the chemical industry, and food industry while meeting certain process conditions (for transport of acids, bases, saline solutions, fats and other substances in accordance with the table of chemical resistance).
- Physiological and microbiological neutrality make our products suitable for widespread use in healthcare facilities.
- High resistance to erosion. Abrasion due to violent water flow, or sand or fine clay included in the water is at minimum level.
- Our products are designed for easy, quick and safe assembly, without the need for specialized tools.
- High tensile strength (pressure).
- With good vibration and noise damping properties.
- Several times less weight in relation to the standard materials.
- High internal smoothness of pipe results in lower flow resistance, and enables using piping with smaller diameters.
- The fitting design and joining method ensures lowering of local flow resistance, i.e. enable full flow.
- High heat insulation properties let you reduce the thickness of pipe heat insulation, reduction of sweating on cold water pipeworks.
- Our products feature the lowest linear thermal expansion among the homogeneous plastics used for sanitary installations (twice smaller than with PP products).
- Excellent fire performance.
- Electrical insulating power means no galvanic corrosion, which is particularly important for underground piping.
- No oxygen diffusion to the installation.
- As our pipes are rigid, any installations built with our pipes ensure a pleasing aesthetic appearance.

III. TYPES AND PARAMETERS OF PVC-U & PVC-C PIPES

PVC-C and PVC-U pipes and fittings are available in inch dimensions, in diameters from ½" to 8". External diameters of pipes for the whole range correspond to dimensions of steel pipes – the Iron Pipe Size system.
Two versions of the PVC-U system are available which refer to size lines:

- American according to ASTM D-1785, pipes from Sch 40 series (thick-walled), and Sch 80 for industrial applications, available on special request.
- European line, manufactured in accordance with PN EN 1452-2 in the following pressure groups PN15, PN12 and PN9.

The technical parameters for PVC-U pipes are shown in tables 2a and 2b.
PVC-C pipes and fittings available in diameters from ½" to 2", with the trade name FlowGuard®; cream coloured, dimensioned in inches according to CTS system SDR11 - Copper Tube Size.
The technical characteristics of PVC-C pipes are shown in table 2c.

The PVC-C pipes and fittings in diameter range from 2½" to 4" are produced in light grey, using IPS (same as with PVC-U) – with pipes as types Sch 40 and Sch 80, and fittings as Sch 80.

PVC-U pipes and fittings are designed for cold drinking water, and PVC-C pipes and fittings are for cold and hot water distribution systems. When using PVC-C pipes for cold water systems, remember that the pipes up to size 2" are CTS pipes, and transitional fittings must be used to connect them with a PVC-U system (IPS system).

COMMENTS:

1. The raw materials used in the production of PVC-U and PVC-C pipes and fittings do not contain lead stabilisers. Zinc-calcium stabilizers are used in PVC-U, and organotin stabilizers are used in PVC-C products.
2. Do not use PVC-C and PVC-U pipes in compressed air systems and gas installations.
3. If you are threading the pipes (applicable only to Sch 80), assume acceptable operating pressure equal to 0.5 of the pressure for a pipe without thread.
4. For temperatures above 23°C, the maximum operating pressure is reduced. Kr reducing factor is shown in table 3 a, b, c.

PVC-U COLD WATER PIPES SCH 40 **Table 2a**

Size	Max. working pressure (23°C)	Ext. diameter	Indicative max.	Wall thickness	Average mass
inches	type / kPa	mm	internal dia. in mm	mm	kg/lm
1/2"	Sch 40 / 4140	21.34±0.10	15.80	2.77+0.51	0.24
3/4"	Sch 40 / 3310	26.67±0.10	20.93	2.87+0.51	0.32
1"	Sch 40 / 3100	33.40±0.13	26.64	3.38+0.51	0.47
1 1/4"	Sch 40 / 2550	42.16±0.13	35.04	3.56+0.51	0.64
1 1/2"	Sch 40 / 2280	48.26±0.15	40.90	3.68+0.51	0.76
2"	Sch 40 / 1930	60.32±0.15	52.50	3.91+0.51	1.02
2 1/2"	Sch 40 / 2070	73.02±0.18	62.70	5.16+0.61	1.59
3"	Sch 40 / 1790	88.90±0.20	77.92	5.49+0.66	2.10
4"	Sch 40 / 1520	114.30±0.23	102.26	6.02+0.71	3.00
6"	Sch 40 / 1240	168.28±0.28	154.06	7.11+0.86	4.46
8"	Sch 40 / 1100	219.08±0.38	202.72	8.18+0.99	5.84

PVC-U COLD WATER PIPES IN LINE WITH PN (pressure types PN15, PN12 & PN9) **Table 2b**

Size	Max. working pressure (25°C)	Ext. diameter	Indicative max.	Wall thickness	Average mass
inches	PN / kPa	mm	internal dia. in mm	mm	kg/mb
1/2"	PN 15 / 1500	21.20+0.30	17.80	1.7+0.4	0.17
3/4"	PN 15 / 1500	26.60+0.30	22.80	1.9+0.6	0.23
1"	PN 15 / 1500	33.40+0.30	29.00	2.2+0.6	0.33
1 1/4"	PN 15 / 1500	42.10+0.30	36.70	2.7+0.6	0.53
1 1/2"	PN 15 / 1500	48.10+0.30	41.90	3.1+0.6	0.68
2"	PN 15 / 1500	60.20+0.30	52.40	3.9+0.6	1.03
3"	PN 15 / 1500	88.70+0.40	77.30	5.7+0.9	2.15
4"	PN 12 / 1200	114.10+0.40	102.10	6.0+0.9	2.94
6"	PN9 / 900	168.00+0.50	154.80	6.6+1.0	4.46
8"	PN9 / 900	218.80+0.60	203.20	7.8+1.2	5.84

PVC-C HOT AND COLD WATER PIPE **Table 2c**

Size	Max. working pressure (23°C)	Ext. diameter	Indicative max.	Wall thickness	Average mass
inches	type / kPa	mm	internal dia. in mm	mm	kg/lm
1/2"	CTS(SDR 11) / 2760	15.90 ± 0.08	12.44	1.52+0.51	0.13
3/4"	CTS(SDR 11) / 2760	22.20 ± 0.08	18.14	2.03+0.51	0.21
1"	CTS(SDR 11) / 2760	28.60 ± 0.08	23.42	2.59+0.51	0.33
1 1/4"	CTS(SDR 11) / 2760	34.90 ± 0.08	28.54	3.18+0.51	0.49
1 1/2"	CTS(SDR 11) / 2760	41.30 ± 0.10	33.78	3.76+0.51	0.69
2"	CTS(SDR 11) / 2760	54.00 ± 0.10	44.20	4.90+0.58	1.18
2 1/2"	Sch 40 / 2070	73.02 ± 0.18	62.70	5.16+0.61	1.79
3"	Sch 40 / 1790	88.90 ± 0.20	77.92	5.49+0.66	2.34
4"	Sch 40 / 1520	114.3 ± 0.23	102.26	6.02+0.71	3.33
2 1/2"	Sch 80 / 2900	73.00 ± 0.18	59.00	7.01+0.84	2.17
3"	Sch 80 / 2550	88.90 ± 0.20	73.66	7.62+0.91	2.92
4"	Sch 80 / 2210	114.30 ± 0.23	97.18	8.56+1.02	4.64

Kr coefficient

Table 3a

Temp. °C	Kr PVC-U PN
10	1
15	1
20	1
25	1
30	0.9
35	0.8
40	0.7
45	0.62

Table 3b

Temp. °C	Kr PVC-U Sch 40
23	1
27	0.9
32	0.75
38	0.62
43	0.5
49	0.4

Table 3c

Temp. °C	Kr PVC-C
23	1
27	0.96
32	0.92
38	0.85
43	0.77
49	0.7
66	0.47
71	0.4
77	0.32
82	0.25

GLOSSARY:

CTS - Copper Tube Size. pipe dimensioning system applied to copper pipes (in inches). This means that a 2" PVC-C pipe will have the same outside diameter as a 2" copper pipe.

IPS - Iron Pipe Size. pipe dimensioning system applied to steel pipes (in inches).

SDR- Standard Dimension Ratio. A dimensionless, numerical marking of pipe type from the point of view of ratio of nominal external diameter of a pipe to its wall thickness. This means that the maximum working pressure is constant for all pipes from the family. For SDR 11, the ratio of external diameter to wall thickness is 11.

SCH - Schedule. This the second parameter next to the nominal diameter, which characterises the pipe size in the American system (e.g. SCH 40, SCH 80). Schedule refers to the thickness of a pipe wall, and the maximum operating pressure for the pipe at the same time. The higher this value, the thicker the pipe's wall, and the greater the maximum pressure but also – the more expensive the pipe. SCH80 pipes and fittings are used primarily in industrial installations.

PN – Pressure Nominal. This is a numerical pressure designation associated with the mechanical properties of a system component. It corresponds to the fixed maximum of working pressure of the water at +20°C expressed in bar (10 bar = 1 MPa). The pipes from the PN15 family have thinner walls in comparison with SCH40 pipes. This results in a lower maximum pressure – (maximum pressure is 1.5 MPa). This pressure is sufficient for many applications.

IV. DESIGN GUIDELINES

1 DESIGN INFORMATION

According to EN 806-3:2006, the maximum pressure at the draw-off point should be 500 kPa and minimum 100 kPa (the exception is a garden/garage sprinkler with max. 1000 kPa). The maximum flow speeds in distribution systems for risers and horizontal branches are 2.0 m/s and 4.0 m/s to individual fixtures.

European standard PN-EN 806-3:2006 provides a simplified method for sizing pipe diameters for water installations. This method involves designating Leading Unit LU values which are given in table no. 4.

When the LU values for draw-off points are known, add them and find the appropriate pipe diameters d_i from tables 5a, 5b, 5c.

FLOW RATES FOR DRAW-OFF POINTS ACCORDING TO PN EN 806-3 Table 4

Draw-off point	Q_A l/s	Q_{min} l/s	Load units LU
Washbasin, kitchen sink, bidet, WC tank	0.1	0.1	1
Household kitchen sink, washing machine [a], dishwasher, sink, shower valve	0.2	0.15	2
Urinal flush valve	0.3	0.15	3
Household bath fittings	0.4	0.3	4
Taps (garden, garage)	0.5	0.4	5
Sinks not intended for household use, DN20; bath fittings not intended for household use	0.8	0.8	8
Flushing device valve DN20	1.5	1.0	15

[a] The devices not intended for home use require consultation with the device manufacturer.

The values given in the table do not correspond to the values shown in the product standards. They are only intended for sizing pipeworks.

DETERMINATION OF PIPE DIAMETERS USING LOAD UNITS

PVC-U per PN 15 **Table 5a**

Max. load unit	LU	16	35	100	350	540	1100
Load unit total	LU	8					
Diameter	inches	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Indicative max. int. diameter	mm	17.80	22.80	29.00	36.70	41.90	52.40
Max. length of a design section	m						

PVC-U per Sch 40 **Table 5b**

Max. load unit	LU	10	30	70	300	500	1100
Load unit total	LU	5	8				
Diameter	inches	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Indicative max. int. diameter	mm	15.80	20.93	26.64	35.04	40.90	52.50
Max. length of a design section	m						

PVC-C **Table 5c**

Max. load unit	LU	3	4	5	16	35	100	200	540
Load unit total	LU			4	8				
Diameter	inches	1/2"			3/4"	1"	1 1/4"	1 1/2"	2"
Indicative max. int. diameter	mm	12.44			18.14	23.42	28.54	33.78	44.20
Max. length of a design section	m	10	6	5					

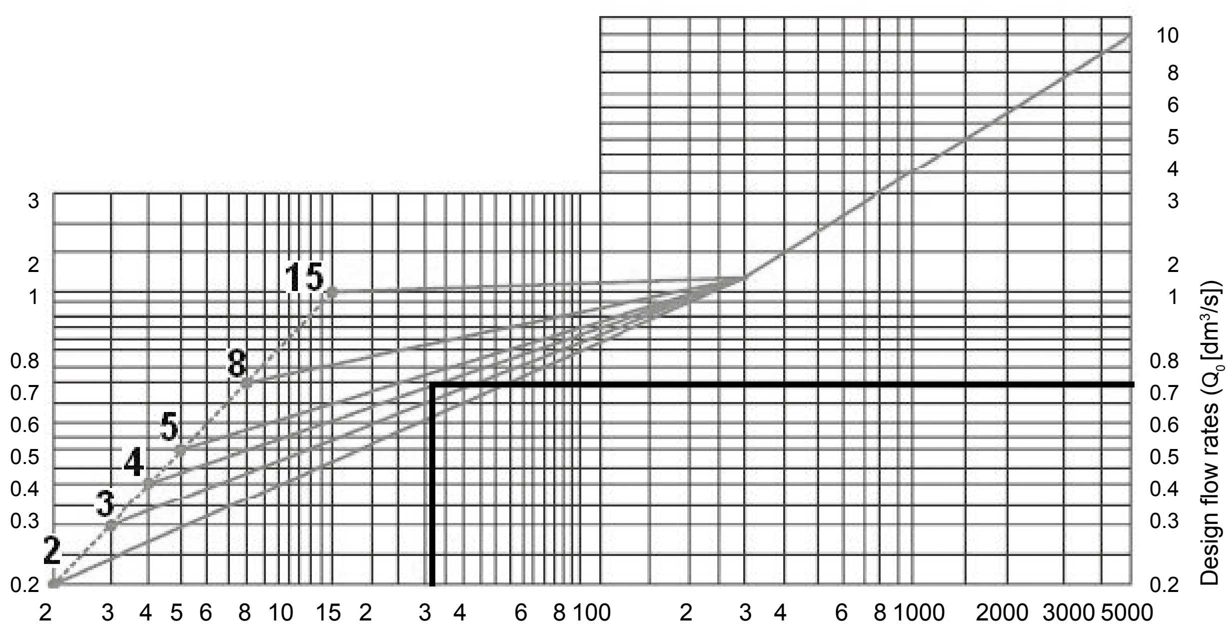


Fig. 1. Nomograph for determining design water flow rates in water distribution systems (Qo [dm3/s]), depending on the total of equivalent load units (ΣLU)

Instructions for use for flow nomograph (Qo [dm3/s]).

1. Determine equivalent total for section ΣLU

Table 6

No.	Tool type	LU	Tool quantity	LU total
1	Washbasin	1	4	4
2	Dishwasher	2	2	4
3	Toilet flushing valve	3	4	12
4	Kitchen sink	2	2	4
5	Domestic bath	4	2	8
			Total	32

2. If you know the sum for equivalents LU=32, and the highest LU value for the design distance (in this example, this is 4 for a domestic bath), you can calculate the design flow rate that results from the nomograph. It is 0.7 l/s.

2. PRESSURE LOSSES ON PVC-U AND PVC-C PIPE INSTALLATIONS

Use the following equation to determine the total design pressure loss of a system section:

$$\Delta p = \sum L_i \bullet R_i + \sum \xi_i \bullet Pd_i$$

where:

R_i – unit linear pressure loss as a result of friction in [Pa/m]

L_i – lengths of design circulation units in (m), with friction Ri in [Pa/m]

ξ_i – local loss coefficient

Pd_i – water jet's dynamic pressure overcoming specific local resistance in [Pa]

Pressure losses on PVC-C and PVC-U pipe pipeworks depend on many factors, including flow speed and coupling system (i.e. number of couplings).

Unit linear pressure losses can be accurately calculated using the Hazen-Williams equation:

$$R=3468{,}85 \bullet \left(\frac{100}{c}\right)^{1{,}852} \bullet Q^{1{,}852} \bullet (0{,}04d)^{-4{,}8655}$$

where:

R – pressure loss as a result of friction in [Pa/lm]

d – pipe internal diameter in [mm]

Q – water flow in [l/s]

c – constant smoothness of the internal pipe's surface.

Water flow speed can be calculated using the following formula:

$$V_w = 1273 \frac{Q}{d^2}$$

where:

Vw – water flow speed in [m/s]

d – pipe internal diameter in [mm]

Q – water flow in [l/s]

For PVC-C and PVC-U pipes, it is assumed as c=150. For copper pipes, it is c =140.
For five-year old steel galvanised pipes, it is c=110.

In practice, nomographs are used to determine pressure and speed losses.

Fig. 2. NOMOGRAPH FOR CALCULATING HYDRAULIC FLOW LOSS WITH PVC-C PIPES

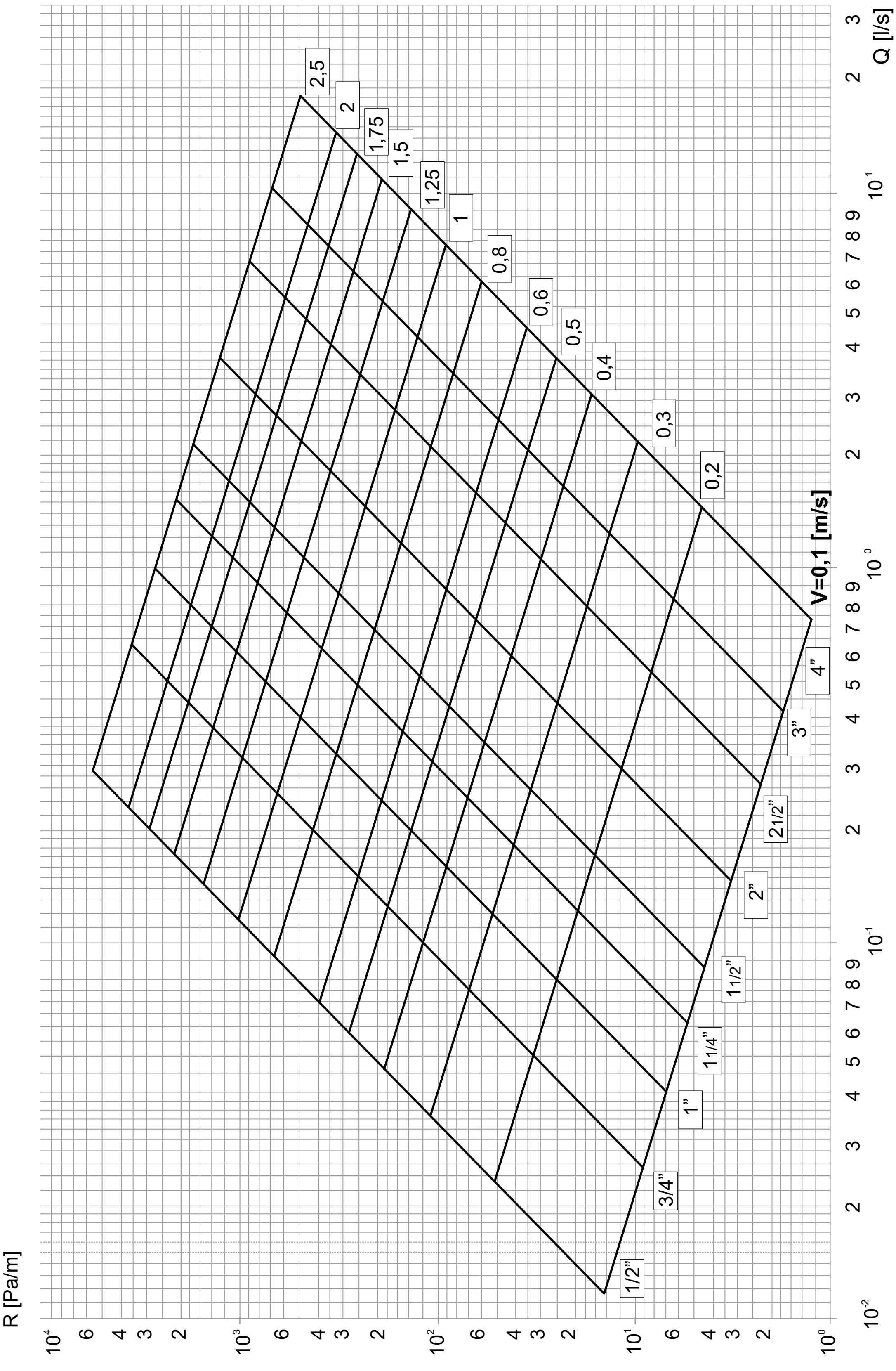


Fig. 3. NOMOGRAPH FOR CALCULATING HYDRAULIC FLOW LOSS WITH PVC-U PN PIPES

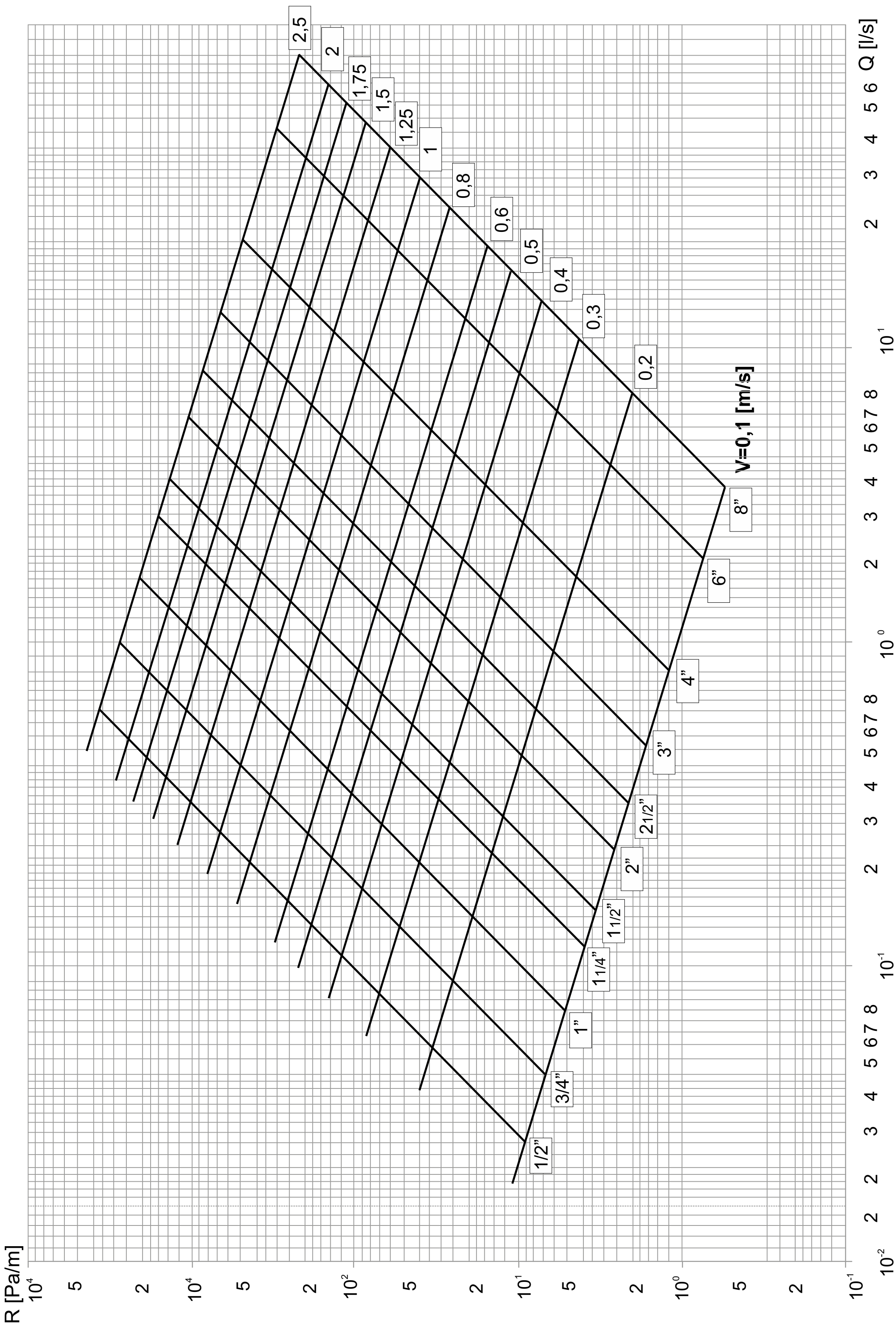
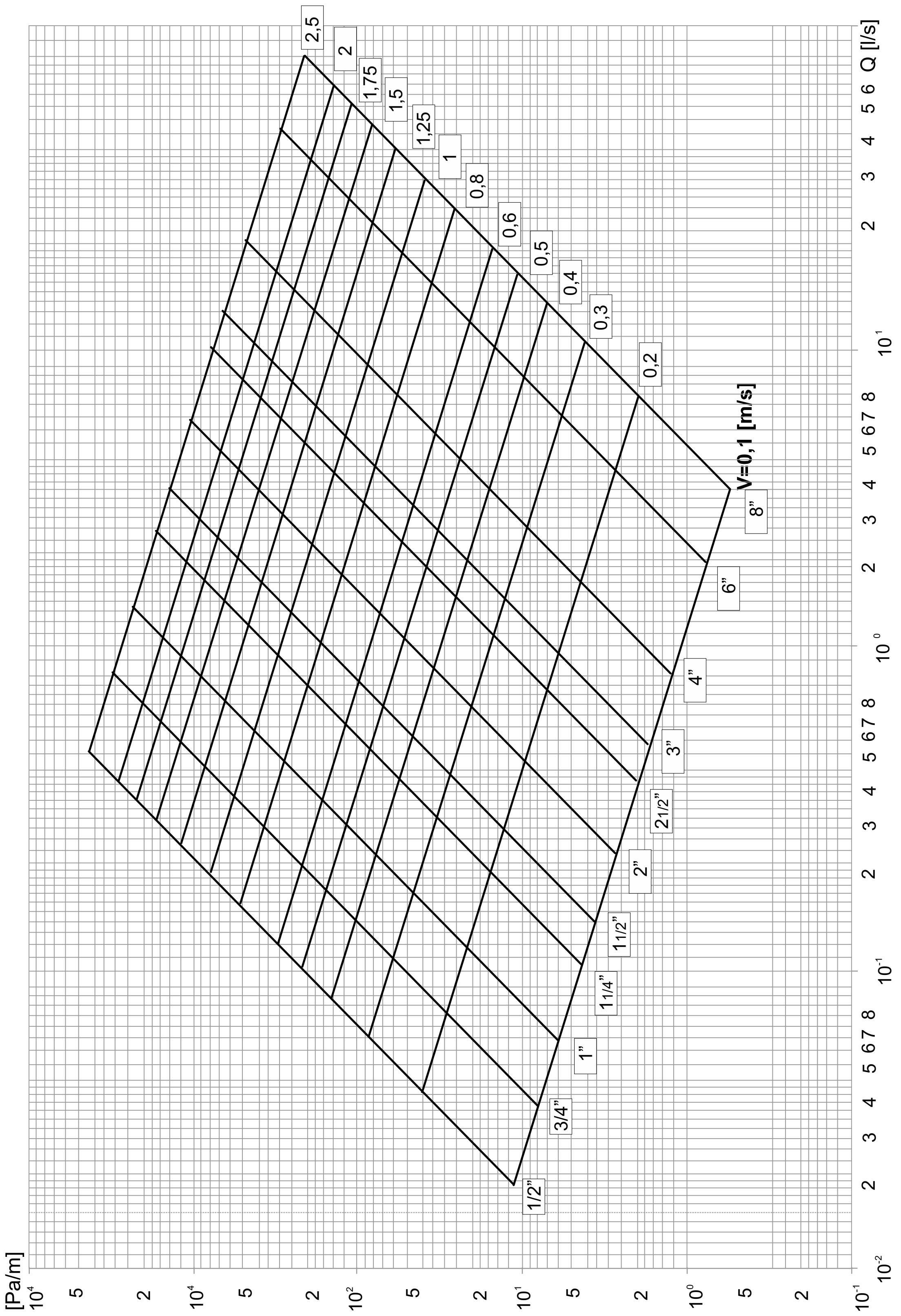


Fig. 4. NOMOGRAPH FOR CALCULATING HYDRAULIC FLOW LOSS WITH PVC-U Sch 40 PIPES



3. PRESSURE LOSSES ON FITTINGS

Pressure losses for local resistances are calculated using the following correlation:

$$Z = \sum_{i=1}^{n} \xi_i \cdot Pd_i$$

where:

Z – pressure loss at local resistance in [Pa]

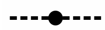
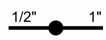
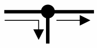
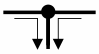
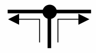
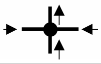
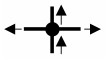
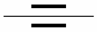
ξ_i – local loss coefficient

Pd_i – water jet's dynamic pressure overcoming specific local resistance in [Pa]

n – number of local resistances

The values for local loss coefficients for the most common fitting types are summarized in table 7.

LOCAL RESISTANCE COEFFICIENT VALUES **Table 7**

Local resistance	Graphic symbol	ξ
Coupling		0.25
Reducing coupling - by two diameters - by three diameters		 0.55 0.85
Elbow 90°		1.20
Elbow 45°		0.50
Tee drainage		1.20
Tee supply		0.80
Tee, bidirectional, supply		3.00
Tee, distribution		1.80
Cross		3.70
Cross		2.10
Union		0.40

For the design calculations, the pressure drop on the couplers is often assumed as equivalent to the pressure drop on the pipe with a suitable length. Tables 8a & 8b give a replacement pipe length in metres for typical couplings.

PVC-C - CTS REPLACEMENT PIPE LENGTH IN METERS **Table 8a**

Coupling type	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Elbow 90°	0.49	0.64	0.79	1.06	1.22	1.67
Elbow 45°	0.24	0.34	0.34	0.55	0.64	0.85
Tee, full flow	0.30	0.43	0.52	0.70	0.82	1.31
Tee, branch	1.22	1.55	1.83	2.10	2.47	3.66

PVC-U - IPS REPLACEMENT PIPE LENGTH IN METERS **Table 8b**

Coupling type	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	3"	4"	6"
Elbow 90°	0.46	0.61	0.77	1.16	1.23	1.75	2.42	3.49	5.11
Elbow 45°	0.25	0.34	0.43	0.55	0.64	0.80	1.23	1.56	2.45
Tee, full flow	0.31	0.43	0.52	0.70	0.83	1.23	1.87	2.42	3.77
Tee, branch	1.16	1.50	0.84	2.24	2.57	3.68	5.02	6.74	10.01

NIBCO

4 PRESSURE LOSSES ON VALVES

Similarly to the couplings, the pressure losses for valves are given as equivalent to pressure drops on a pipe of suitable length.

Use the following formula to calculate pressure losses at ball valves:

$$P=1733 \cdot \frac{Q^2}{k}$$

where:

P – pressure loss at ball valves [kPa]

Q – flow in [l/s]

k – coefficient depending on the diameter and valve design.

The values for this coefficient for ball valves are given in Table 9a.

VALUES FOR COEFFICIENT K FOR BALL VALVES **Table 9a**

Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
k	64	225	841	5625	8100	19600	108900	230400	360000

Valve manufacturers provide flow rates for their valves as C_v, where $k = C^2_{v.}$ In practice, the pressure loss at ball valves are skipped because of their low value.

5. WATER HAMMER

When designing a sanitary installation, you must take into account the hydraulic hammer occurring in such systems, when the speed of flowing liquid rapidly changes. The size of the hydraulic hammer, also known as the water hammer, depends primarily on the speed of water in the pipe, flexibility of the pipe's material and time of closing/opening the valve.
The main cause of the water hammer is rapid opening or closing of valves. It may also occur when a mass of water changes flow direction at high speed. The surge pressure created in this way, even momentary, can lead to the destruction of the fittings or valves. Equation to calculate the resulting pressure hammer is:

$$P = 0.023 \cdot k \cdot V_w$$

where:

P - pressure hammer in [MPa]

k - pressure hammer constant

V_w - water flow speed in [m/s]

Total pressure in the system, i.e. operating pressure including pressure hammer, cannot exceed the maximum operating pressure for the system's elements.
The value of “k” can be determined from Fig. 5, where the x-axis is the quotient of internal diameter of the pipe (d) and wall thickness (e)

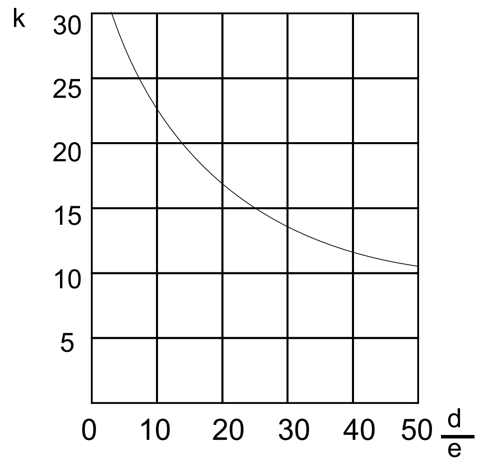


Fig. 5. k graph as a function of d/e quotient

1. EXAMPLE:

Water flows at 1035 kPa, at the speed of 1.5 m/s in the PVC-U SCH40 pipe with 2" in diameter.

What will be the pressure in the event of a sudden closing of the valve?

For a PVC-U Sch 40 pipe:

d – (pipe's internal diameter) is 52.5
e – (pipe wall's thickness) is 3.9
which results in the following:

$$\frac{d}{e} = \frac{52{,}5}{3.9} = 13{,}4$$

For a 2" Sch 40 pipe: $\frac{d}{e}$ 13.4
According to the graph, the k for that value is k=20.
P = 0.023 20 1.5 = 0.69 MPa = 690 kPa
Total pressure in the pipe is:
1035 kPa + 690 kPa = 1725 kPa

Maximum operating pressure for a PVC pipe-U 2 Sch 40 - Table 2a - is 1930 kPa and therefore the pipe used is appropriate for those working conditions.
To avoid the problem of the water hammer:

a. Limit the speed of the water flow to the required value.
b. Use valves with actuators so that it will not be possible to rapidly close or open a valve.
c. Make sure that the system has been properly vented.

V. THERMAL EXPANSION COMPENSATION

One of the most important issues in the design and installation of a water distribution system made of plastics is adequate thermal expansion compensation. Plastics feature a very high linear thermal expansion ratio in comparison with metal, which results in the pipe length increase as the result of even a small increase in temperature. The value of this factor for PVC-U and PVC-C is the smallest of all plastics used in installations (does not apply to multilayer pipes), but is significant enough that the expansion elbow is necessary.
To calculate the expansion elbow's length "L", you must first calculate the increase in length of the pipe δ due to temperature changes.

The value of that growth can be calculated using the formula:

$$\delta = l \cdot \alpha \cdot \Delta t$$

where:

δ – increase in the length of the pipe [m]
l – pipe length [m]
α – temperature expansion coefficient
for PVC-C a = $6.2 \cdot 10^{-5}$ [1/K]
for PVC-U a = $5.2 \cdot 10^{-5}$ [1/K]
Δt – temperature increase [K] where:

$$\Delta t = t_i - t_m$$

t_i – temperature of the fluid in the pipe
t_m – assembly temperature

For PVC-C products, this means a practical increase of 0.062 mm/m K.
The increase in length of PVC-C pipes "d" in (mm) depending on the temperature rise is shown graphically in Fig. 7.

Having established the increase in pipe length caused by temperature, you can calculate the expansion elbow's length L. To do this, use the formula:

$$L = \sqrt{\frac{30 \cdot E \cdot D \cdot \delta}{\sigma}}$$

where:

E – Young's modulus [MPa]
D – outside diameter [mm]
δ – pipe length increase [m]
σ – allowed tensile stresses [MPa]

It should be noted that the value of the change in Young's modulus and allowed tensile stresses change with temperature. This is illustrated in Table 10.

CHANGES IN YOUNG'S MODULUS AND ALLOWED TENSILE STRESSES **Table 10**

Temp. °C	E [MPa]	σ [MPa]
23	2920	13.8
32	2780	12.4
43	2560	10.4
49	2450	9.0
60	2227	6.9
71	2006	5.2
82	1855	3.5

You can determine this value slightly faster and easier using the nomograph shown in Fig. 7.
It is possible to compensate thermal extension by using (Fig. 6):

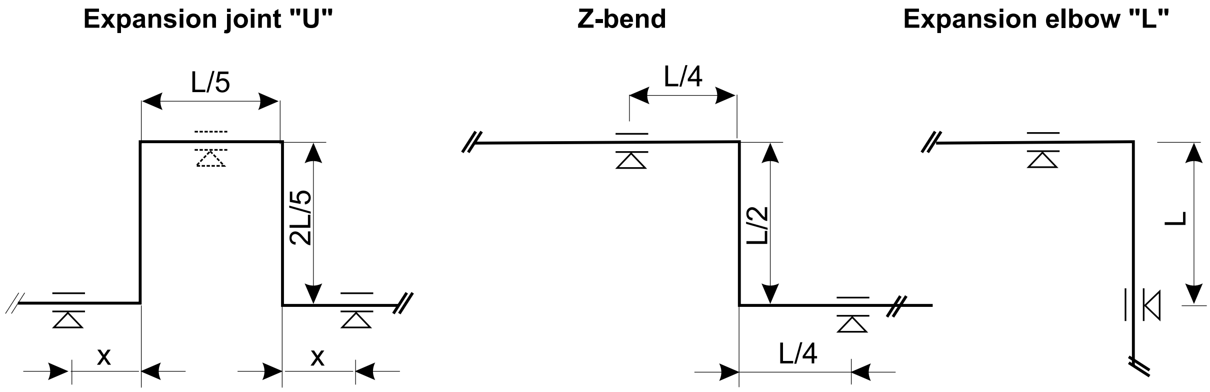


Fig. 6. Expansion joint types

L – length of the expansion arm for compensating extension

– sliding support

– additional fixing points for the extension piece, when necessary

x – fixing distance from the extension piece. The assumed distance is up to 0.3 m for pipes with small diameters (up to 3/4" mm) and up to 0.45 m for pipes with larger diameters.

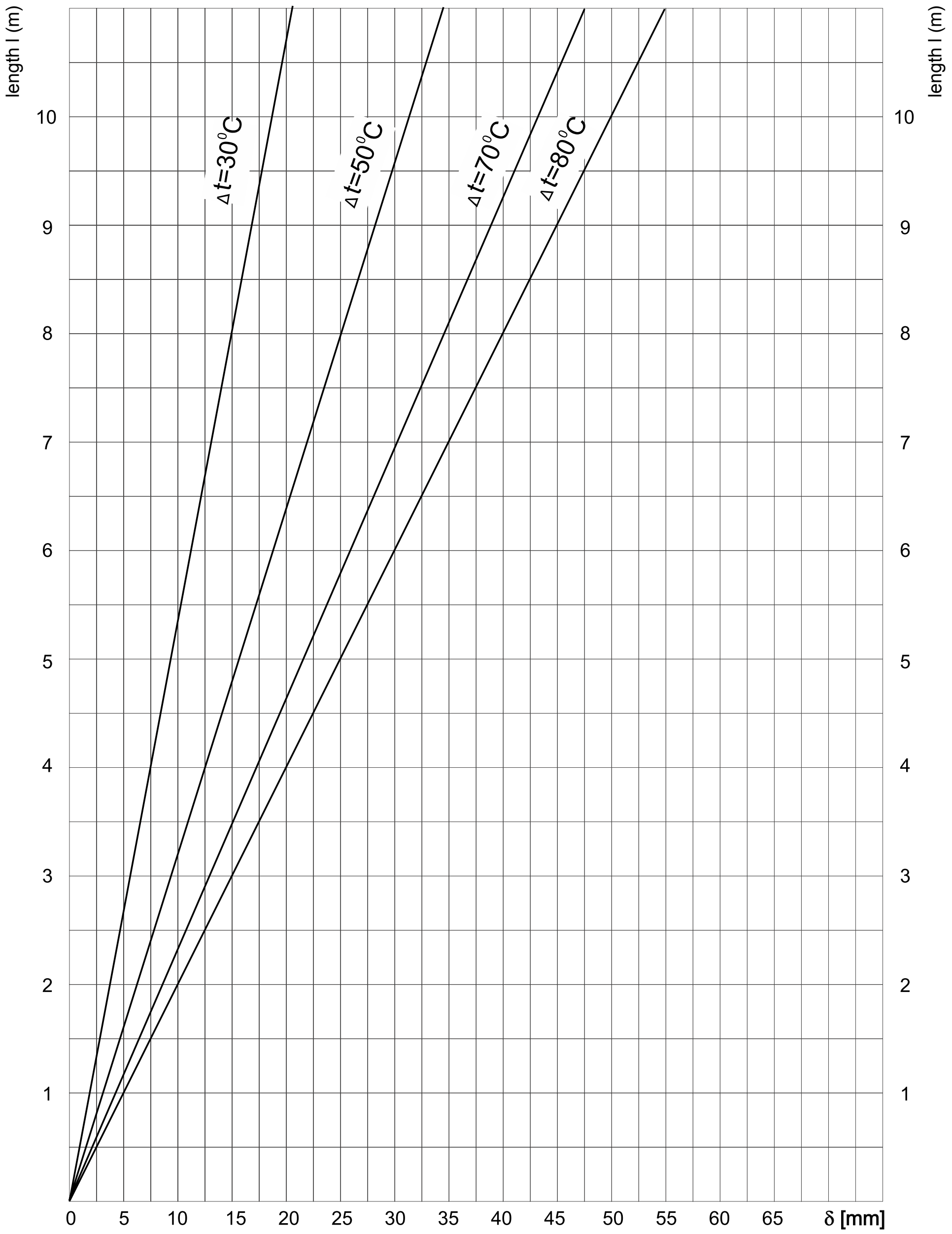
Notes:

If the operating temperature of the system both with PVC-C and PVC-U is different from the assembly temperature, you must use thermal compensation.

If the operating temperature is lower than assembly temperature, the pipes will shrink. To ensure the proper operation of the piping system, calculate the size of expansion joints using the same method as for expansion of the installation.

From our website **www.nibco.com.pl** you can download a calculator tool for calculating compensation level for the expansion of PVC-C tubs.

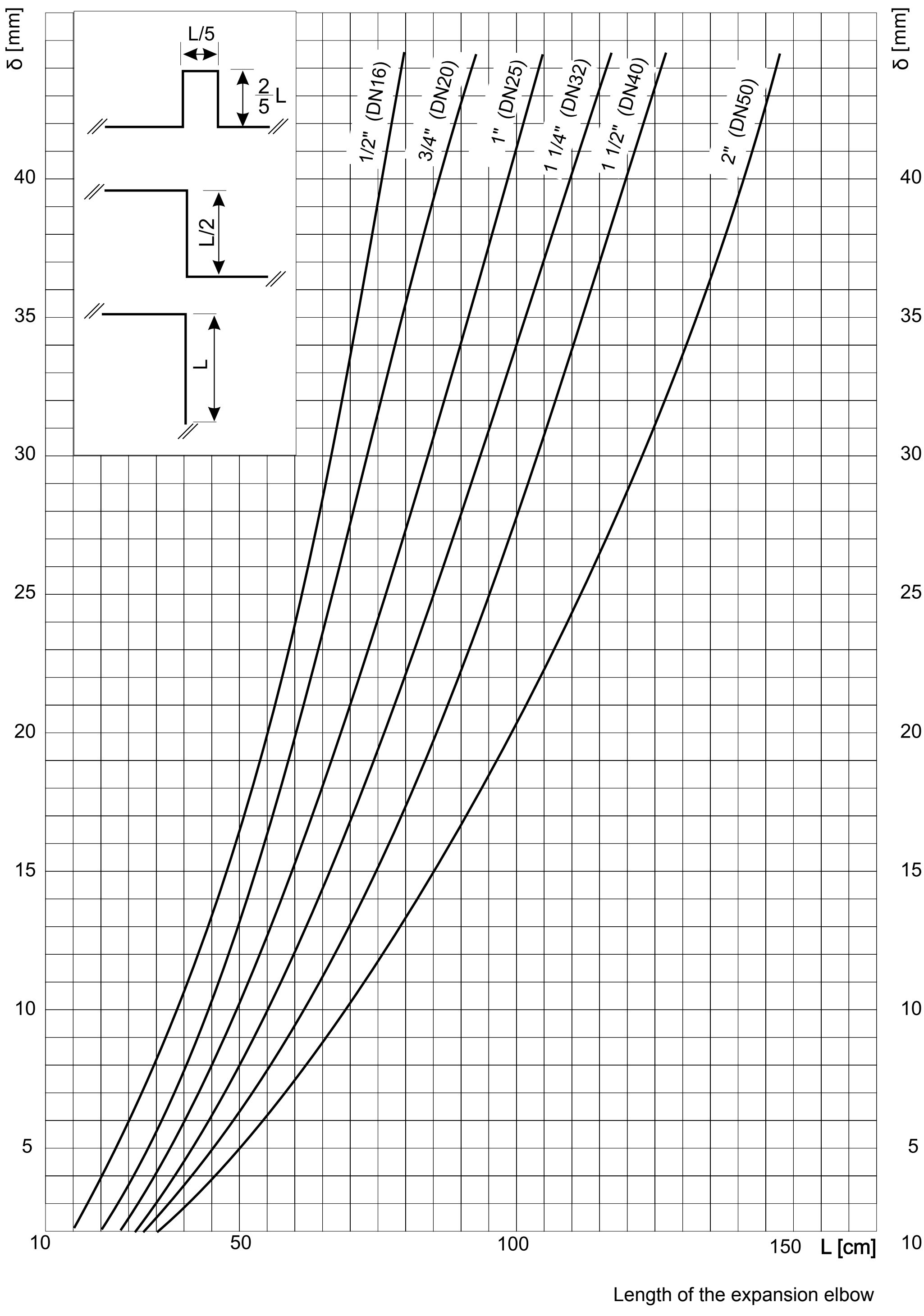
Fig. 7. ELONGATION OF PVC-C PIPES AS THE FUNCTION OF TEMPERATURE RISE



EXAMPLE EXTENSION VALUES **Table 11**

Pipe length l [m]	temperature increase Δt	pipe length increase δ [mm]
1	30	2
	50	3
	70	4
2	30	4
	50	6
	70	9
3	30	6
	50	9
	70	13
4	30	7
	50	12
	70	17
5	30	9
	50	15
	70	22
6	30	11
	50	19
	70	26

Fig. 8. CHOICE OF TYPE AND SIZE OF EXPANSION FOR HOT WATER SYSTEM MADE OF PVC-C (t_i= 55°C, t_m=10°C)



EXAMPLES OF DETERMINATION OF THE COMPENSATING ARM L for PVC-C at t_i=55°C, t_m=10°C **Table 12**

Length of the pipe section	Length increase	Pipework diameter								
l	δ	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
[m]	[mm]	Expansion elbow L [mm]								
3	**8**	344	421	486	543	595	687	768	842	972
4	**11**	397	486	561	627	687	793	887	972	1122
5	**14**	444	543	627	701	768	887	992	1087	1255
6	**17**	486	595	687	768	842	972	1087	1190	1374
7	**20**	525	643	742	830	909	1050	1174	1286	1484
8	**22**	561	687	793	887	972	1122	1255	1374	1587
9	**25**	595	729	842	941	1031	1190	1331	1458	1683

1. INSTALLATION GUIDELINES

Guidelines for installation of PVC-C and PVC-U do not deviate from the guidelines for steel pipe systems. Additional requirements are mainly due to the increased thermal expansion of the pipe material. Expansion, and possibly shrinkage are taken into account in the design using appropriate expansion joints (Chapter V).
When designing the pipework system, take into consideration the construction conditions, i.e. make maximum use of all recesses and angles of walls to achieve natural compensation of thermal expansion, and to make fixed points at penetrations through walls and ceilings.

It is also important to fix the system and lay it as stress-free as possible. This means that the penetrations through construction dividing elements and the holders must be made at a sufficient distance from the change of direction of the installation. Also, sufficient clearance at wall penetrations is required. With installation shafts for vertical routes and branches to floors, make sure that the branch is able to compensate for changes in the length of vertical systems. To do that, you must select the proper location for the pipe inside a shaft (Fig. 9a), provide an oversized hole for the branch (Fig. 9b) or install an expansion arm (Fig. 9c).

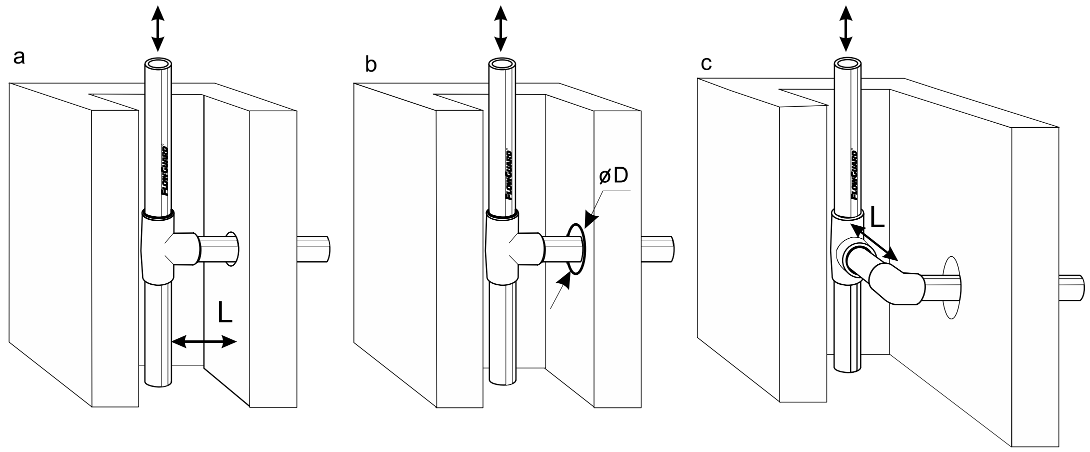


Fig. 9. Compensation of thermal expansion in vertical ducts

IMPORTANT: Do not combine cemented street elbows S/Sp to make the distribution system's branches as well as bonding inserting fittings so that there is no distance between them. This increases the rigidity of the system/reduces thermal expansion compensation capacity.

Methods of laying of pipes in partitions can be divided into:
- laying in grooves
- laying in shafts
- laying in floor layers.

For pipe penetrations through partitions (e.g. horizontal piping, wall penetrations and ceiling penetrations for vertical pipes), use culverts in wall sleeves. The wall sleeve should be longer than the thickness of the vertical partition by at least 2 cm on each side. For wall sleeves, use plastic pipes with a larger diameter to allow free working of installation (Fig. 10).

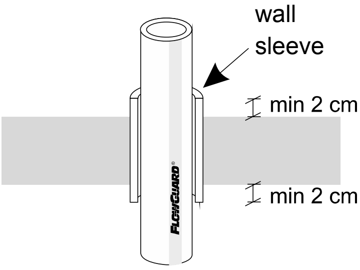


Fig. 10. Penetration through construction partitions

Horizontal pipeworks in cellars should be laid lead under ceilings or in floor channels with at least 5‰ gradient, which enables water drainage from the system, if necessary.

You can use standard insulating materials for piping systems placed in grooves in walls. Use flexible insulating materials for expansion elbows and arms at bends not to limit the possible changes of pipe length. This is the so-called bend area insulation (Fig. 11). Make sure that insulation materials are compatible with PVC-C and PVC-U products.

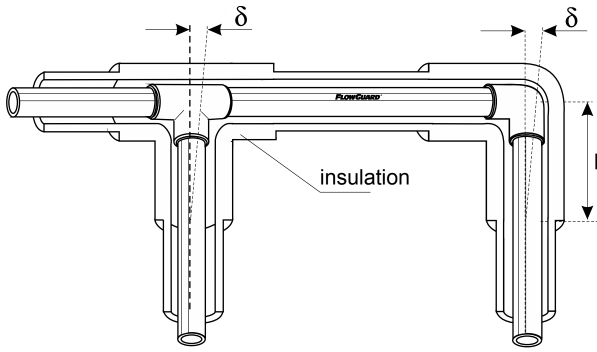
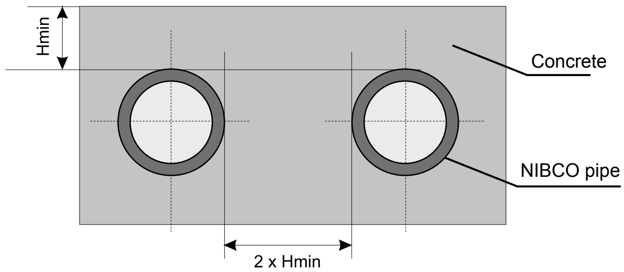


Fig. 11. Bend area insulation

With flush installations, both for insulated systems and systems in flexible corrugate conduit, it is necessary to apply expansion components for thermal expansion of piping.
All shielding components must be joined together in a tight manner so as to avoid flooding of the installation in accidental locations, i.e. undesirable fixed points may be created.
Systems installed in concrete do not require expansion elements but it is necessary to provide an appropriate layer of concrete to fix the pipe. Minimum thickness values of concrete for different pipe diameters are provided in Table 13.

Table 13

PIPE DIAMETER D [inches]	1/2	3/4	1	1 1/4	1 1/2	2
Minimum thickness of concrete Min [mm]	25	33	43	54	66	83



Place pipework to be covered with concrete in a location that will not be subject to damage during settlement of the building (e.g. due to cracking of concrete screed).

Fig. 12. Installation path in concrete

Fig. 13 shows an example of installation routing in a flexible corrugate conduit

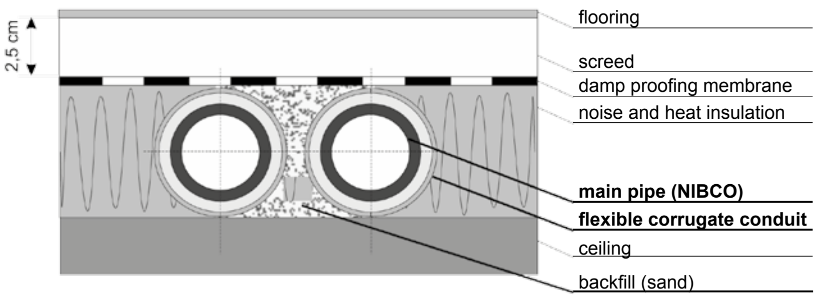


Fig. 13. Laying installation in a flexible corrugate conduit (e.g. through ceiling)

Before pouring concrete over the system, perform a leakage test. It is also a good practice to take photographs of the installation (or make a drawing) to prevent accidental drilling of pipes during installation of finishing elements (such as bathroom cabinets or towel hangers).

To ensure the correct performance of pipes, place pipe clips at specific intervals.

SUPPORT SPACING [m] (horizontal pipes) PVC-C (CTS)

Pipe diameter	Temperature [°C]			
	20	40	60	80
1/2"	0.75	0.70	0.65	0.60
3/4"	0.85	0.80	0.70	0.65
1"	0.90	0.85	0.75	0.70
1 1/4"	1.00	0.95	0.85	0.75
1 1/2"	1.10	1.05	0.95	0.80
2"	1.25	1.15	1.05	0.90

SUPPORT SPACING [m] (horizontal pipes) PVC-U Sch40

Diameter pipe	Temperature [°C]	
	20	40
1/2"	1.10	1.05
3/4"	1.25	1.10
1"	1.45	1.25
1 1/4"	1.60	1.40
1 1/2"	1.65	1.60
2"	1.90	1.70
2 1/2"	2.20	1.90
3"	2.40	2.10
4"	2.80	2.40
6"	3.30	3.00
8"	3.60	3.45

SUPPORT SPACING [m] (horizontal pipes) PVC-U per PN 15/12/9

Pipe diameter	Temperature [°C]	
	25	45
1/2"	0.85	0.80
3/4"	0.95	0.85
1"	1.10	1.00
1 1/4"	1.20	1.10
1 1/2"	1.30	1.20
2"	1.50	1.30
3"	1.90	1.60
4"	2.20	1.90
6"	2.60	2.30
8"	2.80	2.70

SUPPORT SPACING [m] (horizontal pipes) PVC-C Sch 40

Pipe diameter	Temperature [°C]			
	20	40	60	80
2 1/2"	2.10	2.10	1.80	1.06
3"	2.10	2.10	1.80	1.06
4"	2.30	2.30	2.00	1.20

SUPPORT SPACING [m] (horizontal pipes) PVC-C Sch 80

Pipe diameter	Temperature [°C]			
	20	40	60	80
2 1/2"	2.40	2.25	1.95	1.20
3"	2.40	2.40	2.10	1.20
4"	2.40	2.70	2.25	1.35

NIBCO recommends the use of plastic sliding supports for PVC-C and PVC-U systems.

Use metal holders with an EPDM collar only as fixed points and for attaching fixtures. We recommend holders provided by NIBCO. In other cases, use holders with approval and the manufacturer's declaration of fitness for use with PVC-C and PVC-U systems within the full temperature range.

Important: For vertical pipes, you can increase the distances by multiplying by 1.3 for temperatures up to 60°C and by 1.2 for higher temperatures. When installing fittings on pipes, use an independent support. Remember to provide vertical pipes with support located at each ceiling penetration and each change in direction of 90°.

The supporting elements must take the expansion elbow into account. The following figures show examples of the correct and incorrect inclusion of the expansion elbow:

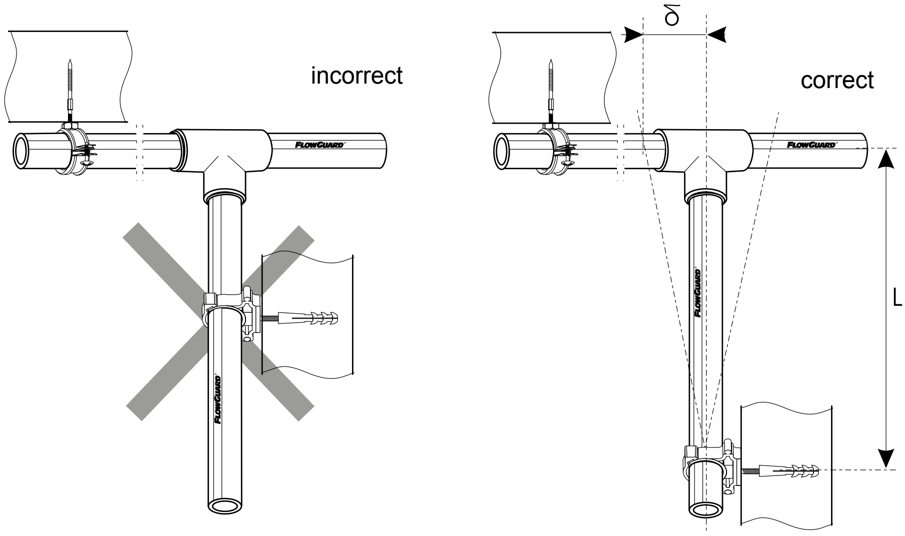


Fig. 14. Correct and incorrect inclusion of an expansion elbow

Thermal expansion elements for long straight pipe sections must be located between the fixed points. The installer can use correctly spaced fixed points – so-called zero points to control the thermal expansion of pipes. The methods for making fixed points are shown in figures 15 and 16.

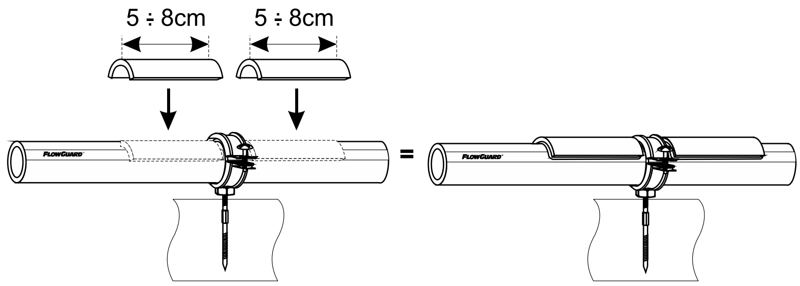


Fig. 15. Fixed support on pipe (using cement)

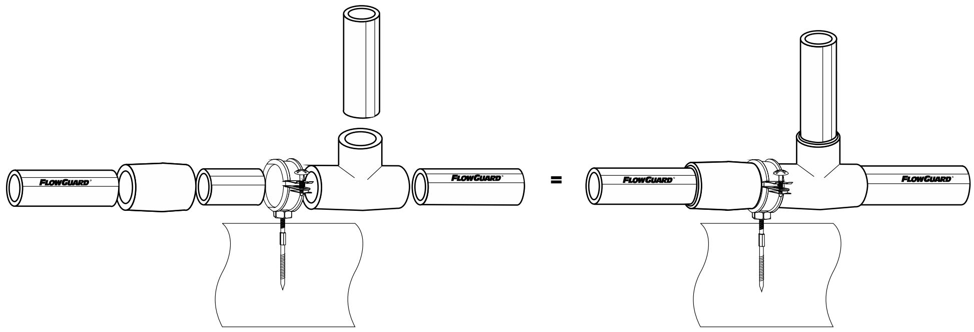


Fig. 16. Fixed support on pipe (using fittings)

An example arrangement of sliding/fixed pipe supports in a multi-floor building's riser is shown in Fig. 17 and for horizontal plumbing in Fig. 18.
The sliding pipe support should enable the axial movement of the pipework without major resistance, but at the same time it should not damage the pipe's surface.

Suspended holders must sometimes be used because of the extensive length of expansion elbows. Such holders allow pipes to move in any direction.

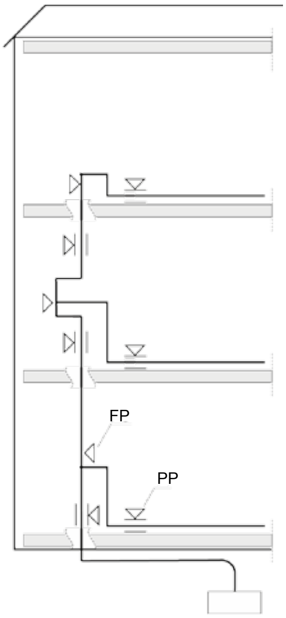


Fig. 17. Locations of fixing supports in service drop

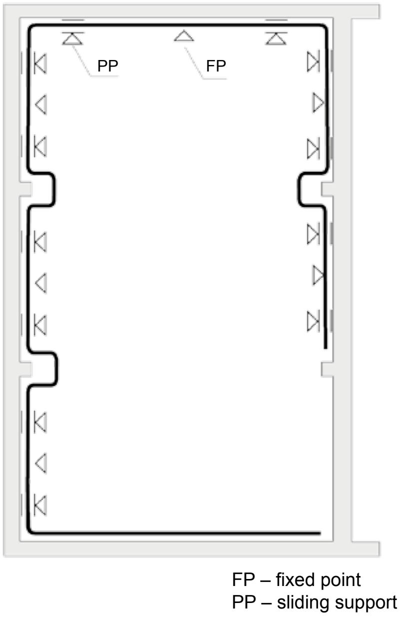


Fig. 18. Locations of fixing supports on horizontal distribution lines

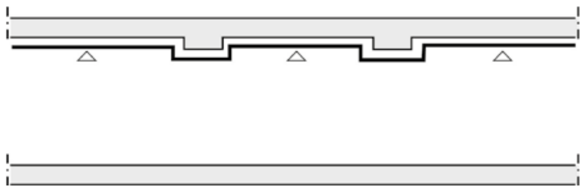


Fig. 19. Locations of the pipe and supports under a ceiling – sectional view

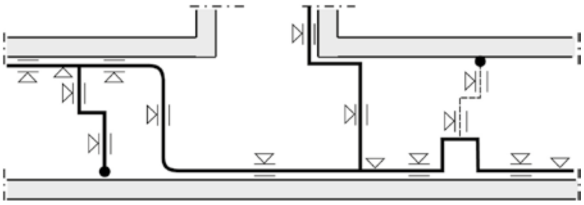


Fig. 20. Locations of the pipe and supports – layout

3. OVERHEATING PROTECTION

All sources of hot water (boilers, heaters, heat exchangers' distributors) supplying a system made of PVC-C, should be provided at the outlet with a proper thermostatic device to regulate water exceeding the maximum acceptable temperature entering the system.

Protect the system against direct heating of piping by the heat source, by using stub pipes between the heating device and the installation system.
The length of these components is specified by the manufacturer of the heating device. If there are no such recommendations with electrical flow heaters, use stub pipes at least of 25 cm in length, and at least 1 m for gas heaters.

3.1 Operation with pump

To avoid vibration in the PVC-U or PVC-C system, connect the pump to the installation system using vibration damping components (e.g. vibration compensators).
Connecting the pump without compensators can cause damage to the components of the installed PVC-U or PVC-C system.

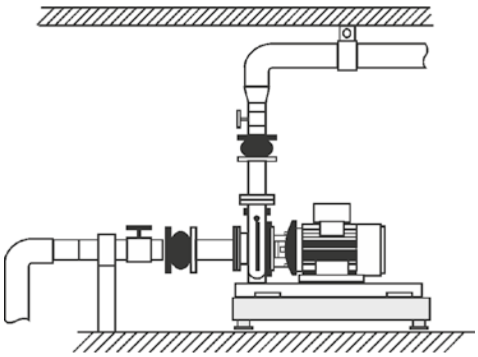


Fig. 21. Installing the pump

4. NIBCO SYSTEMS FOR A/C AND COOLING SYSTEMS

In recent years, air conditioning systems have been more widely used in buildings with various purposes. Our PVC-C system is made of materials complying with the requirements for this type of installations, applicable both for the transport of heating medium and ice water, and PVC-U system is applicable for condensate installation.

In the process of design and installation take into account thermal properties of the pipes and their expansion properties during transferring heating medium contraction during the transfer of ice water. The correct thermal behaviour of pipeworks can be obtained by changing the pipework path to achieve self-compensation, and to make "U" type expansion joints.

Use appropriate pipework supports in sliding supports and fixed supports with EPDM inserts to create "zero points", with fixed points described separately.
If you want to use other media than water with the system, always obtain approval from NIBCO, the pipe manufacturer.

One of the more commonly used air conditioning media is **ethylene glycol**, which depending on the concentration has a working temperature within the range from -4°C to +70°C. This medium has been approved by NIBCO for use with PVC-C and PVC-U pipes. **Each time consult the choice of material and the possibility for use with NIBCO's technical department.**

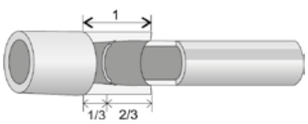
The advantages of using PVC-C and PVC-U in air conditioning installations are numerous and commonly known, as described in this paper. Our systems have been available on European markets for several years, and this has contributed to the large number of trained installers and designers who ensure professional installation.

Important: To reduce the cost of installation, it is permitted to use PVC-U pipes for draining condensate at temperatures not exceeding 45°C.

5 1 Cement joints

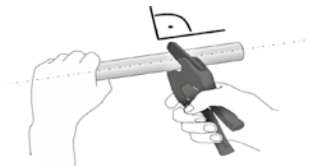
The vast majority of connections in PVC-C and PVC-U systems are adhesive bonds made using special aggressive adhesives. This process is called “solvent cementing”. The cement causes the surface layers of the components being joined to dissolve and then polymer macromolecules of two components to penetrate each other. This produces a uniform, inseparable connection. The joining method is described below.

1.



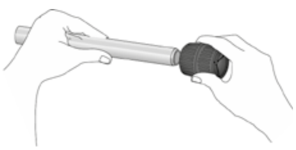
Before cementing the components together, make a “dry connection” to check sizing accuracy. The pipe should freely enter the pipe socket up to 2/3 of the socket’s depth.

2.



It is best to cut the pipes with special cutters or - with larger pipe diameters, with a wheel cutter. You can also cut the pipes with a fine toothed saw, keeping right angle in relation to the axis of the pipe.

3.



Chamfer the ends of pipes after cutting. This is to prevent cement from being scraped while inserting the pipe into the fitting.
Remove file dust and all other impurities with a dry cloth.

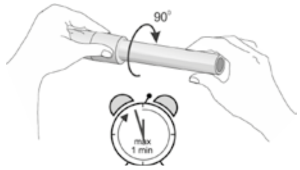
4.

Before performing the actual cementing, use CLEANER to soften the joined elements and clean their surfaces. Wipe the elements to be joined with a cloth soaked in the cleaner.

5.

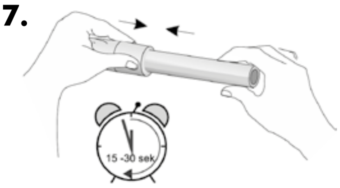
Next, wait for the surface to dry and apply the cement. Place the cement on both the pipe and the socket of the other component.

6.



The joining process should not exceed 1 minute. After inserting THE pipe into the socket until it stops, rotate it by 1/4 of a revolution to distribute the cement evenly.

7.



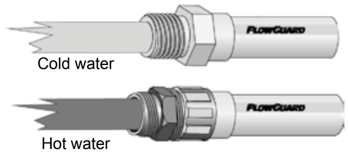
Press the components being joined against each other for 15-30 seconds, without allowing the pipe to slide out from the fittings’ socket. Wipe off any excess cement with a dry cloth. After making the correct joint, there is an even bead of cement along the joint.

8.

CLEANER cleaner | HT-120 FlowGuard® PVC-C cement | HT-120 Cement PVC-C and PVC-U systems | PVC GEL PVC-U cement

Use proper solvent cements for joining PVC-U and PVC-C pipes and fittings as recommended by NIBCO Sp. z o.o.

9.



When joining with other systems or devices for cold water, use PVC-U and PVC-C fittings with external threads. For hot water systems made of PVC-C, use unions.

REMEMBER THAT THE TIME BETWEEN APPLYING CEMENT ON THE PIPE AND THE FITTING'S SOCKET AND PLACING THE PIPE IN THE SOCKET SHOULD NOT EXCEED 1 MINUTE. OTHERWISE, “DRY JOINTS” MAY BE CREATED.

When joining pipes with diameters greater than 1 1/2", two people must be involved.
With the correct bonding there is a cement band around the joint.
Should the components not be joined, for example due to the cement drying too quickly, reapply a thin layer of cement to the pipe and re-insert the pipe to the fitting.

The time after which the cement connection obtains adequate strength depends on the temperature at which the cementing procedure takes place, as well as on the diameter of the components being joined.
See table 14 to get average drying time for connections at different temperatures.

JOINT DRYING TIME **Table 14**

Temp.>10°C	a) For pipes 1/2" - 2"	2 hours
	b) For pipes 2 1/2" - 4"	4 hours
	c) For pipes 6" - 10"	8 hours
Temp. 5 - 10°C	a) For pipes 1/2" - 2"	4 hours
	b) For pipes 2 1/2" - 4"	8 hours
	c) For pipes 6" - 10"	16 hours
Temp. -10°C - +5°C, Only for HT-120 FlowGuard® cement	a) For pipes 1/2" - 2"	16 hours
	b) For pipes 2 1/2" - 4"	72 hours

Carry out a pressure test after the time shown in Table 14.
With locations with high air humidity, i.e. over 60%, increase the time before testing by 50%.

Important:

1. The solvent cements are flammable. **Keep away from fire!**
2. Recommended storage temperature range for the cements and joints is from 5°C to 25°C.
   The cement viscosity increases with a reduction in the temperature; storage at temperatures below 0°C may cause the product to become jelly-like. If that happens, move the container with cement to a room with a temperature above 5°C. The cement should return to its original consistency; if not, the product is not suitable for use.
3. Keep cement containers tightly closed.
4. Avoid breathing vapours of the cement and cleaner; ensure adequate ventilation in the case of enclosed spaces.
5. Avoid direct contact of the product with skin.

Table 15 provides the yield of a typical cement container.

INDICATIVE NUMBER OF JOINTS MADE USING ONE 0.125 l CAN **Table 15**

Pipe and fitting size	PVC-C	PVC-U
1/2"	110	100
3/4"	80	70
1"	60	55
1 1/4"	55	50
1 1/2"	38	35
2"	22	20
2 1/2"	12	12
3"	11	11
4"	5	5
6"	-	2
8"	-	1

The CLEANER's performance is estimated at 1/3 the amount of solvent cement used to make the connection.

5.2 Threaded and flanged joints

In addition to the cement joints in the PVC-C and PVC-U system, also threaded and flanged joints can be made. NIBCO product range includes PVC-C and PVC-U couplings with external and internal threads, as well as unions made of plastic and metal-plastic. These components allow the combination of cement and other systems, and to make separable connections, so that you can easily remove and re-assemble a part of the system, e.g. for its conversion, replacement or repair.
For sealing PVC-C and PVC-U threaded couplings, use high density sealing tape with thickness of min 0.1 mm, sealing cord or special sealing paste for plastic threads. The quantity of the sealant to be used depends on the thread diameter, as well as on the manufacturer's recommendations. Do not use cotton waste as sealant. Manual tightening of the joints should be sufficient. You can further tighten the fittings using a wrench, while observing maximum care (soft tightening).

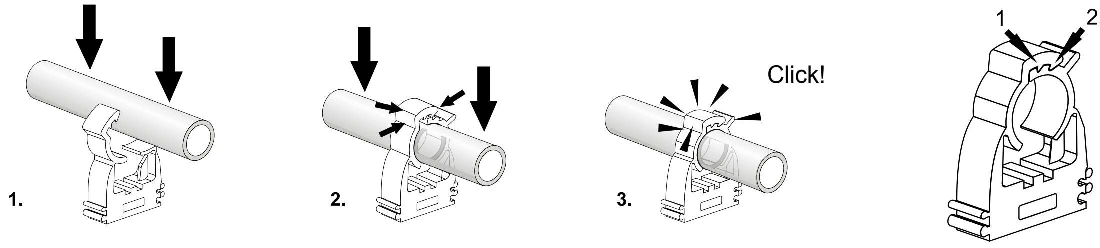
Because of the tapered thread in the PVC-U fitting with internal thread FPT (435-xxx), be careful when connecting it with external metal thread MPT.
Threaded PVC-U fittings (part numbers 435-xxx and 436-xxx) in sizes 2 1/2, 3 and 4 inches have NPT American thread, and therefore an NPT-ISO thread adapter shall be used (part no. PRZ-xxx).

PVC-C fittings with external thread may be used only for cold water. **For hot water applications, it is mandatory to use unions (part no. 4733-3xx, 4733-4xx).** When connecting to a hot water tap, use union elbows (part no. 4707- 356).

The NIBCO system also includes three types of PVC-C and PVC-U flanges. These are one-piece reinforced flanges and two-piece Van Stone flanges made to the American Standard ANSI B16.5 Class 150 (pitch diameter and number of holes), and one-piece flanges with oval holes to match the pitch diameter also to drilling in line with ISO (PN).

INSTALLATION REMARKS

- In the case of concealed installations, remember to execute a pressure test before applying plaster.
- It is advisable to use insulation foam when the installation direction changes and when the installation is also not concealed. The insulation foam allows for some movement resulting from pipe expansion. In places where there is a great probability of high stress, such as shower heads and taps, it is advisable to use transition unions.
- For sealing PVC-C and PVC-U threaded unions, use high density sealing tape with a thickness of min. 0.1 mm. Manual tightening of the joint should be sufficient. You can further tighten the fittings using a spanner, while ensuring maximum care.
- In hot water installations, when making connection between plastic and metal components, use appropriate adaptive fittings, i.e. unions (part no. 4733-3xx, 4733-4xx, 4707-356).
- Because of the tapered threads in the PVC-U fittings with FPT (part no. 435-Xxx), be careful when connecting it with a metal thread MPT.
- Do not dilute the cements.
- Cut the pipes using the appropriate tools, e.g. pipe snips/ shears, pipe cutters which ensure the perpendicularity of the cut. You can also cut the components using household methods, such as a fine toothed saw, but clean the components being joined carefully before cementing.
- Installing Fix Express sliding brackets. A Fix Express bracket closes after a pipe is placed in the bracket and pressed down, as shown in the following drawings. You can open the bracket by pressing the pipe and prising it upwards.



- **At locations of fixed pipe holders, use only clips with EPDM facing between the pipe and the clip. Before using them, make sure that the washer material is compatible with PVC-U and PVC-C.**
At penetrations through ceilings and walls, use insulation foam or plastic sleeves.
- DO NOT ALLOW WATER TO FREEZE IN PVC-C AND PVC-U PIPES.

Leak tightness tests must be carried out in line with PN-EN-806-4. Use drinking water for flushing cold and hot water systems.
For pressure tests, use a gauge with a scale accuracy of 0.2 bar, between 0.0 to 1.6 MPa. The pressure gauge should be installed at the lowest point of the installation.

In accordance with the standard, standard test pressure (TP) is determined using the following formulae, depending on the temperature of the water in the system.

TP = 1.1 X MDP for T ≤ 25º C
TP = 1.1 x MDP x f_T for T > 25º C

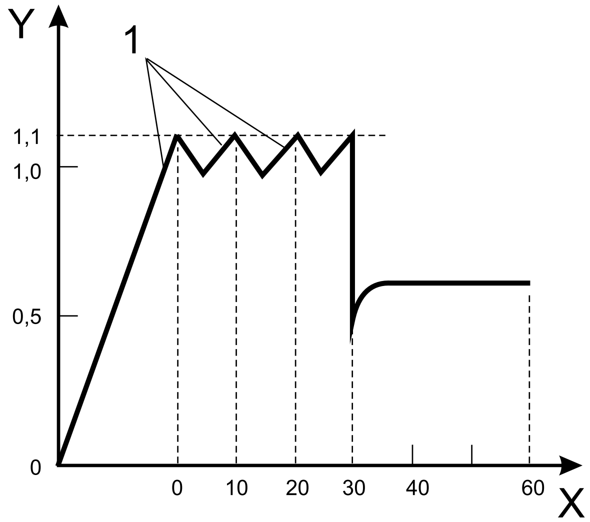
where: T – temperature
TP – test pressure
MDP – max. design pressure
f_T – pressure to temperature correction ratio (kr)

There are two test procedures: B & C defined in the standard for systems made of plastics, which are given below.

TEST PROCEDURE B

It should be possible to bleed the system.

1. Fill the installation with water to bleed it fully, and then cap tightly all the vents and exhaust valves.
2. Activate the pump to raise the test pressure TP to a value equal to the product of 1.1 and the maximum design pressure MDP (Fig. 22), for 30 minutes. Check the system for any obvious signs of leakage.
3. Reduce the pressure to a value equal to the 0.5 of the product of test pressure when draining water from the system (Fig. 22).
4. Close the discharge valve.



Key:
1 – Pumping
X – Time [min]
Y – Test pressure and MDP quotient

Fig. 22 Test procedure B: Hydrostatic pressure test in plastic piping systems with a tightness test

The system is considered as tight when the test pressure keeps the value equal to the product of the 0.5 and work pressure for 30 minutes after reducing pressure as described above. Carry out a visual inspection for leaks. If the pressure drops during that period, the system has a leak. Maintain the pressure at the required level and find the source of the leak.

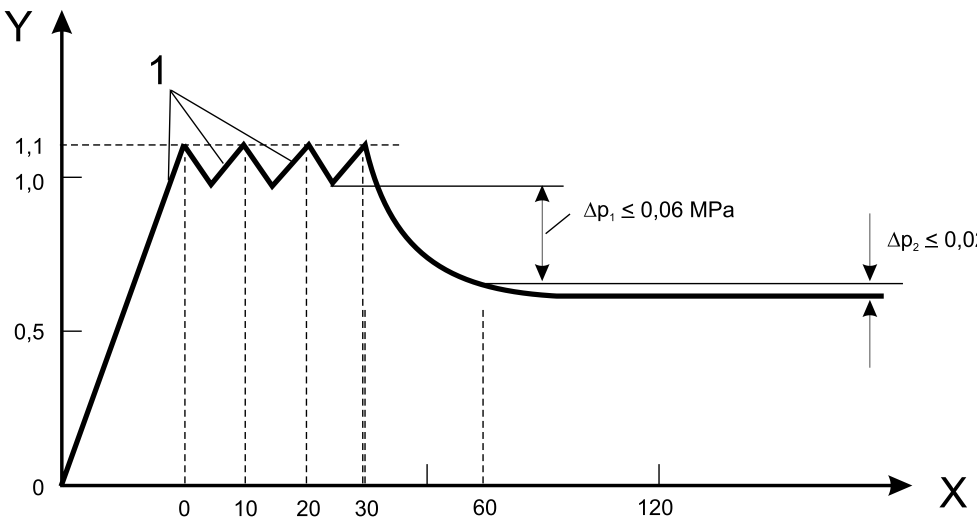
IMPORTANT: If the system's equilibrium temperature exceeds 25°C, include the reduction coefficient of rated parameters f_T on the material.

TEST PROCEDURE C

1. Fill the installation with water to bleed it fully, and then cap tightly all the vents and exhaust valves.
2. Activate the pump to raise the test pressure TP to a value equal to the product of 1.1 and the maximum design pressure MDP, see Fig. 23, for 30 minutes.
3. Record the pressure value after that time. Check the system for any obvious signs of leakage.
4. Record the pressure after another 30 minutes. If the pressure drop does not exceed 0.06 MPa (0.6 bar), it is considered that the system is tight. Continue the test with the pump off.

In the next 2 hours, carry out visual inspections on the system for leaks. If the pressure in the system drops by more than 0.02 MPa (0.2 bar), the system has a leak. Maintain the pressure at the required level and find the source of the leak.
Test sections of the installation (supply and distribution piping) in accordance with the procedure C.
Installations consisting of metal and plastic pipes must be tested in accordance with clause 6.1.3.2 or 6.1.3.3.

IMPORTANT: If the system's equilibrium temperature exceeds 25°C, include the reduction coefficient of rated parameters f_T on the material.



Key:
1 – Pumping
X – Time [min]
Y – Test pressure and MDP quotient
Δp1 – Maximum pressure drop from 30 to 60 minutes of the test procedure
Δ – Maximum pressure drop from 60 to 180 minutes of the test procedure

Fig. 23. Test procedure C: Hydrostatic pressure test in plastic piping systems with a tightness test

7. FLUSHING AND DISINFECTION OF AN INSTALLATION

If the leak tightness test is successful, the piping system must be flushed with potable water.
Minimum flushing speed: 2.0 m/s with 20 times circulation.
If the system after flushing is not commissioned within seven days, repeat flushing.
NIBCO does not allow flushing the system with water with air.

A correctly flushed system does not require disinfection, except when the local regulations require it.

With insulation of the piping system, PN-EN 806-2:2005 (E) refers to the requirements of the local or national regulations. In Poland, it is PN-B-02421:2000(3), and it defines the insulation thickness for hot and cold water (in order to avoid condensation). The standard gives the minimum insulation thickness to be used in heat installations depending on the diameter of the pipe, temperature of the medium being transported and ambient temperature for insulating material with the coefficient of heat transfer at 40°C, λ = 0.035 W/(mK). For insulating materials with a different coefficient of heat transfer, calculate the appropriate thickness of the insulation using the formula listed in the standard. Below is a table with the minimum insulation thickness, where the ti parameter specifies the temperature outside the insulation.

SELECTED VALUES FOR THE THERMAL INSULATION THICKNESS (MM) FOR HEATING PIPING PER PN-B-02421:2000 [3, 4]

Table 16

Pipe diameter [mm] at ambient temperature	$t_i \geq 12°C$	$-2 \leq t_i < 12°C$	$t_i < -2°C$
	≤ 60°C	≤ 60°C	≤ 60°C
≤20	15	30	50
25	15	30	50
32	15	30	50
40	15	30	50
50	20	35	55
65	20	40	60
80	25	40	55
100	25	45	65
125	30	50	75

Insulation materials should not react with PVC-C/PVC-U. In case of any uncertainties, contact the Customer Product department at NIBCO Sp. z o.o.

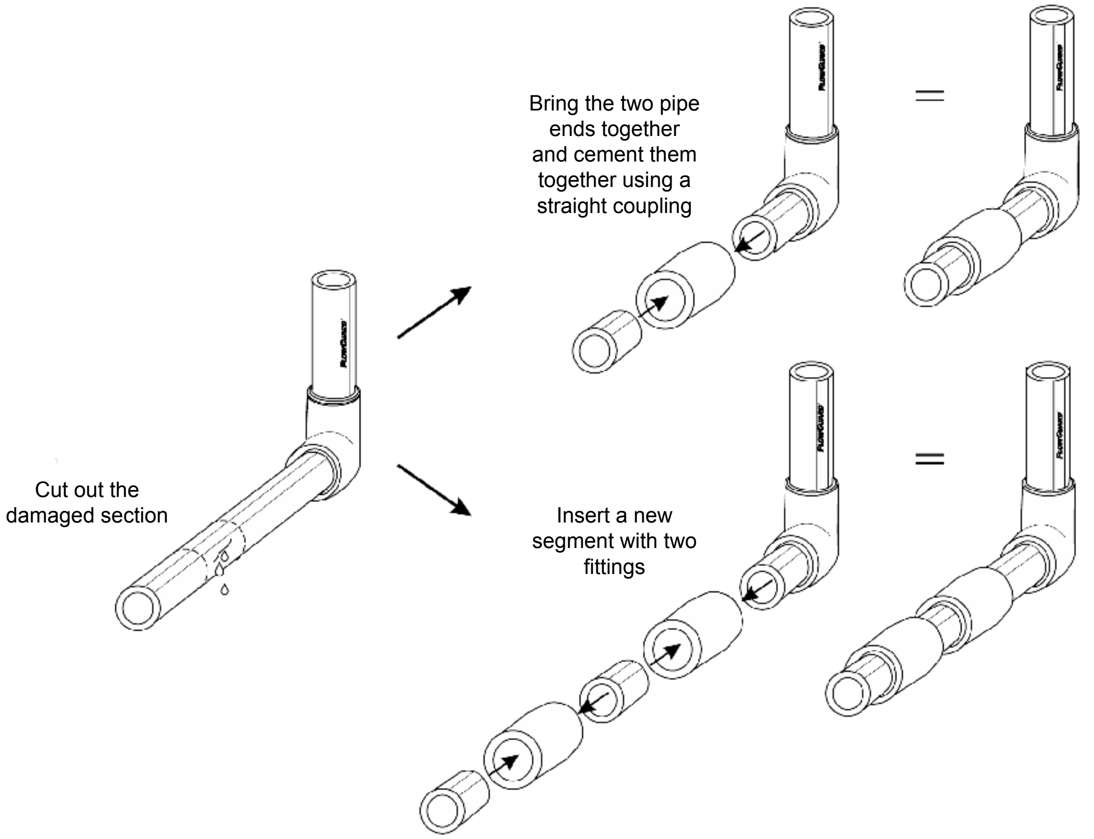
VII UNDERGROUND INSTALLATION

Plastic pipes on the outside are installed in trenches. The bottom of the trench must be smooth and free from stones.
When there are boulders or stones, cover them with a layer of sand or remove them. The trench should be wide enough to allow connection works and zigzag placement of pipes to protect them against temperature (when connecting pipes outside the trench, you can make the trench narrower).

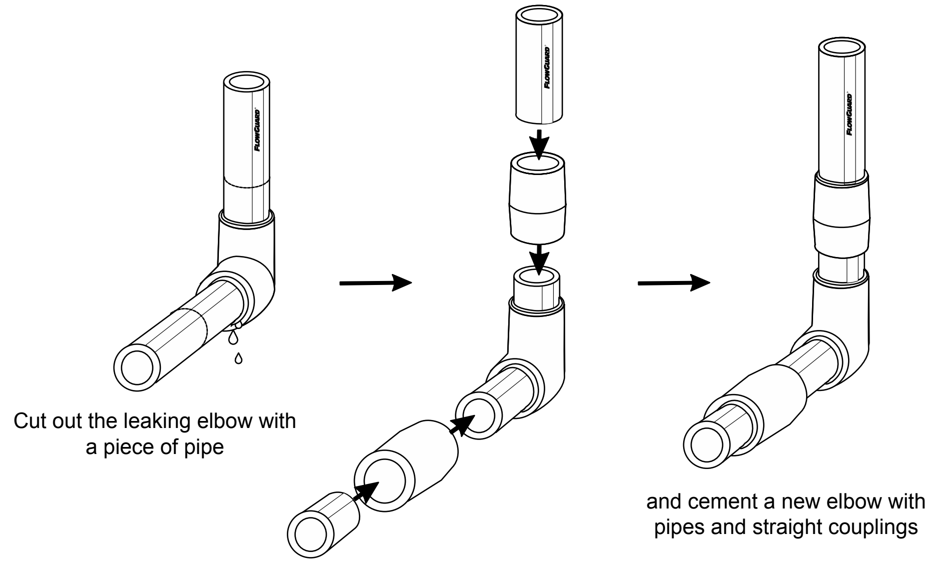
The depth of the excavation depends on the level of freezing. In each case, the plastic pipes should be located below the level of freezing. Pipe carrying liquids, sensitive to freezing, should be installed no less than 30 cm below the freezing depth.
Finished installations should be covered with backfill. The backfill's granulation should be 12 mm. If you cover the trench with sand or gravel, do so by shaking the backfill over the pipes and trench. When using sand or gravel with a large admixture of clay or loam, use mechanical compaction. The trench should be covered in layers.

For easier locating the pipework's route in the future, it is advisable to use metal wire around the plastic pipe.

If the pipe leaks, cut out the damaged piece. If both pipe ends can be put together, use solvent cement to join the components with a single pipe fitting. If this is impossible, it is necessary to use a new section of pipe with two fittings.



When leakage occurs at the fitting, the best repair method is to cut off the fitting with sections of the pipe and insert a new pipe with two fittings.



IX. STORAGE

PVC-C and PVC-U pipes and fittings can be stored both indoors and outdoors, e.g. at a construction site.
When stored in the open air, they should be protected against UV.
The pipes must not be tightly covered to ensure the free flow of air, which reduces the temperature increase at high ambient temperatures and in bright sunlight.

Also, the storage method of the pipes should prevent them becoming bent or exposed to mechanical damage (abrasion, crushing test).
Therefore, do not store plastic pipes with metal pipes.
The layers must be protected against movement. pipes with larger diameters should be placed on the bottom.
Too many layers of stored pipes at high temperatures may cause distortion of the pipes in the lower layers.

It is not recommended to store pipes and fittings at temperatures below 0°C.

When stored indoors, the pipes should be placed on racks. If possible, they should be supported over the entire length of the pipe (the pipes are made in lengths of 3 m). If not, the distance between the supports should not exceed 1 m (minimum width of support: 8 cm).
Fittings and couplings should be stored in the original carton boxes, protected from dirt and damage (indoors, if possible).
Information on the storage of cement is provided on page 24.

Appropriate storage of pipes and fittings decreases the likelihood of problems during their installation. Before joining pipes and fittings, check them for mechanical damage.

X. SUMMARY

The durability and quality of a construction installation depends not only on the type of material used for the construction and the joint type. The correct functioning of a new system depends also on the **automatic control system for work parameters and the quality of the automation system's components.**
Even cold water systems that have been equipped with minimum automatic controls require some form of pressure reduction for today's modern systems, as well as valves to prevent the water hammer, and, in some cases, pressure differential regulators.

Hot water systems without a correctly operating automation system should not be used at all.
A faulty temperature regulator or a temperature regulator unable to keep the maximum temperature at the recommended level may lead to exceeding the maximum temperature value, and thus to a significant and unnecessary shortening of the installation's operational life.

Such faulty temperature-regulating devices can also lead to scalding and burns with the water used in the system.

NIBCO®

Catalog

PVC-C & PVC-U

Pipe & Fittings

Abbreviations:
S - Socket
Sp - Spigot
FPT - Female Pipe Thread
MPT - Male Pipe Thread
IPS - Iron Pipe Size
CTS - Copper Tube Size

FlowGuard® is a registered trademark of The Lubrizol Corporation.

Pipe PVC-C FlowGuard®

Pipe length is 3,048m(10ft)

SYMBOL	SIZE INCH	BOX QUANTITY	PALLET QUANTITY
4700N-005	1/2	50	800
4700N-007	3/4	25	400
4700N-010	1	16	256
4700N-012	1 1/4	10	160
4700N-015	1 1/2	7	112
4700N-020	2	4	64
Pipe PVC-C Sch 40			
4700-025	2 1/2	1	54
4700-030	3	1	35
4700-040	4	1	18

Transition Coupling IPS/CTS S/S

Use only for cold water.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4701-707	3/4	25/500
4701-710	1	10/100
4701-720	2	5/25

Street Elbow 45° S/Sp

Use only for cold water.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4706-805	1/2	25/500
4706-807	3/4	25/500

Female Adapter S/FPT

Use only for cold water.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4703-005	1/2	25/500
4703-007	3/4	25/500
4703-010	1	10/100

Coupling S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4701-005	1/2	20/1000
4701-007	3/4	20/500
4701-010	1	10/100
4701-012	1 1/4	25
4701-015	1 1/2	25
4701-020	2	25
PVC-C Sch 80		
1829-025	2 1/2	5
1829-030	3	5
1829-040	4	5

Male Adapter S/MPT

Use only for cold water.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4704-005	1/2	20/1000
4704-007	3/4	10/500
4704-010	1	10/100
4704-012	1 1/4	5/25
4704-015	1 1/2	5/25
4704-020	2	5/25

Elbow 90° S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4707-005	1/2	20/1000
4707-007	3/4	20/500
4707-010	1	10/100
4707-012	1 1/4	25
4707-015	1 1/2	25
4707-020	2	25
PVC-C Sch 80		
1806-025	2 1/2	5
1806-030	3	5
1806-040	4	5

Reducing Coupling S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4701-101	3/4 x 1/2	10/250
4701-131	1 x 3/4	10/100

Elbow 45° S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4706-005	1/2	20/500
4706-007	3/4	20/500
4706-010	1	10/100
4706-012	1 1/4	25
4706-015	1 1/2	25
4706-020	2	25
PVC-C Sch 80		
1817-025	2 1/2	5
1817-030	3	5
1817-040	4	5

Female Transition Brass Elbow S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4707-305	1/2	100
4707-307	3/4	50

Female Drop Ear Elbow S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4707-355	1/2	25

Female Transition Brass Drop Ear Elbow S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4707-356	1/2	1/50

Street Elbow 90° S/Sp

Use only for cold water.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4707-805	1/2	10/500
4707-807	3/4	10/250

Female Brass Drop Ear Elbow FPT/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4708-355	1/2	1/100

Tee S/S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4711-005	1/2	20/1000
4711-007	3/4	20/500
4711-010	1	10/100
4711-012	1 1/4	25
4711-015	1 1/2	25
4711-020	2	25
PVC-C Sch 80		
1801-025	2 1/2	5
1801-030	3	5
1801-040	4	5

Reducing Tee S/S/S

Tee sizes are read: run/run/branch

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4711-094	3/4 x 1/2 x 1/2	25/250
4711-095	3/4 x 1/2 x 3/4	25/250
4711-101	3/4 x 3/4 x 1/2	25/250
4711-131	1 x 1 x 3/4	10/100
4711-211	1 1/2 x 1 1/2 x 1	5/25
4711-249	2 x 2 x 1	5/25

Cap S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4717-005	1/2	10/1000
4717-007	3/4	10/500
4717-010	1	10/100
4717-012	1 1/4	5/25
4717-015	1 1/2	5/25
4717-020	2	5/25
PVC-C Sch 80		
1847-025*	2 1/2	5
1847-030*	3	5
1847-040*	4	5

*For special order

Bushing Sp/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4718-101	3/4 x 1/2	10/250
4718-130	1 x 1/2	10/100
4718-131	1 x 3/4	10/100
4718-166	1 1/4 x 1/2	5/25
4718-167	1 1/4 x 3/4	5/25
4718-168	1 1/4 x 1	5/25
4718-209	1 1/2 x 1/2	5/25
4718-210	1 1/2 x 3/4	5/25
4718-211	1 1/2 x 1	5/25
4718-212	1 1/2 x 1 1/4	5/25
4718-247	2 x 1/2	5/25
4718-248	2 x 3/4	5/25
4718-249	2 x 1	5/25
4718-250	2 x 1 1/4	5/25
4718-251	2 x 1 1/2	5/25
PVC-C Sch 80		
1837-292	2 1/2 x 2	5
1837-338	3 x 2	5
1837-339	3 x 2 1/2	5
1837-422	4 x 3	5

Bushing IPS x CTS Sp/S

Use for industrial PVC-C valves (up to 2")
and for cold water

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4718-710	1	10/100
4718-712	1 1/4	5/25
4718-715	1 1/2	5/25
4718-720	2	5/25

Union S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4733-005	1/2	10/1200
4733-007	3/4	10/500
4733-010	1	10/450

NIBCO

Female Transition Union S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4733-305	1/2	1/60
4733-307	3/4	1/50
4733-310	1	1/30
4733-312	1 1/4	1/30
4733-315	1 1/2	1/20
4733-320	2	1/10

Male Transition Union S/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4733-405	1/2	1/50
4733-407	3/4	1/50
4733-410	1	1/30
4733-412	1 1/4	1/30
4733-415	1 1/2	2/20
4733-420	2	2/10

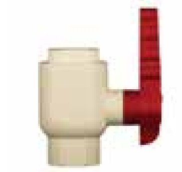
Running Trap "V" Sp/Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4788-005	1/2	50
4788-007	3/4	30

Running Trap "S" Sp/Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
4789-005	1/2	50
4789-007	3/4	30

Ball Valve S/S



SYMBOL	SIZE INCH	BAG/BOX QUANTITY
652-005	1/2	5/500
652-007	3/4	5/300
652-010	1	5/150
652-012	1 1/4	5/100
652-015	1 1/2	2/60
652-020	2	2/30

Assembling Plate with Transition Brass Drop Ear Elbows S/FPT

SYMBOL	BAG/BOX QUANTITY
631 C	1

Assembling Plate with Brass and Transition Brass Drop Ear Elbow FPT/FPT and S/FPT

SYMBOL	BAG/BOX QUANTITY
631 UC	1

Drop Assembling Plate

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
630 B	20,6 x 2,4	10

Flange PVC-C Sch80 One-Piece Design S

oval holes

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
1851-020	2	10
1851-030	3	10
1851-040	4	10

Flange PVC-C Sch80 Two-Piece Van Stone Design S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
1854-005*	1/2	10
1854-007*	3/4	15
1854-010*	1	10
1854-012	1 1/4	5
1854-015	1 1/2	10
1854-020	2	10
1854-025	2 1/2	5
1854-030	3	10
1854-040	4	10

*For special order

Pipe PVC-U
PN 15/12/9

Pipe length is 3.048m 10(ft)

SYMBOL	SIZE INCH	BOX QUANTITY	PALLET QUANTITY
PN15 400-105	1/2	30	480
PN15 400-107	3/4	18	288
PN15 400-110	1	10	160
PN15 400-112	1 1/4	***15**	147
PN15 400-115	1 1/2	***10**	108
PN15 400-020	2	***5**	66
PN15 400-030	3	1	35
PN12 400-040	4	1	18
PN9 400-060	6	1	
PN9 400-080	8	1	

*Boundle

Pipe PVC-U
Sch 40

Pipe length is 3.048m 10(ft)

SYMBOL	SIZE INCH	BOX QUANTITY	PALLET QUANTITY
400-005	1/2	30	480
400-007	3/4	18	288
400-010	1	10	160
400-012	1 1/4	***15**	147
400-015	1 1/2	***10**	108
400-020	2	***5**	66
400-025	2 1/2	1	54
400-030	3	1	35
400-040	4	1	18
400-060	6	1	
400-080	8	1	

*Boundle

Tee
S/S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
401-005	1/2	50
401-007	3/4	50
401-010	1	50
401-012	1 1/4	25
401-015	1 1/2	25
401-020	2	25
401-025	2 1/2	10
401-030	3	10
401-040	4	5
401-060	6	4
401-080	8	2

Tee Reducing
S/S/S

Tee sizes are read: run/run/branch

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
401-094	3/4x1/2x1/2	50
401-095	3/4x1/2x3/4	50
401-101	3/4x3/4x1/2	50
401-130	1x1x1/2	50
401-131	1x1x3/4	50
401-166	1 1/4x1 1/4x1/2	25
401-167	1 1/4x1 1/4x3/4	25
401-168	1 1/4x1 1/4x1	25
401-209	1 1/2x1 1/2x1/2	25
401-210	1 1/2x1 1/2x3/4	25
401-211	1 1/2x1 1/2x1	25
401-212	1 1/2x1 1/2x1 1/4	25
401-247	2x2x1/2	10
401-248	2x2x3/4	10
401-249	2x2x1	10
401-250	2x2x1 1/4	10
401-251	2x2x1 1/2	10
401-335	3x3x1	10
401-338	3x3x2	10
401-420	4x4x2	5
401-422	4x4x3	5
401-532	6x6x4	5
401-585	8x8x6	2

Female Tee
S/S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
402-005	1/2	50
402-007	3/4	50
402-010	1	50

Elbow 90°
S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
406-005	1/2	50
406-007	3/4	50
406-010	1	50
406-012	1 1/4	25
406-015	1 1/2	25
406-020	2	25
406-025	2 1/2	10
406-030	3	10
406-040	4	5
406-060	6	5
406-080	8	2

Reducing
Elbow 90°
S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
406-101	3/4x1/2	50
406-130	1x1/2	50
406-131	1x3/4	50

Female
Elbow 90°
S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
407-005	1/2	50
407-007	3/4	50
407-010	1	50
407-012	1 1/4	25

Street Elbow 90°
S/Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
409-005	1/2	50
409-007	3/4	50
409-010	1	50
409-012	1 1/4	25
409-015	1 1/2	25
409-020	2	10

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Male Elbow 90° S/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
410-005	1/2	50
410-007	3/4	50
410-010	1	50
410-012	1 1/4	25
410-015	1 1/2	25
410-020	2	10

Elbow 45° S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
417-005	1/2	50
417-007	3/4	50
417-010	1	50
417-012	1 1/4	25
417-015	1 1/2	25
417-020	2	25
417-025	2 1/2	10
417-030	3	10
417-040	4	5
417-060	6	4
417-080	8	4

Cross S/S/S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
420-005	1/2	50
420-007	3/4	50
420-010	1	50
420-012	1 1/4	25
420-015	1 1/2	25
420-020	2	10
420-025	2 1/2	8
420-030	3	10
420-040	4	5

Coupling S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
429-005	1/2	100
429-007	3/4	50
429-010	1	50

Coupling S/S cont.

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
429-012	1 1/4	25
429-015	1 1/2	25
429-020	2	25
429-025	2 1/2	10
429-030	3	10
429-040	4	5
429-060	6	4
429-080	8	4

Male Adapter Sp/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
433-005	1/2	50
433-007	3/4	50

Female Adapter Sp/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
435-005	1/2	100
435-007	3/4	50
435-010	1	50
435-012	1 1/4	25
435-015	1 1/2	25
435-020	2	25
435-025*	2 1/2	10
435-030*	3	10
435-040*	4	5

*Use with thread adapter

Male Adapter S/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
436-005	1/2	100
436-007	3/4	50
436-010	1	50
436-012	1 1/4	25
436-015	1 1/2	25
436-020	2	25
436-025*	2 1/2	10
436-030*	3	10
436-040*	4	5

*Use with thread adapter

Reducing Male Adapter MPT/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
436-074	1/2 x 3/4	50
436-101	3/4 x 1/2	50
436-102	3/4 x 1	50
436-131	1 x 3/4	50
436-169	1 1/2 x 1 1/4	50

Bushing Sp/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
437-101	3/4 x 1/2	100
437-130	1 x 1/2	100
437-131	1 x 3/4	100
437-166	1 1/4 x 1/2	25
437-167	1 1/4 x 3/4	25
437-168	1 1/4 x 1	25
437-209	1 1/2 x 1/2	25
437-210	1 1/2 x 3/4	25
437-211	1 1/2 x 1	25
437-212	1 1/2 x 1 1/4	25
437-247	2 x 1/2	10
437-248	2 x 3/4	10
437-249	2 x 1	10
437-250	2 x 1 1/4	10
437-251	2 x 1 1/2	10
437-290	2 1/2 x 1 1/4	10
437-291	2 1/2 x 1 1/2	10
437-292	2 1/2 x 2	10
437-335	3 x 1	10
437-336	3 x 1 1/4	10
437-337	3 x 1 1/2	10
437-338	3 x 2	10
437-339	3 x 2 1/2	10
437-420	4 x 2	5
437-421	4 x 2 1/2	5
437-422	4 x 3	5
437-528	6 x 2	5
437-530	6 x 3	5
437-532	6 x 4	5
437-582	8 x 4	4
437-585	8 x 6	4

Cap
S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
447-005	1/2	100
447-007	3/4	100
447-010	1	50
447-012	1 1/4	25
447-015	1 1/2	25
447-020	2	25
447-025	2 1/2	10
447-030	3	10
447-040	4	5
447-060	6	5
447-080	8	2

Female Cap
FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
448-005	1/2	100
448-007	3/4	100
448-010	1	50

Plug
Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
449-005	1/2	50
449-007	3/4	50
449-010	1	50
449-012	1 1/4	25
449-015	1 1/2	25
449-020	2	10
449-025	2 1/2	10
449-030	3	10
449-040	4	6

Male Plug
MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
450-005	1/2	50
450-007	3/4	50
450-010	1	50
450-015	1 1/2	15
450-020	2	10

Union
S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
457-005	1/2	10
457-007	3/4	10
457-010	1	10
457-012	1 1/4	10
457-015	1 1/2	5
457-020	2	5
457-030	3	12
457-040	4	12

Female Transition Union
S/FPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
457-305	1/2	100
457-307	3/4	50
457-310	1	50

Male Transition Union
S/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
457-405	1/2	100
457-407	3/4	50
457-410	1	50

Running Trap "V"
Sp/Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
488-005	1/2	50
488-007	3/4	50

Running Trap "S"
Sp/Sp

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
489-005	1/2	50
489-007	3/4	50

Ball Valve
S/S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
602-005	1/2	25
602-007	3/4	15
602-010	1	8
602-012	1 1/4	5
602-015	1 1/2	4
602-020	2	2
602-025	2 1/2	12
602-030	3	12
602-040	4	6

Adapter
(NPT/ISO)
FPT/MPT

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
PRZ025	2 1/2 NPT x 2 1/2	1
PRZ030	3 NPT x 3	1
PRZ040	4 NPT x 4	1

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Drop Assembling Plate

SYMBOL	SIZE cm	BAG/BOX QUANTITY
630 B	20,6 x 2,4	10

Assembling Plate with Brass Drop Ear Elbows FPT/FPT

SYMBOL	SIZE cm	BAG/BOX QUANTITY
631 U	20,6 x 2,4	1

Flange PVC-U Sch80 One-Piece Design S

oval holes

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
851-020	2	12
851-030	3	10
851-040	4	10
851-060	6	5

Flange PVC-U Sch 80 One-Piece Design Heavy Duty S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
851-H10	1	24
851-H12	1 1/4	10
851-H15	1 1/2	12
851-H20	2	5
851-H25	2 1/2	5
851-H40	4	10

For Special order

Flange PVC-U Sch80 Two-Piece Van Stone Design S

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
854-005*	1/2	10
854-007*	3/4	10
854-010	1	24
854-012	1 1/4	10
854-015	1 1/2	12
854-020	2	10
854-025	2 1/2	5
854-030	3	10
854-040	4	10
854-060	6	5
854-080	8	2

*For Special order

PVC-U Butterfly Valve

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
W45BGE3-020	2	1
W45BGE3-025	2 1/2	1
W45BGE3-030	3	1
W45BGE3-040	4	1
W45BGE3-060	6	1

For special order

HT-120 PVC-C / PVC-U Cement

SYMBOL	SIZE ml	BAG/BOX QUANTITY
UNIV-125	125	24
UNIV-250	250	24
UNIV-500	500	12

PVC GEL PVC-U Cement

SYMBOL	SIZE ml	BAG/BOX QUANTITY
499-125	125	24
499-250	250	24
499-500	500	12

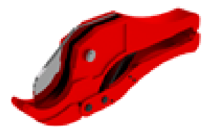
HT-120 FlowGuard® PVC-C Cement

SYMBOL	SIZE ml	BAG/BOX QUANTITY
4799-125	125	24
4799-250	250	24

CLEANER

SYMBOL	SIZE ml	BAG/BOX QUANTITY
CLEAN-125	125	20
CLEAN-250	250	12
CLEAN-500	500	12

Pipe Cutter

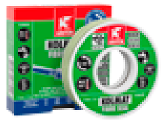


SYMBOL	SIZE INCH	BAG/BOX QUANTITY
MGB-42A	do 1 1/2 CTS	1

Deburring Tool

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
640P	do 1 1/4 IPS	1

Tape Kolmat®



SYMBOL	BAG/BOX QUANTITY
JMT 101920	1

Flange's Washer

SYMBOL	SIZE INCH	BAG/BOX QUANTITY
NR5112	1/2	1
NR5134	3/4	1
NR511	1	1
NR51114	1 1/4	1
NR51112	1 1/2	1
NR512	2	1
NR51212	2 1/2	1
NR513	3	1
NR514	4	1
NR516	6	1
NR518	8	1

Metal Holder with Double Threaded Screw (EPDM rubber)

SYMBOL	SIZE INCH		BAG/BOX QUANTITY
	PVC-U	PVC-C	
625-003	-	1/2	100
625-005	1/2	3/4	100
625-007	3/4	1	100
625-010	1	1 1/4	100
625-012	1 1/4	1 1/2	50
625-015	1 1/2	2	50
625-020	2	-	50
625-025	2 1/2	2 1/2	50
625-030	3	3	50
625-040	4	4	1

Rubber collar in metal clamps for NIBCO system must by made from EPDM. Producer attest is necessary.

Plastic Clamp Fix Express

SYMBOL	SIZE mm	SIZE INCH		BAG/BOX QUANTITY
		PVC-U	PVC-C	
62T1416	14-16	-	1/2	100
62T2023	20-23	1/2	3/4	100
62T2529	25-29	3/4	1	50
62T3235	32-35	1	1 1/4	50
62T4045	40-45	1 1/4	1 1/2	50
62T4855	48-55	1 1/2	2	25
62T5865	58,5-65	2	-	25

NIBCO

NIBCO INC:

- Elkhart, Indiana, U.S.A. – World Headquarters
- Established in 1904
- 10 Manufacturing Facilities
    - 8 in U.S.A.
    - 1 in Mexico
    - 1 in Poland
- Approximately 2,200 employees
- 130,000 SKU's

NIBCO:

- A value-based and relationship-oriented company.
- An industry leader in the manufacturing of commercial, mechanical and fire protection valves.
- In its 114th consecutive year of operation.
- ISO certified and compliant with broad range of industry standards which are monitored and verified on a consistent basis.
- Currently exporting to over 66 countries.
- Delivering 97% of orders on-time and complete.
- Significantly outperforming competitors on international and domestic shipment lead-times.

NIBCO® SYSTEMS

FITTINGS

Wrot and cast copper pressure and drainage fittings • Cast copper alloy flanges • Wrot and cast press fittings • ABS and PVC DWV fittings • Schedule 40 PVC pressure fittings • CPVC CTS fittings • CPVC CTS-to-metal transition fittings • Schedule 80 PVC and CPVC systems • CPVC BlazeMaster® fire protection fittings • Lead-Free * fittings

BlazeMaster® is a registered trademark of The Lubrizol Corporation.

*Weighted average lead content ≤0.25%

VALVES

Pressure-rated bronze, iron and alloy-iron gate, globe and check valves • Pressurerated bronze ball valves • Boiler specialty valves • Commercial and industrial butterfly valves • Lined butterfly valves • Circuit balancing valves • Carbon and stainless steel ball valves • ANSI flanged steel ball valves • Lined ball valves • Pneumatic and electric actuators and cotrols • Grooved ball and butterfly valves • High performance butterfly valves • UL/FM fire protection valves • MSS specification valves • Bronze specialty valves • Low pressure gate, globe, check and ball valves • Frostproof sillcocks • Quarter-turn supply stops • Quarter-turn low pressure valves • PVC and CPVC plumbing and industrial ball valves • Bronze & Iron Y-strainers • Sample valves • Sanitary valves • Lead-Free* valves • Coil-Connect® Kits

*Weighted average lead content ≤0.25%

INDUSTRIAL PLASTICS

Thermoplastic pipe, valves, and fittings in PVC, Corzan® CPVC, polypropylene and PVDF Kynar® • Pneumatic and electric actuation systems • BlazeMaster® CPVC fire protection fittings

BlazeMaster® and Corzan® are registered trademarks of the Lubrizol Corporation

Kynar® is a registered trademark of Arkema Inc.

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Printed in Poland