

Overview plastic tubing, standard O.D.

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-VO | NPQM | Very safe in areas where there is a risk of fire thanks to flame-retardant properties. |
| Resistant to welding spatter | PUN-VO-C | NPQH | Ideal in the vicinity of welding spatter and safe thanks to an increased tubing wall thickness for all diameters. |
| | PAN-VO | QS-VO | 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-VOS for flame-retardant plastic tubing PAN-VO
- Connecting pliers ZMS/disconnecting pliers ZDS for connecting/disconnecting the plastic tubing and barbed fitting

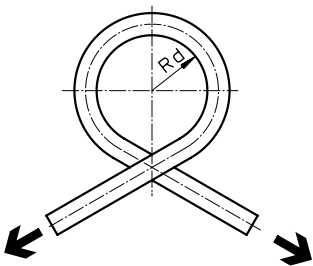
Suitability for contact with food



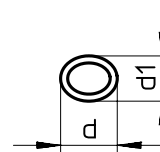
Tubing PFAN and PUN-H-F are suitable for contact with food. They have the necessary declaration of conformity in accordance with EU Regulation (EC) No. 1935/2004.

Measurement method

Flow-relevant bending radius R_d



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

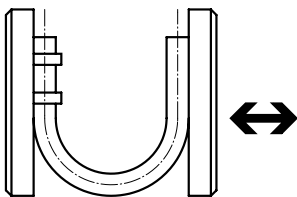


Cross-section flattened by bending the tube.

d = non-deformed tubing O.D.

d_1 = deformed tubing O.D.

Minimum bending radius R_{min}



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

Product range overview

| Type | Material | O.D. [mm] | Colour | | | | | | | | | | | | | | |
|-----------|-------------------------|--|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|--------------------|-------------------|-------------------|-------------------|-----------------|-------------------|-------------------|-------------------|------------|
| | | | 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-VO | Polyurethane | 6, 8, 10, 16 | - | ■ | - | ■ | - | ■ | - | ■ | - | ■ | - | ■ | ■ | - | - |
| PUN-VO-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-VO | Polyamide | 4, 6, 8, 10, 12 | - | ■ | - | ■ | - | ■ | - | ■ | - | ■ | - | - | ■ | - | - |
| PFAN | Perfluoroalkoxy alkane | 3, 4, 6, 8, 10, 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | ■ | - |
| PTFEN | Polytetrafluoroethylene | 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 | | | | | | Material fire test | Antistatic | Halogen-free | Contact with electric cables | Suitable for energy chains | Approved by the German Technical Control Board (TÜV) | Maritime classification | Resistance | | | | Flexible | Shore hardness ⁸⁾ | Tolerance for packaging length | → Page/Internet |
|-----------|------------------------|-------|-----------------|--------|-------------------------|--------------------------|--------------------|------------|--------------|------------------------------|----------------------------|--|-------------------------|------------|----------|------------------|------------|----------|--|--------------------------------|-----------------|
| | Compressed air, vacuum | Water | Mineral oil | Oxygen | Food-safe ⁹⁾ | Food-safe ¹⁰⁾ | | | | | | | | Chemicals | Microbes | UV radiation | Hydrolysis | | | | |
| PUN | ■ | - | - | - | - | - | UL94 HB | - | ■ | ■ ⁷⁾ | ■ | ■ | - | - | - | ++ ⁴⁾ | + | +++ | D 52 ±3 | ±1% | 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 | | 64 |
| PUN-H-SF | ■ | ■ | - | - | ■ | - | UL94 HB | - | ■ | ■ | ■ | - | - | + | ++ | ++ ⁴⁾ | ++ | +++ | D 54 +/-3 | | 65 |
| PUN-VO | ■ | ■ | - | - | - | - | UL94 VO...V2 | - | ■ | ■ | ■ | ■ | - | + | ++ | ++ ⁴⁾ | ++ | ++ | D 54 ±3 | | 64 |
| PUN-VO-C | ■ | ■ | - | - | - | - | UL94 VO...V2 | - | ■ | ■ | ■ | ■ | - | + | ++ | ++ ⁴⁾ | ++ | ++ | D 54 ±3 | | 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-VO | ■ | ■ | ■ | - | - | - | 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-VO | PUN-VO-C | PAN | PAN-R | PAN-MF | PAN-VO | 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-VO 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-VO / PUN-VO-C

- Sub-optimal combination with regard to welding spatter resistance when insulation is removed from double-sheathed tubing PAN-VO

Note: Fitting QS-VO is specially designed for tubing PAN-VO with the insulation removed using tubing cutter PAN-VOS.

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)

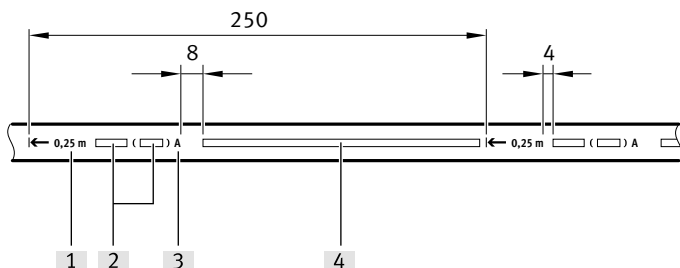
| | Tube diameter [mm] | Colours | Packing unit [m] | Delivery time | Minimum order quantity ¹⁾ [m] |
|----------|--------------------|-------------|------------------|-------------------|--|
| PUN-H | 4 | NT, TBL, SI | 50; 500 | + 20 working days | 1000 |
| | 6 | | | | |
| | 8 | | 50; 400 | | 800 |
| | 10 | | 50; 300 | | 600 |
| PEN, PLN | 6 | BL; SW; NT | 50; 500 | + 20 working days | 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; | all colours | 150; 500; 1000; 1500 | + 20 working days | 9000 |
| | 1/4; 5/16 | | | | |
| | 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 9011¹⁾

- 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)