

# The World of Thermoplastic Polyurethane Hoses and Ducting

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## Content:

### TPU – Hoses and Ducting

- **Characteristics of TPU Raw Material**
- **Hose Constructions**
- **Typical Applications for TPU**



# Thermoplastic Polyurethane

- Characteristics of Material -



**What do we know about this material?**

# Thermoplastic Polyurethane

## - Characteristics of Material -

TPU <b>Ester</b> based	TPU <b>Ether</b> based
<ul style="list-style-type: none"> <li>• One of the best material for abrasive applications</li> <li>• Extremely good tensile strength (<i>do the pencil test</i>)</li> <li>• Good temperature resistance: -40°C up to +90°C (+125°C short term)</li> <li>• But: Raw material is much more expensive than many materials, e.g. PVC</li> </ul>	
<ul style="list-style-type: none"> <li>• <del>Abrasion resistance up to 30% better than Ether based TPU</del> <i>not true!</i></li> <li>• Material is less expensive than Ether based TPU</li> </ul>	<ul style="list-style-type: none"> <li>• Microbe resistance</li> <li>• Hydrolysis resistance</li> <li>• FDA certification</li> </ul>
<ul style="list-style-type: none"> <li>• <b>both materials are available in / with:</b> <ul style="list-style-type: none"> <li>• in standard wall thickness: 0,4mm 0,6mm 0,8mm 1,0mm 1,2mm 1,5mm 1,7mm</li> <li>• different shore hardness (standard: Shore 85°A)</li> <li>• flame retardant (optional) – according to DIN 4102 B1</li> <li>• antistatic or electro conductive (optional)</li> </ul> </li> </ul>	

# Thermoplastic Polyurethane

## - Characteristics of Material -

Progress of microbial degradation of polyester-based TPU



Left: reference sample

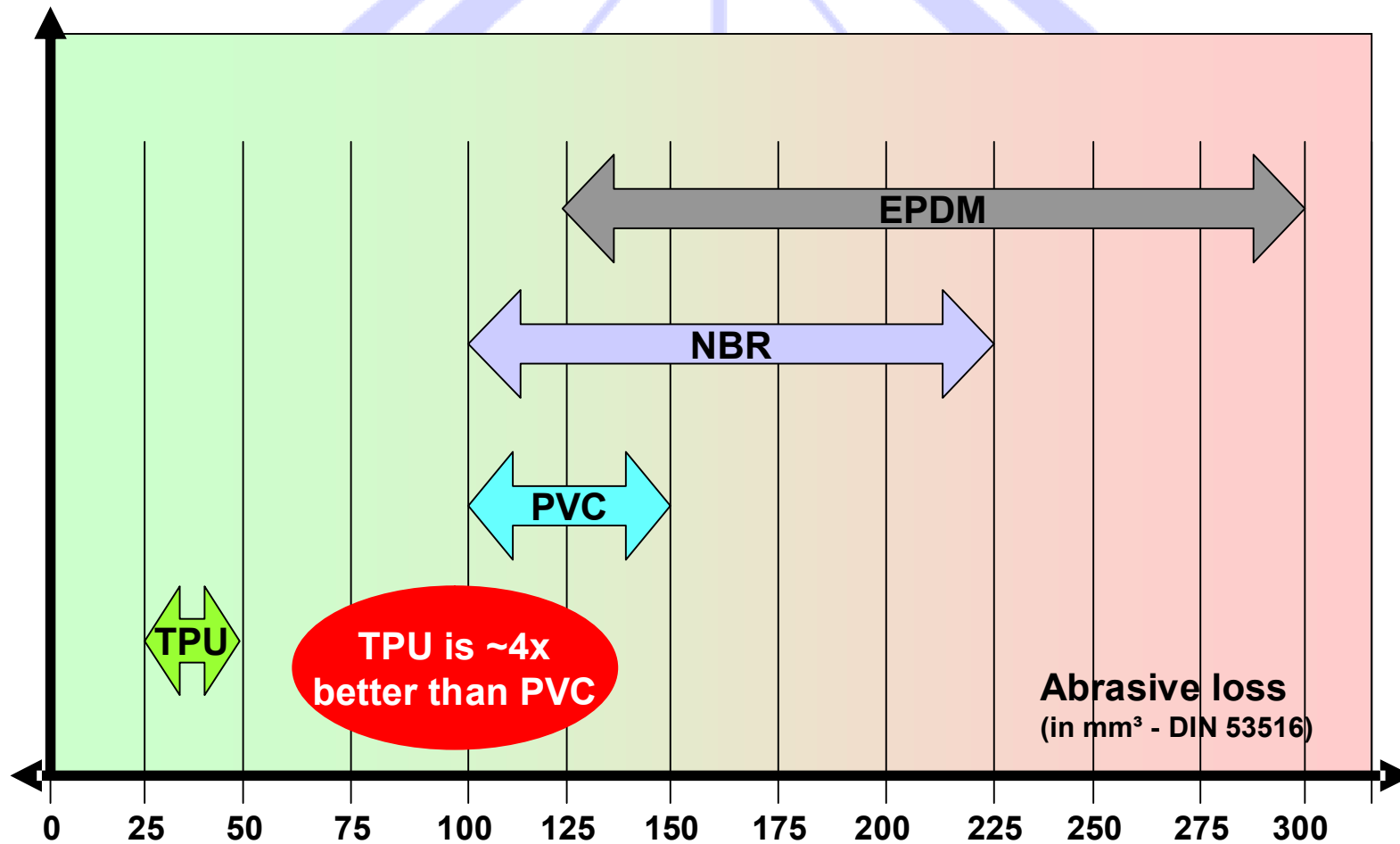
Middle: mild discoloration

Right: discoloration and distinctly visible cracks

**Will not happen with  
Ether based TPU!**

# Thermoplastic Polyurethane

- Characteristics of Material -



# Thermoplastic Polyurethane

## - The truth in the Abrasion Resistance matters -

Abrasion Resistance Testing Methods in comparison (DIN 53516 vs. ASTM D-1044):

**Elastollan® 1185A10**  
Polyether Type

Technical Bulletin

Elastollan® 1185A10 is a polyether-based thermoplastic polyurethane (TPU) with an M<sub>w</sub>-value of 211 (at 100°C/21.5 kg), it is specifically formulated for reduced profile, sheet and film applications. It exhibits excellent abrasion resistance, toughness, transparency, low temperature properties, hydrolytic stability and fungus resistance. Elastollan® 1185A10 is also conforming to the FDA food contact section 175.309 section 175.3500. As with all TPU products, Elastollan® 1185A10 must be dried before processing. The drying step is required to maintain a low moisture content until the product enters the processing equipment. The water content must be less than 0.02% before and during processing. The typical drying conditions should be 2-4 hours @ 170°-195°F (80-90°C). Elastollan® 1185A10 can be stored for up to 1 year in its original container. Containers should be stored in a cool and dry area.

Properties	Test Method	Typical Value	SI
Specific Gravity	ASTM D-702	1.12	1.12
Hardness	Shore A, ASTM D-2240	85A	85A
<b>Mechanical</b>			
Tensile Strength (Elongation)	psi/MPa, ASTM D-115	4300 / 30	30 MPa
Tensile Stress	@100% Elong, ASTM D-115	1700 psi	11.7 MPa
Tensile Strain	@100% Elong, ASTM D-115	1700 psi	11.7 MPa
Elongation at Break	%, ASTM D-115	440%	440%
Tensile Modulus	psi, ASTM D-115	700	700
Compression Set, %	22 hrs @ 210°C, ASTM D-375 (B)	25%	25%
Compression Modulus	psi/MPa, ASTM D-375 (B)	400	400
Flex Modulus	psi/MPa, ASTM D-790	2500	17.2 MPa
Tear Strength	lb/in, ASTM D-521, D-524	500 lb/in	135 N/cm
Impact Absorption (Charpy)	ft-lb/in, ASTM D-2544	29 mg	29 mg
<b>Processing Conditions, Extrusion</b>			
	°F/°C	350 - 400 / 177 - 204	

**30mg**

**BASF**

- Same Material:
- TPU Ether based
- Shore 85 A
- same producer
- Different Testing Methods:
- DIN
- ASTM
- Different Results!

**Conclusion:**  
Abrasion results also depend on the testing methods  
=> only compare figures which are based on the same testing method

**Elastollan® 1185 A 10**  
Thermoplastisches Polyether-Polyurethan, hydrolyse- und mikrobebestandig

Technische Daten

Physikalische Eigenschaften	Methoden	Minim.	Maxim.
Dichte	DIN 53516, DIN 53535	1,12	1,12
Dehnung	MPa	DIN 53516	450
Reißdehnung	%	DIN 53516	450
Spannung bei 20 % Dehnung	MPa	DIN 53516	100
Spannung bei 100 % Dehnung	MPa	DIN 53516	300
Spannung bei 200 % Dehnung	MPa	DIN 53516	400
Wärmeleitfähigkeit	W/mK	DIN 53516	0,25
Artleib	MPa	DIN 53516	70
Druckverformungsmaß bei Raumtemperatur	%	DIN 53516	25
Druckverformungsmaß bei 100 °C	%	DIN 53516	35
Zugfestigkeit nach 42 tägiger Lagerung im Wasser bei 80 °C	MPa	DIN 53516	35
Reißdehnung nach 42 tägiger Lagerung im Wasser bei 80 °C	%	DIN 53516	35
Katzenapfanggerät (Charpy)	ft-lb/in, ASTM D-2544	29 mg	29 mg

**25mm<sup>3</sup>**

**Elastogran**

**BASF**

# Thermoplastic Polyurethane

## - The truth in the Abrasion Resistance matters -

Ether and Ester Abrasion resistance in comparison (according ASTM D-1044):

Technical Bulletin
**Elastollan® C85A10**

Polyester Type

Elastollan® C85A10 is a polyester-based thermoplastic polyurethane (TPU). It exhibits excellent abrasion resistance and toughness, good hydrolytic stability, good flow, oil, fuel, and solvent resistance. As with all TPU products, Elastollan® C85A10 may be used only before processing. The extruder must be installed at a low moisture content until the product enters the processing equipment. The water content must be less than 0.01% before and during processing. The typical drying conditions should be 2-4 hours @ 175°-190°F (80°-90°C). Elastollan® C85A10 can be stored for up to 1 year in its original container. Containers should be stored in a cool and dry area.

Properties	Test Method	Typical Values		
		Eng/US	SI	
Physical	Specific Gravity	ASTM D-1555	1.18	1.18
	Modulus	ASTM D-2573	60A	35A
Mechanical	Tensile Strength (Ultimate)	ASTM D-112	3850 psi	26 MPa
	Tensile Stress	ASTM D-112	3850 psi	26 MPa
	Tensile Stress at Break	ASTM D-112	1090 psi	7.5 MPa
	Elongation at Break	ASTM D-112	620%	620%
	Tensile Set at Break	ASTM D-112	35%	35%
	Compression Set, %	ASTM D-112	20%	20%
	Compression Set, %	ASTM D-112	20%	20%
	Tear Strength	ASTM D-112	25 lb/in	25 MPa
	Tuber Abrasion Resistance / mg loss	ASTM D-112	25 mg	25 mg
	Thermal			
Heat Resistant Point	ASTM D-112	233°F	112°C	
Processing Conditions, Extrusion				
Processing Conditions, Molding				

**BASF**

Ester based Material

Materials with same  
- shore hardness  
- same producer

Testing Method  
acc. ASTM D-1044

Result: 20% difference

**Conclusion:**  
Ester material seems  
to be better than  
Ether based material!

(typical market view)

Technical Bulletin
**Elastollan® 1185A10**

Polyether Type

Elastollan® 1185A10 is a polyether-based thermoplastic polyurethane (TPU) with an MF value of <math>\ge 20</math> and 190-D (21.0 ag). It is specifically formulated for extruded profile, sheet and film applications. It exhibits excellent abrasion resistance, toughness, low temperature, low heat resistance to organic liquids, hydrolytic stability and fungus resistance. Elastollan® 1185A10 is also conforming to the -18 bond contact section, break 21, Section 17, 21 (B). As with all TPU products, Elastollan® 1185A10 must be dried before processing. The drying step is required to maintain a low moisture content until the product enters the processing equipment. The water content must be less than 0.02% before and during processing. The typical drying conditions should be 2-4 hours @ 175°-190°F (80°-90°C). Elastollan® 1185A10 can be stored for up to 1 year in its original container. Containers should be stored in a cool and dry area.

Properties	Test Method	Typical Values		
		English	SI	
Physical	Specific Gravity	ASTM D-792	1.12	1.12
	Modulus	ASTM D-2573	60A	35A
Mechanical	Tensile Strength (Ultimate)	ASTM D-112	3850 psi	26 MPa
	Tensile Stress	ASTM D-112	3850 psi	26 MPa
	Tensile Stress at Break	ASTM D-112	1750 psi	12 MPa
	Elongation at Break	ASTM D-112	640%	640%
	Tensile Set at Break	ASTM D-112	70%	70%
	Compression Set, %	ASTM D-112	20%	20%
	Compression Set, %	ASTM D-112	20%	20%
	Tear Strength	ASTM D-112	20.7 lb/in	20.7 MPa
	Tuber Abrasion Resistance / mg loss	ASTM D-112	30 mg	30 mg
	Processing Conditions, Extrusion			

**BASF**

Ether based Material



# Thermoplastic Polyurethane

## - The truth in the Abrasion Resistance matters -

Ether and Ester Abrasion resistance in comparison (according DIN 53516):

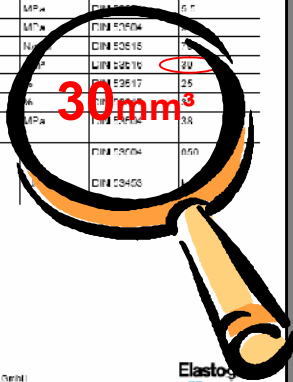
**Elastollan® C 85 A 10**  
Thermoplastisches Polyester-Polyurethan

Technische Daten

Physikalische Eigenschaften	Maßeinheit	Norm	Wert
Härte	Shore A	DIN 53506	87
	Shore D	DIN 53506	38
Dichte	g/cm³	DIN 53470	1,19
Zugfestigkeit	MPa	DIN 53504	60
Reißdehnung	%	DIN 53504	650
Spannung bei 20 % Dehnung	MPa	DIN 53504	3
Spannung bei 100 % Dehnung	MPa	DIN 53504	5,7
Stammung bei 100 % Dehnung	MPa	DIN 53504	7
Weiterzugsvermögen	%	DIN 53516	20
Druck	MPa	DIN 53516	20
Druckverformungsgrad bei Raumtemperatur	%	DIN 53517	25
Druckverformungsgrad bei 70 °C	%	DIN 53517	35
7-tägige Quillung nach 28-tägiger Lagerung in Wasser bei 80 °C	MPa	DIN 53517	35
Reißfestigkeit nach 21-tägiger Lagerung in Wasser bei 80 °C	MPa	DIN 53504	650
Korrosionsbeständigkeit (Cl <sup>-</sup> Ionen)	- 20°C - 30°C	DIN 53403	

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**Ester based Material**

**Elastollan® 1185 A 10**  
Thermoplastisches Polyether-Polyurethan, hydrolyse- und mikrobenbeständig

Technische Daten

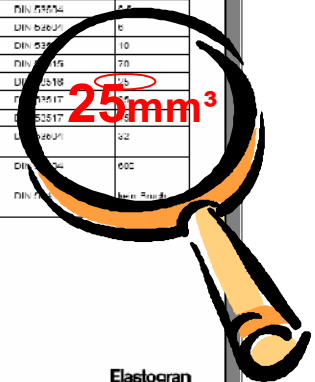
Physikalische Eigenschaften	Maßeinheit	Norm	Wert
Härte	Shore A	DIN 53506	87
	Shore D	DIN 53506	38
Dichte	g/cm³	DIN 53470	1,12
Zugfestigkeit	MPa	DIN 53504	16
Reißdehnung	%	DIN 53504	600
Spannung bei 20 % Dehnung	MPa	DIN 53504	3,3
Spannung bei 100 % Dehnung	MPa	DIN 53504	6
Spannung bei 300 % Dehnung	MPa	DIN 53504	10
Weiterzugsvermögen	%	DIN 53516	70
Druck	MPa	DIN 53516	10
Druckverformungsgrad bei Raumtemperatur	%	DIN 53517	25
Druckverformungsgrad bei 70 °C	%	DIN 53517	35
Zugfestigkeit nach 12-tägiger Lagerung in Wasser bei 80 °C	MPa	DIN 53504	62
Reißdehnung nach 42-tägiger Lagerung in Wasser bei 80 °C	%	DIN 53504	600
Korrosionsbeständigkeit (Cl <sup>-</sup> Ionen)	+ 20°C - 30°C	DIN 53403	best. Resist.

Die aufgeführten Werte sind Richtwerte. Aktualisierung August 2002.

Bei Fragen zum Einsatz in medizintechnischen, Lebensmittel- und Pharmaanwendungen kontaktieren Sie bitte den zuständigen Fachbereich.

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BASF Gruppe



**Ether based Material**

Materials with same  
- shore hardness  
- same producer

Testing Method  
acc. DIN 53516

Result: 20% difference

**Conclusion:**  
**Here Ether material is better than Ester material!**

**(not expected!)**

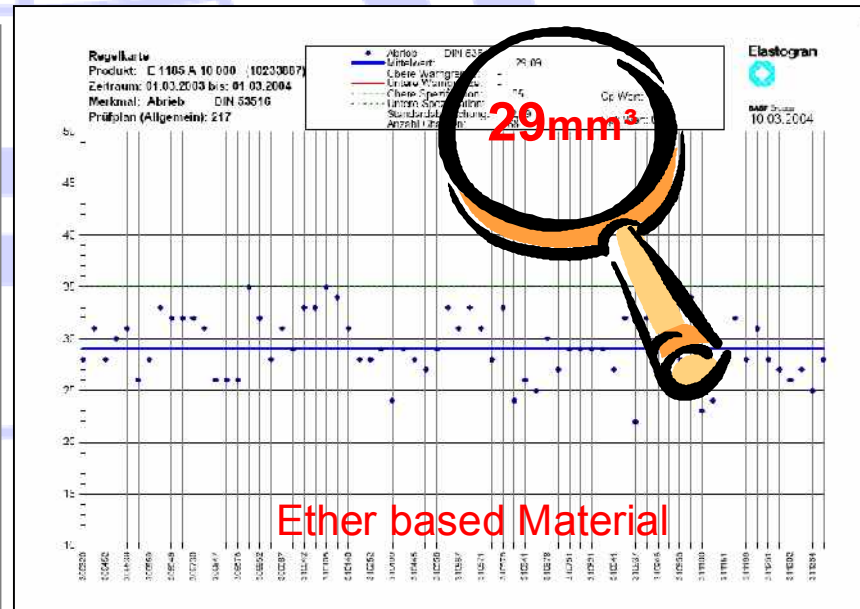
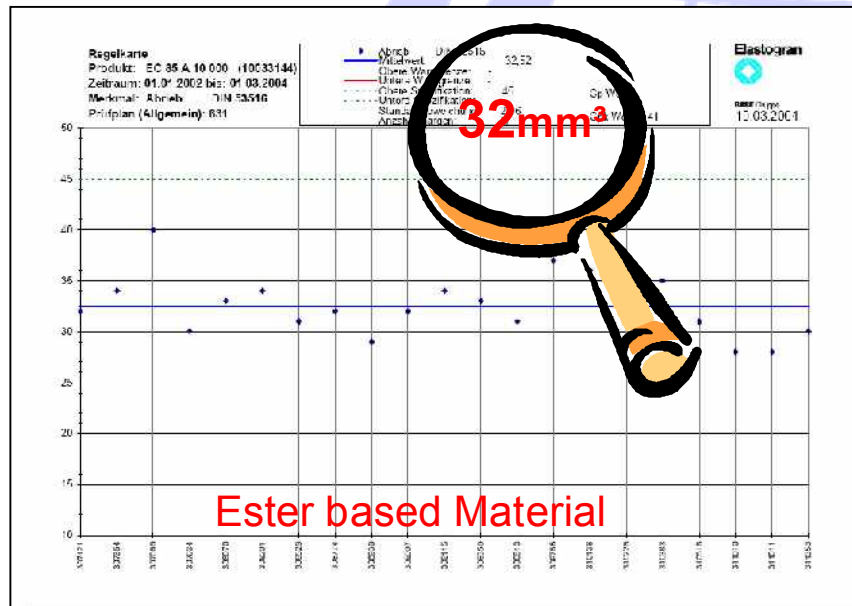
# Thermoplastic Polyurethane

## - The truth in the Abrasion Resistance matters -

Production lots regarding Abrasion resistance in comparison (according DIN 53516):

**Ester** based Material

**Ether** based Material



These internal production control cards (done by raw material supplier – internal information) show that there is a high variety of results which differs from production lot to production lot.

**Conclusion:** in general you can't say Ester is better than Ether or the other way round!

# Thermoplastic Polyurethane

## - The truth in the Abrasion Resistance matters -

Abrasion resistance regarding the shore hardness in comparison:

**Elastollan<sup>®</sup> 1179A10W**  
Polyether Type

Shore 75A

**25mg**

**BASF**

**Elastollan<sup>®</sup> 1185A10**  
Polyether Type

Shore 85A

**30mg**

**BASF**

**Elastollan<sup>®</sup> C95A10**  
Polyether Type

Shore 95A

**35mg**

**BASF**

But we can say that the abrasion resistance is better the softer the TPU material is

**Please note:** our standard is Shore 85 A; most of the **Italian manufacturers** are mainly using Shore 95A (which is cheaper, if same volume of raw material has been ordered)



# Thermoplastic Polyurethane

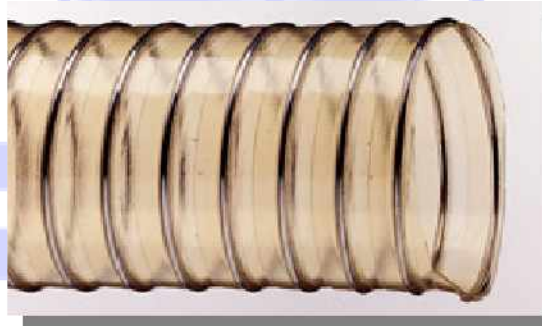
## - Characteristics of different Hose Constructions -

Type: K1H-PU



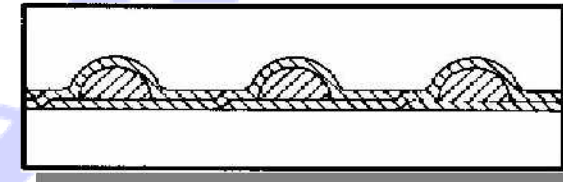
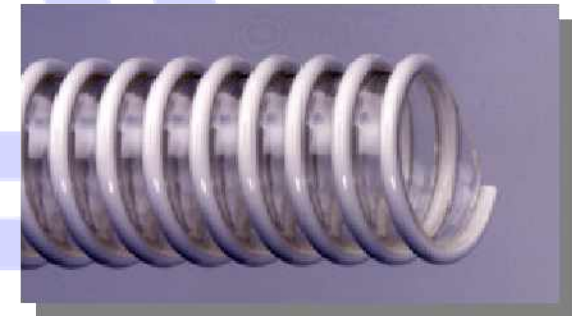
- highly flexible
- double protected for outside abrasion

Type: K1Z-PU



- flexible and smooth
- protected for internal abrasion

Type: Serie 3 PU



- extremely smooth inside
- protected for internal abrasion

**=> each type can be produced in TPU based on Ester or Ether**

# Thermoplastic Polyurethane

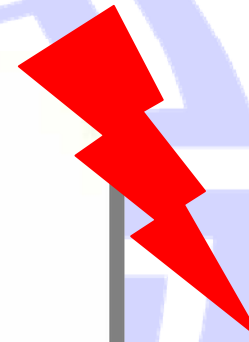
- Characteristics of different Hose Constructions -

## Why Spiral Hoses?

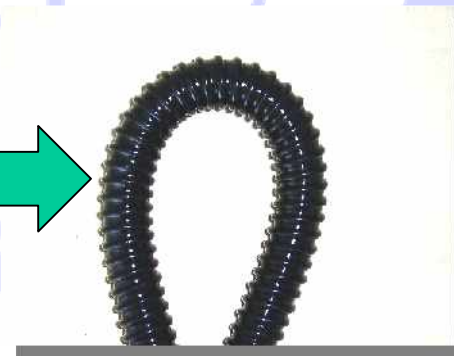
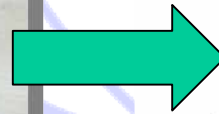
Straight (Plain)  
Extruded  
Hose



Risk of  
Collapsing  
(Buckling)



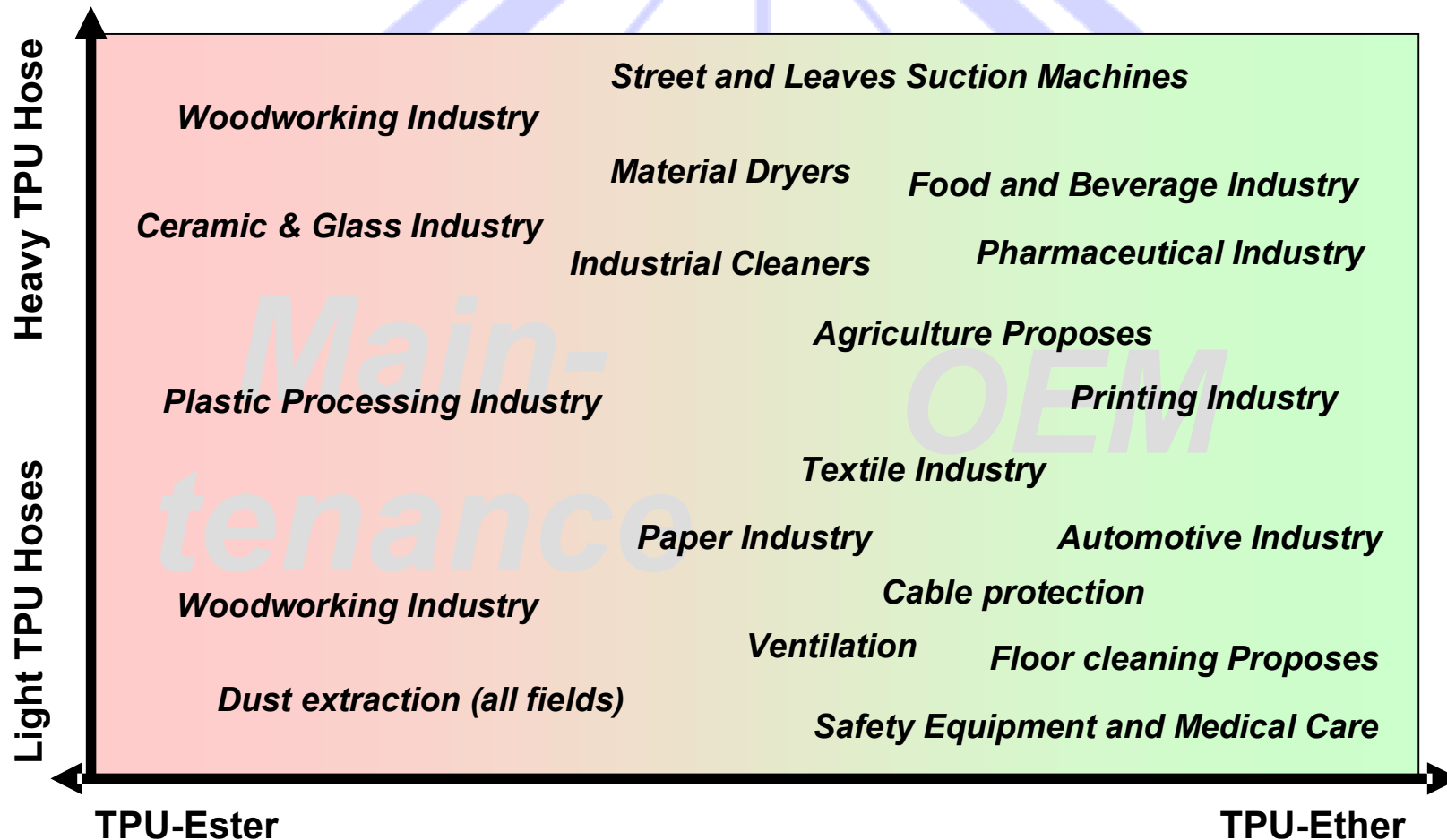
Spiral  
Hose  
(hard/soft  
combination)



No Collapsing  
also with  
small bending  
radius and/or  
higher temperature

# Thermoplastic Polyurethane

## - Applications -



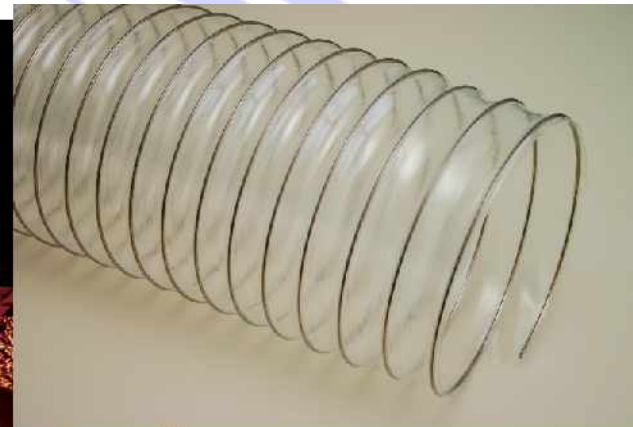
# Thermoplastic Polyurethane

## - Additional Features -

- **Special fix length's (pre-cut)**
- **Compressed packaging (for 0,4mm hoses in foil or net)**
- **Customer's name, part no. or other information can be printed on the hose**
- **Special colors (also translucent color) possible**
- **White or bronze colored helix**
- **Special construction (wider or smaller pitch etc.)**
- **Standard Cuffs (directly over-molded or screwed/glued on)**
- **Customized Cuffs (over-molded)**



# Product Developments

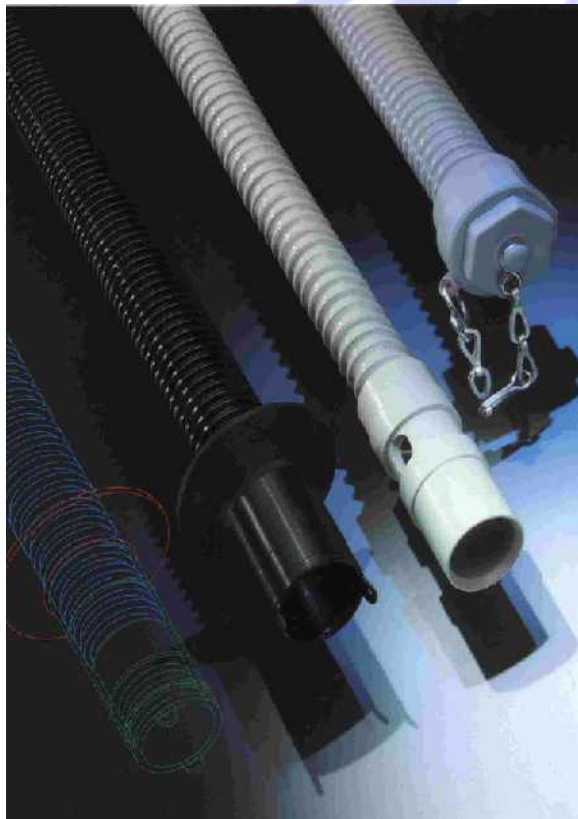


## High Temperature TPU Hoses

Temp. Resistance  
**up to +150°C**

(but only in TPU Ester  
available)

## Your Link for a Better Solution



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