



Thermal Properties

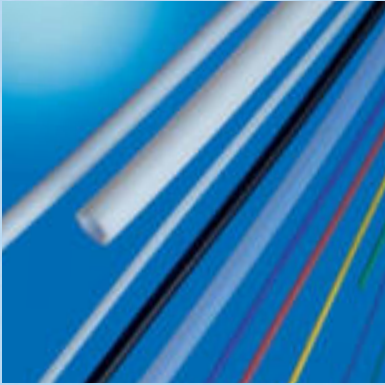
Thermal loadability

- The thermal loadability of PTFE ranges from -260°C to $+300^{\circ}\text{C}$ (e.g. no brittling in boiling helium at -269°C)
- This temperature range is not achieved by any other commercially available plastic material. The permanent service temperatures, however, depend on the respective load and stress factors
- In concrete terms this means that PTFE in case of moderate mechanical stress can be used at temperatures ranging between -200°C to $+260^{\circ}\text{C}$

Physiological Properties

- Unfilled PTFE is physiologically neutral
- PTFE conforms to the requirements of the U.S. Food & Drug Administration (FDA) and therefore be used with components coming into contact with food-stuffs
- A very positive factor in this context is the material's resistance to hot vapor which means that PTFE parts are very suitable for sterilization in medical or food applications
- Conformity certifications for various pigmented tubes are available

PTFE Tubings



Paste-Extruded Tubings Made from the Fluoro-Plastic, PTFE

Thanks to its exceptional chemical, thermal and dielectric properties, PTFE ranks at the top of the list of fluoro-plastic materials.

These properties enable manifold problem solutions in the chemical, electrical and medical sectors. Due to the stable combination of fluorine and carbon atoms and the nearly complete shielding of the carbon chain by the fluorine atoms PTFE has nearly universal chemical resistance. This property is attributable to the material's molecular structure. The straight carbon chain is completely covered with a layer of fluorine atoms.

Chemical reactions between PTFE and other substances are limited to a few exceptions: alkali metals in melted or dissolved form attack the polymerizate, causing a brown discoloration. Also, elementary fluorine and chlorinetrifluoride effects PTFE at higher temperatures and pressures.

For some years, paste compounds have been used increasingly as well. The most common compounds are PTFE-carbon, PTFE-glass, PTFE-bronze and PTFE-graphite.

Pure-white material will continue to be used wherever the PTFE's outstanding chemical and thermal resistance and adhesive properties are required. Glass-filled material is preferably used when wear resistance, which is required with industrial applications in particular,

should be increased. Carbon and graphite improve the thermal conductivity of the tube in addition to some mechanical properties.

By adding bronze as a filler the creep tendency of the base material can be reduced. A filler which has been gaining continuously increasing importance is bismuth-carbonate, which is primarily suitable for medical applications. This enables tubes used in endoscopic surgery to be made visible on respective fluoroscopic monitors during surgical procedures.

The aforementioned properties are key factors contributing to the continuously increasing utilization of PTFE tubings in the chemical, electrical and mechanical industries, but also in medical technology. Standard tube dimensions range from 0.3 x 0.8 mm to 24 x 26 mm and above.

Typical Application Examples

Chemical Industry

- For analytical and measuring equipment in chromatography and lab technology as well for lining measuring sensors in chemical process technology
- For transportation of food products, oils, resins and paints
- For transportation of aggressive media such as acids, alkaline solutions, gases and solvents

Plant and Machinery, e.g. Painting Lines

- In spray-painting lines in which pressure-proofed tubes and tubes are used

Electrical Industry

- Insulation of high voltage cables
- Lining of electrical heating elements as protective sheathing for electroplating and micro-electronics

Medical Technology

- Cannulas
- Catheters
- Pipettes
- Endoscopes

PTFE is physiologically harmless, non-toxic and can be used in medical applications. Even a respective pre-treatment of the surface using a plasma- or wet-chemical etching process will not substantially impair the tube properties. This special additional treatment is required whenever PTFE surfaces are supposed to be bonded with accessory parts, such as ceramic tips.

Mechanical Applications

The lower friction coefficient of PTFE enables bowden cables to be lined for example. In view of the high ambient temperatures in the engine

compartment and due to stricter emission standards, automotive applications have been gaining increasing importance.

Liquid Chromatography

Ultra-pure PTFE tubes without aromates which interfere with analytical processes.

Stock Dimensions of PTFE Tubings

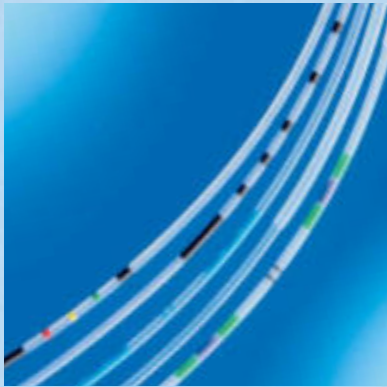
Type HN 1331, Virginal PTFE,

Tolerance According to GKV Guideline

ID mm	OD mm	Part No.
0.30	1.75	062.693
0.50	2.00	062.782
0.60	1.10	062.804
0.70	2.00	062.698
0.90	1.50	062.936
1.00	1.50	062.979
1.00	1.60	063.002
1.00	1.80	063.010
1.00	2.00	063.096
1.00	3.00	063.177
1.15	1.75	063.231
1.40	2.20	063.320
1.50	2.50	063.452
1.50	3.00	063.460
2.00	3.00	063.525
2.00	4.00	063.541
2.50	4.00	063.835
2.50	4.50	063.843
2.70	3.20	063.878
2.70	3.50	066.125
3.00	3.90	064.106
3.00	5.00	064.203
4.00	5.00	064.262
4.00	6.00	064.270
4.50	6.00	216.801
5.00	6.00	064.327
5.00	7.00	064.335
6.00	7.00	064.378
6.00	8.00	064.386
7.00	8.00	064.424
8.00	9.00	386.073
8.00	10.00	064.467
9.00	11.00	064.483
9.00	12.00	224.480
10.00	12.00	064.491
14.00	16.00	064.556

Tools are available for numerous additional dimensions. Please let us know your requirements.

Special Version for Medical Technology – Flexible Endoscopy



**Color-Coded Tubes,
with X-ray Contrast Capability**

Application

- ERCP catheter, papillotomes in the field of polypectomy, lithoscopy or as a sclerosing needle
- UV-resistant
- Optimum visual detectability of intra-corporeal positioning
- Suitable for autoclaving and ETO sterilization
- High abrasion resistance

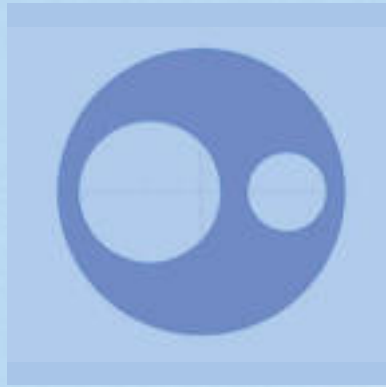
For X-ray applications, the PTFE matrix can be changed by means of contrast-capable additives, such as bismuth-carbonate, so as to ensure visual detectability of the tube.

Bio-Compatibility

In view of the stringent requirements, certain tube materials have been tested using the basic cytotoxicity test. Approval by a GLP-certified institute has been granted for:

- HS 10008 • HS 17006
- HS 11004 • HS 11007

as well as for other ElringKlinger-specific material combinations.



Tube, 2 Lumens

Application

Fibrin-gluing-needle

- 1 lumen for glue
- 1 lumen for hardener (gluing of intra-corporeal “fissures”)

Catheter for gall stone extraction/surgery in the bile duct with X-ray marking if needed

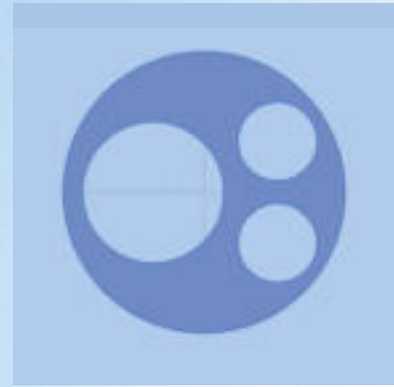
- 1 channel has a dual function for a cutting wire/guiding wire
- 1 channel for contrast agent

Stone-retrieving basket

- 1 channel for wire basket
- 1 channel for guiding wire

Feeder channels for electricity conductors

- Into each channel a wire is inserted for intra-corporeal coagulation

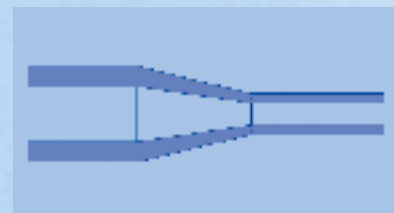


Tube, 3 Lumens

Application

Catheter for gall stone extraction/surgery in the bile duct with X-ray marking if needed. Optimized endoscopic solution compared to 2 lumens

- Each “extraction agent” has its own service channel



Tapered Tube

Particularly in bronchoscopy, tapered tubes are being used increasingly because they enable deeper penetration of damaged areas. This means that in case of severe stenosis, the passage of instruments in the respiratory tract is facilitated for more targeted treatment of tumors or lymphomas which may be present.

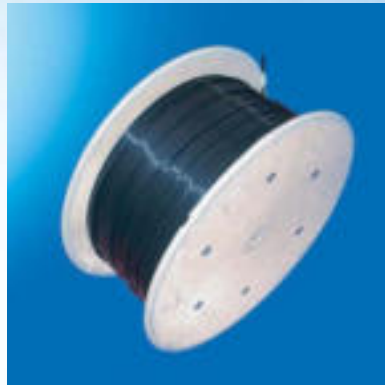


Special Solutions



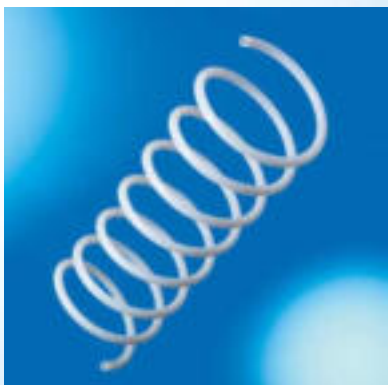
Tube Module

for de-gassing of liquids in liquid chromatography equipment.



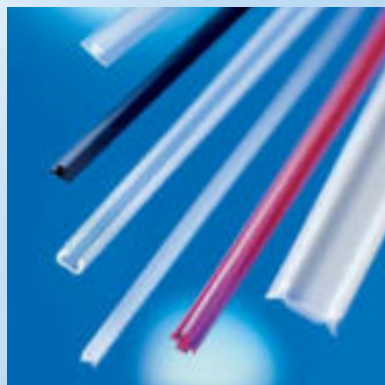
PTFE Tubes as Continuous Material

For custom cable packaging in the electrical engineering industry, PTFE tubes can also be manufactured cut to size according to customer specifications.



Spiral Tubes

for chemical process engineering.



Profiles

In different geometries and dimensions.

Examples of Profile Cross-Sections



Technical Details

Diameter and Wall Thickness Tolerances for Paste-Extruded PTFE Tubes, Type HN 1331 According to GKV Guideline ⁽¹⁾

Smaller functional tolerances available after prior coordination.

Inner Diameter (mm)	Tolerance (mm)
3 to 5	± 0.2
above 5 to 7	± 0.25
above 7 to 10	± 0.3
above 10 to 15	± 0.35
above 15 to 20	± 0.4

Wall Thickness (mm)	Tolerance (mm)
0.1 to 0.3	± 0.05
above 0.3 to 0.6	± 0.1
above 0.6 to 1.0	± 0.15
above 1.0 to 2.0	± 0.2
above 2.0 to 4.0	± 0.4
above 4.0 to 6.0	± 0.5

Precision Tubes

In addition to the high-grade standard material, ElringKlinger offer even special versions for particular application. The diameter tolerance and material characteristic can be varied.

PTFE Compounds with Fillers

available on request.

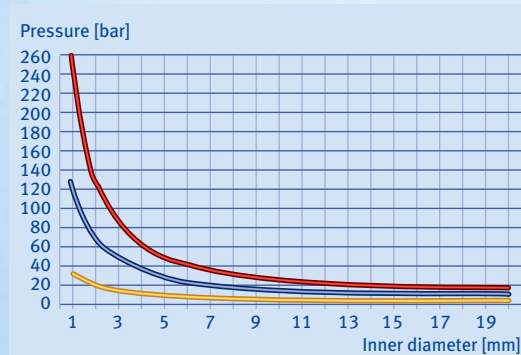
Pigmentation Colors

black	green
brown	blue
red	orange
gray	yellow
white	

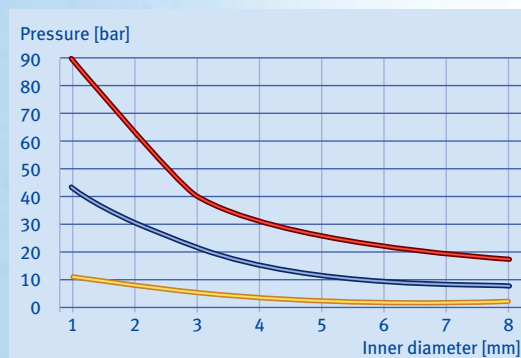
Pressure Resistance of Unfilled PTFE Tubes ⁽²⁾

Pressurization Period: 1min

Wall Thickness, 1 mm



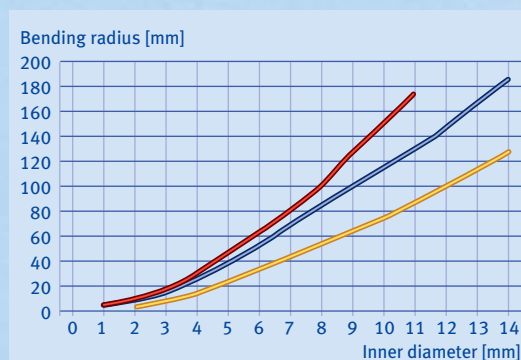
Wall Thickness 0.5 mm



- Bursting pressure at 20°C
- Service pressure at 20°C
- Service pressure at 100°C

In case of critical applications involving the PTFE tubes an additional pressure test up to 35 bar (depending on the particular dimensions) may be performed.

Minimum Bending Radii of Unfilled PTFE Tubes at 23°C ⁽²⁾



- Wall thickness 0.5 mm
- Wall thickness 1.0 mm
- Wall thickness 1.5 mm

