MIETZSCH

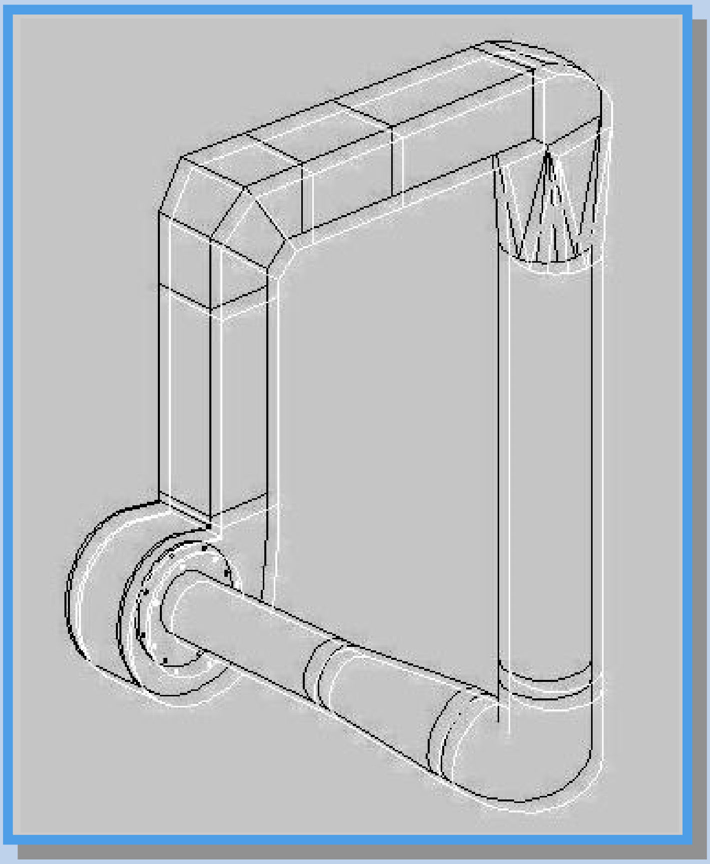
GmbH Lufttechnik Dresden

INFORMATION FOR USERS

VENTILATION COMPONENTS

(plastic)

Planning Guideline



Our catalogue of components contains the standard versions of all air duct components, air control elements and air inlets/outlets and also provides important information on application fields, operating limits and order placement. Customised parts are also available on request.

This planning information discusses the principles for planning and designing optimum and professional solutions for ventilation systems made of plastic.

Special information on ventilation systems for laboratories is given in the brochure
"Air conditioning in laboratories" --> https://www.mietzsch.de/around4/media/documents/katalog/i_lab.pdf

Information on sound dampers and acoustic enclosures is given in the brochure
"Sound insulation" --> https://www.mietzsch.de/around4/media/documents/www_spezial/w_schall_en.pdf

APPLICATION

Ventilation components made of high-quality plastic have a high corrosion resistance and are thus preferred for applications such as fume extraction of process gases in the chemical/pharmaceutical industry as well as ventilation of laboratories, battery rooms, pickling baths, scrubbers, electroplating units and agricultural facilities, etc.

Special features relating to the use of plastic components (compared to sheet steel)

The components are made of thermoplastics, which slowly deform under loads (creep). It is quite normal that these deformations are permanent. This is why particular attention must be paid to the operating limits for over- or underpressures in combination with the temperature.

At low temperatures, thermoplastics are brittle and susceptible to notching.
This must be taken into account during transport and assembly.

Thermal expansion is about 6 (PVC) to 14 (PE) times higher than that of steel. Corresponding expansion compensators must be carefully planned.
Example: For a temperature change of 20 K, a PPs pipe with a length of 10 m expands by 32 mm,
whereas a comparable steel pipe expands by only 2.6 mm.

Dimensional tolerances must be larger owing to the physical properties and manufacturing process.
Imperfect fits can be remedied relatively easily by heating.

The flow dynamics design is the same as for systems made of sheet steel. If not otherwise stated, the pressure loss coefficients can be taken from the relevant literature for hydraulically unobstructed designs.

In spite of their lower density, plastic components do not weigh less than those made of sheet steel because they have to be thicker. This must be taken into account when selecting assembly materials and specifying the assembly method.

Preference should be given to welded connections. This ensures good air tightness, even for large amounts of condensate. Only PVC can be adhesively bonded.

TERMS

The following terms are used for ventilation components:
Components with a rectangular cross-section: ducts and fittings, connectors, frames ("rectangular flanges")
Components with a circular cross-section: pipes and fittings, connectors, flanges ("circular flanges")
The nominal sizes always refer to the external dimensions of the pipes, ducts and fittings.

TYPES OF PLASTICS

All standard components are available in the following materials:

PVC - polyvinyl chloride
PPs - polypropylene, flame-retardant

These materials have an excellent track record in many facilities.

The components can also be made of other thermoplastic materials on request. These include:

PE - polyethylene (particularly for highly loaded outdoor applications; normal flammability B2)
PP - polypropylene (if physiological safety is required; however, it can only be used indoors)
PVDF - polyvinylidene fluoride (for high chemical loads, but very expensive)

For applications in **explosion hazard areas**, electrically conductive plastics can be used, but they are significantly more expensive

PPsX - electrically conductive polypropylene, difficult to ignite (Class B1)

Further possibilities, depending on application and availability:
PEX - electrically conductive polyethylene
PVCX - electrically conductive polyvinyl chloride

MATERIAL PROPERTY DATA

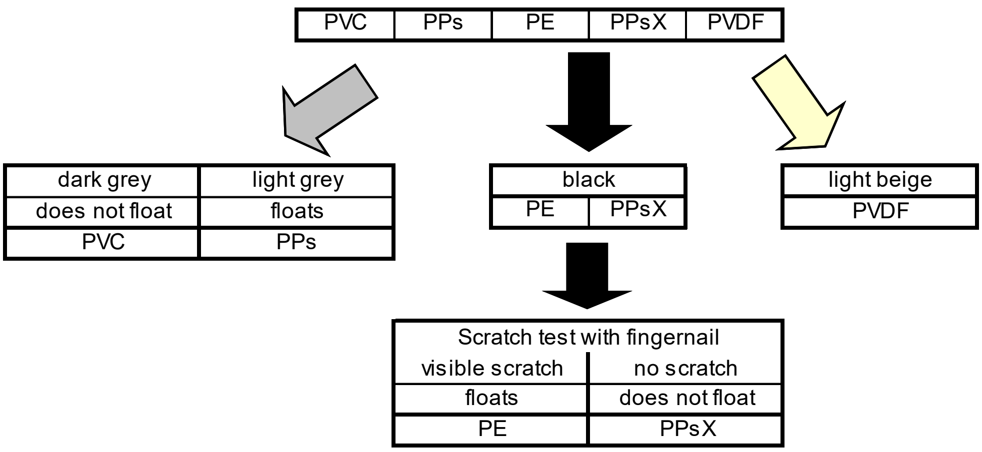
(datasheets --> https://www.mietzsch.de/around4/media/documents/allgemein/plastic_data.pdf

Material	**Polyvinyl chloride**	**Polypropylene** difficult to ignite	**Polyethylene**	**Polypropylene** difficult to ignite conductive	**Polyvinylidene** fluoride
Abbreviation	PVC	PPs	PE	PPsX 1)	PVDF
Density kg/m³	1440	950	950	1180	1780
Colour	iron grey RAL 7011	platinum grey RAL 7036	black	black	natural light beige
Long-term Young's modulus / MPa 20°C / 40°C	1510 / 1250	375 / 285	250 / 170	375 / 285	723 / 570
Maximum operating temperature °C	50 (60)	70	60	70	70
Flammability acc. to DIN 4102	B1 difficult to ignite	B1 difficult to ignite	B2 normal flammability	B1 difficult to ignite	B1 difficult to ignite
Surface resistance / ohm	10^{13}	10^{14}	10^{14}	10^{6}	10^{13}
Linear expansion / 1/K	0.8×10^{-4}	1.6×10^{-4}	1.8×10^{-4}	1.6×10^{-4}	1.3×10^{-4}
Physiologically safe	no	no	yes	no	yes
Special properties and application fields	inexpensive standard material	inexpensive standard material	excellent resistance to UV and weathering; disadvantageous flammability class	for stringent explosion protection requirements; expensive	excellent resistance to chemicals; very expensive
Joining method	adhesive bonding welding	welding	welding	welding	welding

1) "X" is the MIETZSCH designation for electrically conductive plastics

Identification and differentiation of the various plastics is not always easy for inexperienced users.
If it is certain that the component consists of one of the 5 materials listed above, it can be identified using the following properties:

Colour
Behaviour in water
Scratch test with a fingernail



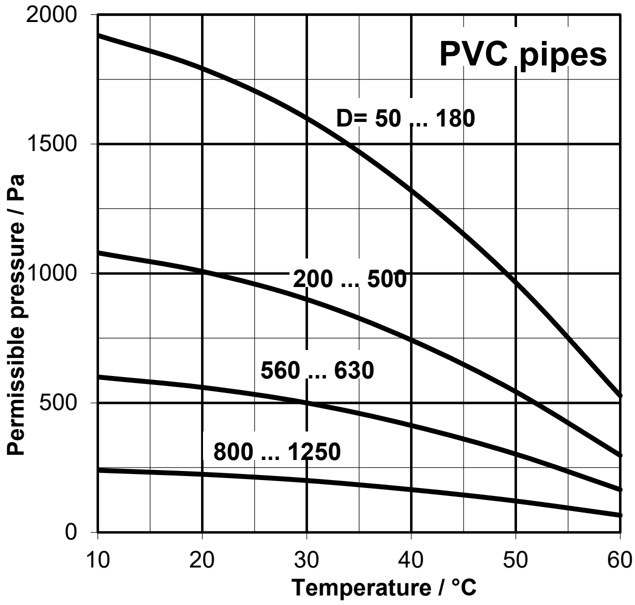
OPERATING LIMITS - pressure and temperature

In addition to assessing the resistance to chemicals, the permissible pressure and temperature limits must be taken into account. Owing to the particular properties of thermoplastic materials, account must be taken of the fact that their strength characteristics are temperature-dependent. Thus the permissible pressure loads are also temperature-dependent.
The components are divided into two groups, which have either a circular or a rectangular cross-section.

PIPES and CIRCULAR FITTINGS

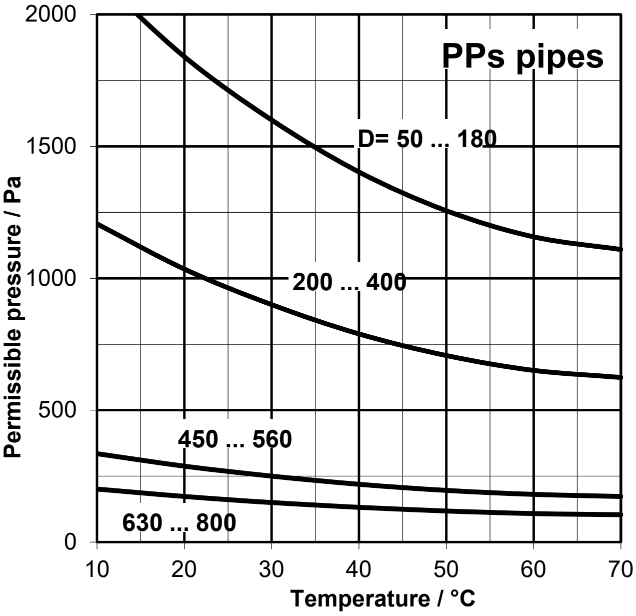
For components with a circular cross-section, only loads resulting from underpressures are critical in practical applications because instabilities may result in severe buckling. In extreme cases, an excessively loaded pipe can completely collapse, thus causing the entire system to fail.
If not otherwise specified for the particular product, the following operating limits apply to the standard range of **ventilation components with circular cross-sections**:

	PVC	PPs
permissible ambient temperature	-20 … +50°C	-20 … +60°C
permissible temperature of flowing medium permissible overpressure	60°C 3500 Pa	70°C 3500 Pa
permissible temperature of flowing medium permissible underpressure	see diagram depends on pipe diameter	



If higher underpressures occur, either the component's wall thickness is increased or stiffening is added.

We use computers to design the most cost-effect solution. This requires accurate details of the operating conditions.



DUCTS and RECTANGULAR FITTINGS

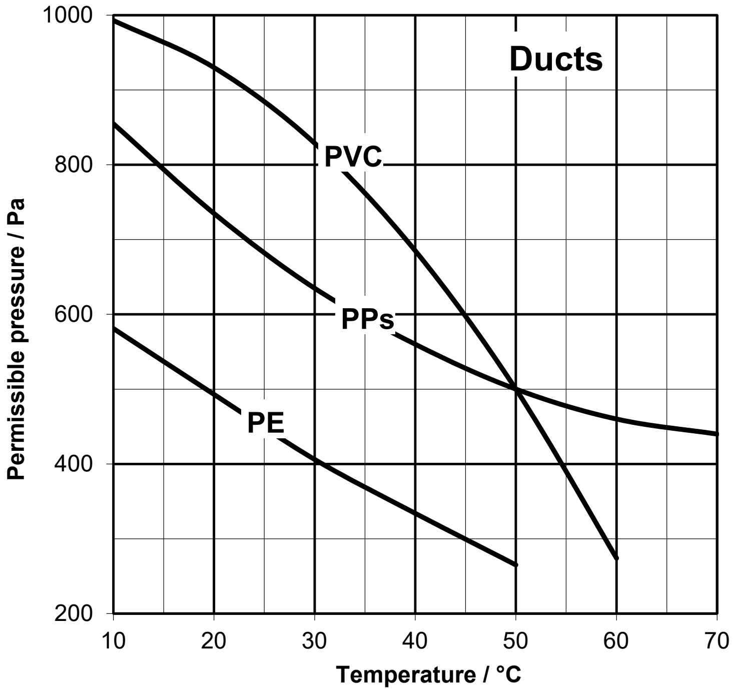
The limitations due to overpressures or underpressures also apply to rectangular components. The components are deformed inwards or outwards; however, this generally has little effect on the functionality.
The following operating conditions apply:

According to the specifications of DIN 4740 and DIN 4741, ducts must be dimensioned so that the maximum deflection of 2% of the largest duct side is not exceeded during a loading period of 10 years at the respective pressures and temperatures.

Although these standards only apply to unstiffened ducts, this 2% requirement is fulfilled by all stiffened ducts and fittings in the MIETZSCH product range.
The limiting curves given in the diagram apply to standard MIETZSCH ducts complying with this 2% requirement.

At higher pressures, either the wall thicknesses are increased or additional stiffening is used.

Rectangular components can be used at 2x higher pressures without the risk of them rupturing. In this case, the deformations may be twice as high (i.e. 4%).



RESISTANCE TO CHEMICALS

All ventilation components are made of high-quality plastics and are thus characterised by excellent resistance to many chemicals. Special components, such as screws, etc., that may come into contact with the flowing medium are either made of high-quality stainless steel or are protected by covers.

Nevertheless, every plastic is susceptible to attack by certain chemicals. Owing to its loose structure, such chemicals can penetrate the material and thus cause swelling, a mass increase, discolouration and decomposition. The physical properties deteriorate, the service life is reduced and/or the material can be destroyed.
Destruction of the material depends on the respective plastic and the nature of the corrosive chemical as well as its concentration, temperature, exposure time, mechanical load and residual stresses from processing, etc. It is not possible to make a generalised statement for every type of application.

In many application fields, e.g. in laboratories, chemical stores, agricultural facilities and moisture-laden processes, good experience has been made with "standard materials" such as PVC or PPS, which can generally be used without problems. Critical applications include process engineering fields such as surface finishing, pickling units, process off-gas in microelectronics, etc.

In order to select a suitable material, the intended use of the system and the type of flowing medium must always be stated for queries or when placing an order.

Media containing small amounts of particles can also be conveyed; however, a higher wear rate can be expected.

BEHAVIOUR IN OUTDOOR APPLICATIONS

The properties of most plastics and natural materials are changed to differing degrees by extended exposure to various weathering conditions.
Thermoplastics change their colour and mechanical properties, particularly as a result of UV radiation in sunlight in combination with atmospheric oxygen.
The UV stability can be greatly improved by adding light stabilisers such as carbon black.

Although flame-retardant polypropylene **PPs** was not originally designed by the manufacturer for outdoor applications, it has a good track record for multi-year outdoor use.
The grey pigmentation of the material provides good resistance to UV radiation. The plastic does not exhibit low-temperature embrittlement that would affect the functionality.
In practice, the components used in ventilation systems are generally subjected to only low mechanical loads so that a reduction in the mechanical properties is not important.
Likewise, any discolouration (bleaching) does not affect the functional performance.

Although **PVC** has a good to very good weathering resistance, its thermal stability is lower than that of PPs, PE and PVDF. Under intense and long-term exposure to sunlight, even low mechanical loads can cause severe deformations that may even affect the functional performance. Furthermore, the use of PVC is often ruled out for fire protection reasons (although unjustified).

PE (black) has excellent weathering resistance. In practical applications, its lower strength may make it slightly more expensive than PVC or PPs. It is used preferentially in systems with a high chemical load and in cases in which high reliability and durability are required.
The disadvantage of PE is that it has only normal flammability (Class B2 of DIN 4102).

PVDF has very good weathering resistance, but is only used in special cases because it is very expensive.

Unpigmented PP and PE undergo severe embrittlement and are thus unsuitable for outdoor applications.
We must strongly advise against its use in outdoor applications, even if the mechanical load is very low.

UNDERGROUND INSTALLATION

Pipes and fittings can also be installed underground, but they must be specially designed for such applications. The external load due to the active earth pressure and possible surface loads and live loads must also be taken into account when dimensioning.

Circular standard fittings and duct components are not suitable for underground installation.

EXPLOSION PROTECTION

Explosion hazard areas are found in the chemical industry, gasworks, coking plants, painting facilities, fuelling stations, sewage treatment plants, and laboratories, etc.

Requirements for an explosion are
flammable substance (e.g. gas, dust)
sufficient oxygen (air)
source of ignition (sparks, fire, hot surfaces, electrostatic discharge)

The following measures must be implemented in areas with a potential explosion hazard:
an explosive atmosphere is prevented from developing
no sources of ignition
measures to weaken the deleterious effects of an explosion

In many cases, an efficient and monitored ventilation system is sufficient to prevent the formation of an ignitable atmosphere and thus an explosion hazard.

There are three types of explosion hazard zone (ATEX zones):

Explosion hazard	Hazard zone	Avoidance of ignition sources	ATEX classification
continuous or long-term	Zone 0	even for operating disturbances that are very unlikely to occur	1
occasional	Zone 1	also for operating disturbances that are likely to occur frequently	2
only rarely and briefly	Zone 2	during routine operation	3

Which explosion hazard zone is present and the additional requirements to be observed is the **responsibility of the system operator** or the relevant supervisory authority. This means that the customer's order must specify how the system is to be designed.
Applications in Zone 0 are not possible as a matter of principle.

According to Directive 2014/34/EU (ATEX), components such as pipelines and pipeline fittings as well as auxiliary equipment, such as dampers and gate valves, do not represent a source of ignition and thus cannot cause explosions.
Plastics cannot generate sparks and are thus suitable for explosion hazard areas. Their disadvantage is possible electrostatic charging generated by friction or by gases containing particles and which cannot be discharged owing to the high surface resistance. The corresponding discharges may generate sparks that can ignite an explosive gas.

Conductive plastics must be used for machines (e.g. fans) in ATEX Zone 1. These plastics contain additives that reduce the surface resistance to less than 10^9 ohm, thus preventing the development of dangerous electrostatic charges.

If the system operator requires a ventilation system that complies with such stringent requirements, the components to be used in ATEX Zone 1 (*occasional explosion hazard*) would have to be made of a conductive plastic. However, this is associated with a considerable increase in costs 1) . Therefore, it is always necessary to determine the system's explosion hazard zone classification in consultation with the system operator and the supervisory authority and, in the case of ATEX Zone 1, whether the system must be made of an electrically conductive material.

Application of an external conductive layer (as a conductive coating or wrapped with a metallic tape) does not dissipate charges that form inside the pipe. Earthing the pipe with conductive collars at regular intervals is also not a solution because the high surface resistance prevents the charge flowing to these earthing points.

For systems in ATEX Zone 2, normal thermoplastics can be used in all cases.

1) Conductive PPsX is about 4x more expensive than standard PPs.