Overview plastic tubing, standard O.D. and additional information

FESTO

Key features

Application

The requirements for pressure, temperature, flexibility and environmental influences differ from one industry sector to the next. Users frequently underestimate the risks: around 90% of all cases of damage can be traced back to the wrong choice of tubing or tubing materials. This doesn't only result in energy losses, but also in machine downtimes. It is therefore really important to find a reliable and cost-effective product that prevents the tubing getting damaged during operation.

Summary of tubing/fitting combinations

Applications	Tubing	Fitting	Description
Standard	PUN-H	QS	Maximum flexibility in standard applications thanks to an extremely wide range of options for combining the different types.
	PAN	QS	Meets all requirements, even for standard applications with increased pressure and temperature ranges.
	PEN	QS	Suitable for a wide range of tasks and attractively priced. Can be widely used thanks to materials with good resistance, easy to install. High level of abrasion resistance in dynamic applications (e.g. in energy chains).
High pressures	PAN-MF	NPQM	The tubing meets DIN standard 73378: ideal for use in mobile pneumatics. Suitable for increased temperature ranges combined with high pressure ranges.
	PAN-R	NPQH	Powerful in pressure ranges up to 20 bar, for example in applications with the pressure booster DPA.
	PUN-H-SF	NPQR	For applications with increased requirements in terms of robustness, flexibility and pressure resistance. The tubing has maximum flexibility and is resistant to kinking and hydrolysis. The combination is suitable for applications with a high moisture content.
Chemical-resistant, hydrolysis-resistant	PLN	NPQP	Resistant to cleaning agents. Easy-to-clean and economical combination, made from material listed for use in the food zone. Can be used instead of the combination with stainless steel fittings.
	PUN-H	NPCK	Hydrolysis-resistant and suitable for water applications. Corrosion-resistant and made from material listed for use in the food zone.
	PUN-H-F	NPQR	Food-safe to Regulation (EC) No. 1935/2004 and FDA-listed materials. Can be used in the food and packaging industry in combination with fittings NPQR or NPQH. The tubing is hydrolysis-resistant and is suitable for water applications. Extremely flexible and thus easy to install.
	PFAN/PTFEN	NPQH	For high temperatures up to 150°C. Resistant to cleaning agents and made from material listed for use in the food zone.
	PFAN/PTFEN	NPCK	Easy to clean thanks to the union nut's edge-free design. Maximum corrosion resistance (CRC 4), highly resistant to aggressive acids and alkalis, made from material listed for use in the food zone. Suitable for a wide range of media.
	PFAN	NPQR	Food-safe to Regulation (EC) 1935/2004 and made from FDA-listed material. For high temperatures up to 150°C. Pressure range up to 1.5 MPa. Maximum corrosion resistance (CRC 4).
Antistatic	PUN-CM	NPQM	Antistatic tubing plus solid metal fitting: maximum protection for electrical and electronic components.
Flame-retardant	PUN-V0	NPQM	Very safe in areas where there is a risk of fire thanks to flame-retardant properties.
Resistant to welding spatter	PUN-V0-C	NPQH	Ideal in the vicinity of welding spatter and safe thanks to an increased tubing wall thickness for all diameters.
	PAN-V0	QS-V0	Safe even in the vicinity of welding spatter thanks to double-walled tubing with special fitting.
Battery production	PUN-H	NPQE-F1A[1)]	Suitable in battery production areas, ideal in combination with push-in connector NPQE-F1A.

1) F1A = Free of copper, zinc and nickel

Note

Ambient conditions and the medium to be transported can have a considerable effect on the service life of plastic tubing. Based on experience, Festo recommends the following time specifications for using plastic tubing in general and in safety-related applications:

- For general applications, a minimum service life of 10 years can be expected.
- We recommend that for safety-related applications the tubing is inspected regularly, at least every 12 months.
- For applications that have an effect on the material, inspections must be carried out at suitable intervals. We recommend that the interval between inspections should be no more than 6 months, at most half of the period in which failures can occur.

Key features

Note

Tubing that is too long, diameters that are too small, and bending radii that are too small result in flow rate losses. One of the most important rules when selecting tubing is therefore that it should be as long as necessary and as short as possible.
Make sure, therefore, that in practice tubing is loosely installed and is not stretched.

Tools for bundling tubing or for avoiding bending/pinching the tubing are available as accessories:
- Tubing strap PB
- Spiral tubing binder PKB
- Tubing support NPAW
- Tubing support PKS
- Multi-tube holder KK

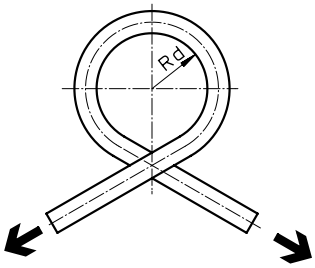
Other accessories include connecting tools for tubing:
- Pipe and tubing cutter ZRS
- Tubing cutter PAN-V0S for flame-retardant plastic tubing PAN-V0
- Connecting pliers ZMS/disconnecting pliers ZDS for connecting/disconnecting the plastic tubing and barbed fitting

Suitability for contact with food

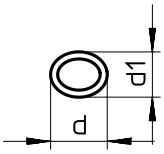
Tubing PFAN and PUN-H-F are suitable for contact with food. They have the necessary declaration of conformity in accordance with EU Regulation (EC) No. 1935/2004.

Measurement method

Flow-relevant bending radius Rd

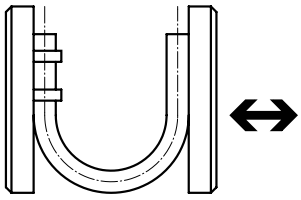


The tube is bent in the direction of its own curve until the tubing outer diameter is flattened by 5%.
Rd is then calculated mathematically.
The flow rate is not reduced until Rd is reached.



Cross-section flattened by bending the tube.
d = non-deformed tubing O.D.
d1 = deformed tubing O.D.

Minimum bending radius Rmin



The tubing fixed to the base plate is bent until the deformation results in a kink. The measured value is the minimum bending radius Rmin. This Rmin results in significant reductions in the flow rate.

Product range overview

Type	Material	O.D.	Colour													
		[mm]	Silver	Blue	Translucent blue	Black	Translucent black	Yellow	Translucent yellow	Green	Translucent green	Red	Translucent red	Brown	White	Natural	Blue/black
PUN	Polyurethane	3, 4, 6, 8, 10, 12, 14, 16	■	■	–	■	–	■	–	■	–	■	–	(■)[1]	(■)[1]	–	–
PUN-DUO	Polyurethane	4, 6, 8, 10	■	–	–	–	–	–	–	–	–	–	–	–	–	–	■
PUN-CM	Polyurethane	4, 6, 8, 10, 12, (14)[1]	–	–	–	■	–	–	–	–	–	–	–	–	–	–	–
PUN-H	Polyurethane	2	–	–	–	■	–	–	–	–	–	■	–	–	–	■	–
		3, 4, 6, 8, 10, 12, 14, 16	■	■	■	■	■	■	■	■	■	■	■	(■)[1]	(■)[1]	■	–
PUN-H-DUO	Polyurethane	4, 6, 8, 10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	■
PUN-H-F	Polyurethane	4, 6, 8, 10, 12, 16	–	■	■	■	–	■	–	■	–	■	–	–	–	■	–
		14	–	■	–	■	–	–	–	–	–	■	–	–	–	■	–
PUN-H-SF	Polyurethane	4, 6, 8, 10, 12, 14, 16, 18, 22, 25	–	■	–	■	–	–	–	–	–	–	–	–	–	–	–
PUN-V0	Polyurethane	6, 8, 10, 16	–	■	–	■	–	■	–	■	–	■	–	■	■	–	–
PUN-V0-C	Polyurethane	4, 6, 8, 10, 12, 14, 16	–	■	–	■	–	■	–	■	–	■	–	■	■	–	–
PAN	Polyamide	4, 6, 8, 10, 12, 14, 16	■	■	–	■	–	■	–	■	–	■	–	(■)[1]	(■)[1]	■	–
PAN-R	Polyamide	4, 6, 8, 10, 12, (14)[1], 16	■	(■)[1]	–	(■)[1]	–	(■)[1]	–	(■)[1]	–	(■)[1]	–	(■)[1]	(■)[1]	(■)[1]	–
		22, 28	–	–	–	■	–	–	–	–	–	–	–	–	–	–	–
PAN-MF	Polyamide	4, 6, 8, 10, 12, 14, 16	(■)[1]	(■)[1]	–	■	–	(■)[1]	–	(■)[1]	–	(■)[1]	–	(■)[1]	(■)[1]	(■)[1]	–
PAN-V0	Polyamide	4, 6, 8, 10, 12	–	■	–	■	–	■	–	■	–	■	–	–	■	–	–
PFAN	Perfluoroalkoxy alkane	3, 4, 6, 8, 10, 12	–	–	–	–	–	–	–	–	–	–	–	–	–	■	–
PTFEN	Polytetrafluoro-ethylene	4, 6, 8, 10, 12, 14, 16	–	–	–	–	–	–	–	–	–	–	–	–	–	■	–
PEN	Polyethylene	4, 6, 8, 10, 12, 14, 16	■	■	–	■	–	■	–	■	–	■	–	(■)[1]	(■)[1]	■	–
PLN	Polyethylene	4, 6, 8, 10, 12, 14, 16	■	■	–	■	–	(■)[1]	–	(■)[1]	–	■	–	(■)[1]	(■)[1]	■	–

1) Please observe the note below.

Note

Product options in brackets can only be ordered using the modular product system.

Please observe the minimum order quantity for tubing with O.D. ≤ 8 mm is 3000 m and for tubing with O.D. > 8 mm. it is 1500 m.

There is a modular product system for plastic tubing:

- PUN → page 64
- PAN → page 50
- PEN → page 61
- PLN → page 65

Product range overview

Type	Operating medium													Resistance							
	Compressed air, vacuum	Water	Mineral oil	Oxygen	Food-safe [9]	Food-safe [10]	Material fire test	Antistatic	Halogen-free	Contact with electric cables	Suitable for energy chains	Approved by the German Technical Control Board (TÜV)	Maritime classification	Chemicals	Microbes	UV radiation	Hydrolysis	Flexible	Shore hardness [8]	Tolerance for packaging length	→ Page/Internet
PUN	■	–	–	–	–	–	UL94 HB	–	■	■[7]	■	■	–	–	–	++[4]	+	+++	D 52 ±3		65
PUN-DUO	■	–	–	–	–	–	UL94 HB	–	■	■[7]	■	■	–	–	–	+	+	++	D 52 ±3		64
PUN-CM	■	–	–	–	–	–	–	■	■	■	■	–	–	+	++	++	++	++	D 52 ±3		65
PUN-H	■	–	–	–	–	–	–	–	■	■	■	–	–	+	++	++[4]	++	+++	D 52 ±3		65
	■	■	–	–	■	–	UL94 HB	–	■	■	■	■	–	+	++	++[4]	++	+++	D 52 ±3		64
PUN-H-DUO	■	■	–	–	■	–	UL94 HB	–	■	■	■	■	–	+	++	+	++	++	D 52 ±3		65
PUN-H-F	■	■	–	■	–	■	UL94 HB	–	■	■	■	■	–	+	++	++[4]	++	++	D 52 ±3		64
	■	■	–	■	–	■	UL94 HB	–	■	■	■	■	–	+	++	++[4]	++	++	D 52 ±3		
PUN-H-SF	■	■	–	–	■	–	UL94 HB	–	■	■	■	–	–	+	++	++[4]	++	+++	D 54 +/-3		65
PUN-V0	■	■	–	–	–	–	UL94 V0...V2	–	■	■	■	■	–	+	++	++[4]	++	++	D 54 ±3		64
PUN-V0-C	■	■	–	–	–	–	UL94 V0...V2	–	■	■	■	■	–	+	++	++[4]	++	++	D 54 ±3	±1%	64
PAN	■	–	–	–	–	–	–	–	■	■	■	■	■[3]	+	++	+	++	++	D 55 ±3		38
PAN-R	■	–	–	–	–	–	–	–	■	■	■	■	–	+	++	+	++	+	D 62 ±3		42
	■	–	–	–	–	–	–	–	■	■	■	–	–	+	++	+	++	+	D 62 ±3		43
PAN-MF	■	–	■[2]	–	–	–	–	–	■	■	■	–	–	+	++	+	++	+	D 65 ±3		45
PAN-V0	■	■	■	–	–	–	UL94 V0	–	–	■	■	–	–	+	++	++	++	++	A 72 ±4[5] D 57 ±3[6]		48
PFAN	■	■	–	–	■	■	UL94 V0	–	–	■	–	■	–	+++	++	++	+++	+	D 60 +5		52
PTFEN	■	–	–	–	■	–	UL94 V0	–	–	■	–	–	–	+++	++	++	+++	+	D 55 ±5		55
PEN	■	■	–	–	–	–	–	–	■	■	■	■	–	++	++	++[4]	+++	++	D 52 ±3		58
PLN	■	■	–	–	■	–	–	–	■	■	–	■	–	++	++	++[4]	+++	+	D 59 ±3		63

2) As a precaution, please check the operating medium with Festo.
3) Applies to the colours silver and natural
4) Applies to the colour black
5) Outside tubing
6) Inside tubing
7) Cables containing organophosphates may damage PUN tubing under unfavourable conditions.
8) Values are determined using test panels. Values determined using tubing may vary.
9) See the supplementary material information
10) See the declaration of conformity

■ Criterion met
– Not suitable

+++ Highly suitable
++ Suitable
+ Limited suitability (on request)

Recommended tubing/fitting combinations

Fitting	Tubing type																
	PUN	PUN-DUO	PUN-CM	PUN-H	PUN-H-DUO	PUN-H-F	PUN-H-SF	PUN-V0	PUN-V0-C	PAN	PAN-R	PAN-MF	PAN-V0	PEN	PLN	PFAN	PTFEN
Fitting CK [1]	++	++	+	++	++	++	–	++	–	++	–	–	–	++	++	++	++
Fitting CN [2]	++	++	+	–	–	–	–	+	–	++	–	–	–	++	+	++	++
Fitting QS [3]	+++	+++	+	+++	+++	++	++	+	+	+++	++	++	+	+++	++	++	++
Fitting NPQH [4]	++	++	++	+++	+++	+++	+++	++	+++	++	+++	++	+	++	++	+++	+++
Fitting CRQS [5]	++	++	+	++	++	+++	++	++	++	++	++	++	+	++	++	+++	+++
Fitting NPQP [6]	++	++	+	++	++	+++	++	+	+	++	++	++	+	++	+++	+++	+++
Fitting NPKA [7]	++	++	+	+++	++	+++	++	+	–	++	++	–	–	++	++	++	++
Fitting NPCK [8]	++	++	++	++	++	+++	–	++	–	++	–	–	–	++	++	+++	+++
Fitting CQ [9]	–	–	–	–	–	–	–	–	–	–	++	–	–	–	–	–	–
Fitting QS-V0 [10]	+	+	+	+	+	+	+	+	+	+	+	+	+++	+	+	+	+
Fitting NPQM [11]	++	++	+++	++	++	++	++	+++	++	++	++	++	+	+++	++	++	++
Fitting NPQR [12]	++	++	++	+++	+++	+++	+++	++	++	++	++	++	+	++	+++	+++	+++

+++ Recommended tubing/fitting combination
++ Well suited
\+ Limited suitability due to:
– Tubing PLN with fitting CN provides little flexibility
– No conductive contact with PUN-CM
– Incompatible characteristic "resistance to welding spatter" with PUN-V0 / PUN-V0-C
– Sub-optimal combination with regard to welding spatter resistance when insulation is removed from double-sheathed tubing PAN-V0
Note: Fitting QS-V0 is specially designed for tubing PAN-V0 with the insulation removed using tubing cutter PAN-V0S.
With other fittings, there is a gap near the releasing sleeve and the protective function against welding spatter is lost.
There is also an increased risk of the tubing kinking in this area.
However, this risk of kinking can be prevented by ensuring large bending radii when installing the tubing.
– Not suitable
1) For tubing size 4 to 8
2) For tubing size 3 to 8
3) For tubing size 2 to 12, 16 and 22
4) For tubing size 4 to 14
5) For tubing size 4 to 12; 16
6) For tubing size 4 to 12
7) For tubing size 6
8) For tubing size 4 to 10
9) For tubing size 22 and 28 (22 also possible with QS)
10) For tubing size 4 to 12
11) For tubing size 3 to 14
12) For tubing size 4 to 16

Note

Greater force is required when assembling the fittings CK/CN. Expanding the tubing ends using a tapered mandrel makes pushing them on easier.

Select and dimension using the configurator

Minimum order quantity via the FESTO modular product system

General minimum order quantity (metric)

	Tube diameter [mm]	Colours	Packing unit [m]	Delivery time	Minimum order quantity[1] [m]
PUN, PAN, PEN, PLN	≤ 8 mm	all colours	25; 50; 100; 200; 300; 500	+ 20 working days	3000
			400		3200
	> 8 mm		25; 50; 100; 300		1500
			200		1600

Smaller quantities can be ordered in combination with the features „TXT“/“TXT-AS“ (metric)

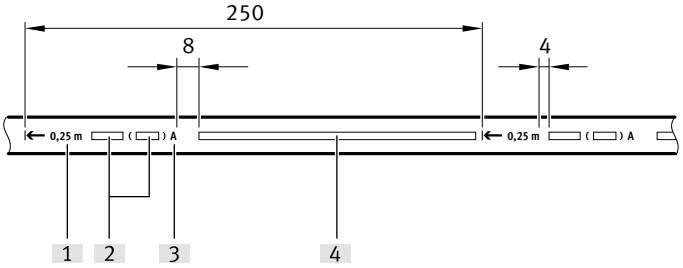
	Tube diameter [mm]	Colours	Packing unit [m]	Delivery time	Minimum order quantity[1] [m]
PUN-H	4	NT, TBL, SI	50; 500	+ 20 working days	1000
	6				
	8		50; 400		800
	10		50; 300		600
PEN, PLN	6	BL; SW; NT	50; 500		1000
	8		50; 400		800

General minimum order quantity (inch)

	Tube diameter [inch]	Colours	Packing unit [ft]	Delivery time	Minimum order quantity[1] [ft]
PUN-U, PEN-U; PLN-U	1/8; 5/32; 3/16; 1/4; 5/16	all colours	150; 500; 1000; 1500	+ 20 working days	9000
	3/8		150; 500; 1000		6000
	1/2; 5/8		150; 500		4500

1) Any further increase in the minimum order quantity depends on the packaging unit.

Optional tube printing



[1] Cut marking
[2] Production period and plant according to FN 940065
[3] Month information in plain text
[4] Material coding
[5] Specific printing

Print colour: Black RAL 9011[1]

1) Exception: Print colour = white:
– Hoses in the colour black (SW) & translucent black (TSW)
– All PEN & PLN #hoses (depending on the hose colour, the imprint appears between almost white and grey)

Note

- The specific printing can have a max. of 90 characters.
- Accepted characters: A-Z, a-z, 0-9, # ; , % < & = “ > (@) [* +] ^ - _ . ` / | : ~
- The printing is repeated every 250 mm.
- Cutting mark every 250 mm can be deselected.