Technical Annex

PVC AND TPE MATERIAL QUALITY
Sponge Rubber Varieties

Contents:

PVC AND TPE QUALITY

Thermoplastic Elastomers - Elastic like rubber, yet not rubber!

Elastic, supple and flexible - these are the properties typical for rubber, a material known by everybody and part of everyday life in many forms.

Rubber is made from caoutchouc, a natural or synthetic product. Caoutchouc is a viscous plastic material, which is transformed into elastic rubber only by adding polymerizing sub- stances such as sulphur or peroxide and subsequent heating. During this “vulcanization” the thread-like caoutchouc molecules polymerize due to the build-up of chemical bonds between each other. This polymerization is the reason for the product‘s elasticity. The vulcanization can only be reversed by thermal destruction.

The **Thermoplastic Elastomers (TPEs)** show a completely different behaviour. As their name conveys, these materials turn plastic during heating (Greek: thermos = heat), when cooling, however, they revert to elastic behaviour again. In contrast to the **chemical polymerization** of rubber, in this case a **physical polymerization** occurs.

Considering their structure and behaviour, TPEs range between thermoplastics and elastomers. They can be processed as easily as thermoplastics and have the most important properties of rubber. Above all, TPEs are not a risk to the environment. In contrast to rubber, they can simply be recycled and re-processed.

In the mean time, there exists a plurality of TPE qualities for the most various applications such as the food handling industry which must comply with FDA quality standards.

Polyvinyl-Chloride (PVC)

PVC (polyvinyl-chloride) is the most important among all polymers. Its part in the German chlorine production amounts to about one quarter. It has been produced for more than 55 years.

The advantages of PVC are its stability as a material and its extremely good resistance against weather. It does not corrode, is hardly flammable and does not de-polymerize. Yet, the formation of dioxines during combustion is an extreme disadvantage.

Nowadays, PVC is mostly used in construction, medicine (in instruments, not drugs) and packaging. There is a difference made between hard PVC, used in pipes, profiles for windows and borders (ratio of PVC: 77-89%) and soft PVC, which is used in insulation, tubes, floors and edge protection profiles (ratio of PVC: 44-61%).

SPONGE RUBBER VARIETIES

Natural Rubber (NR)

Harvested as latex from the Hevea brasiliensis, polymerized with sulfur.

Temperature range: -40 to +70°C.

Advantages: Good elasticity and mechanical properties (tear and abrasion resistance, notch toughness, elasticity), no remaining deformation after strain, and high resistance to alternating bending.

Disadvantages: Medium~low resistance to oil, weather, and ozone, as well as thermal resistance; flammable.

Ethylene-Propylene-Diene Monomer (EPDM)

Synthetic caoutchouc, terpolymers (EPDM polymerized with sulfur).

Temperature range: -50 to +120°C dry conditions; with water and steam up to 130°C.

Advantages: Excellent weather resistance, as well as to aging, ozone, chemicals, hot water and steam; good resistance to polar fluids such as acetone, methanol etc., outstanding electrical insula tion properties, low steam permeability, good thermal resistance, extremely low brittleness temperature.
Disadvantages: Low resistance to aliphatic and aromatic hydrocarbons (mineral oil, petrol, fuels); flammable.

Polychloroprene (CR)

Synthetic caoutchouc mostly polymerized with metal oxides, not sulfur.
Temperature range: -30 to +90°C, hot water not recommended.
Advantages: Good thermal resistance as well as to aging, weather, ozone, low flammability, high resis tance to alternating bending, medium resistance against oil (higher than NR, lower than nitrile rubber; good mechanical properties and elasticity, but not as good as for NR; small deforma tion remaining.
Disadvantages: According to type of CR-Type, possibility of crystallization due to lasting cold.

Nitrile rubber (NBR)

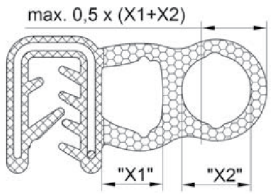
Synthetic caoutchouc, Polyacryl-Nitrile-Butadiene rubber polymerized with sulfur.
Temperature range: -20 to +100°C with dry conditions, hardens with hot air, with oils up to +120°C, with water up to +80°C.
Advantages: High oil, petrol and thermal resistance, good mechanical toughness, low remaining deforma tion under pressure.
Disadvantages: Very low weather and ozone resistance, low elasticity, flammable

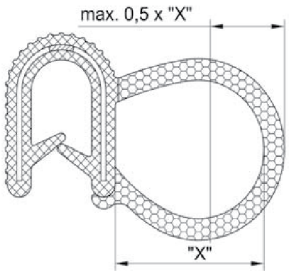
COLOURS

All cell rubber round and square cords are available in Black. (Grey may be available upon request - subject to MOQ's and extended lead-times.)

COMPRESSION RECOMMENDED FOR SEALING EDGE PROTECTION PROFILES

The compression of our sealing edge protection proiles should have a maximum of 50% as otherwise the compact-ness, and the restoring force are affected. In practice, the proile should be compressed 30-40%

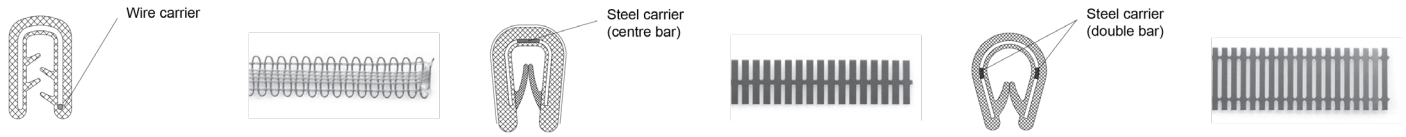




STEEL OR WIRE CARRIER?

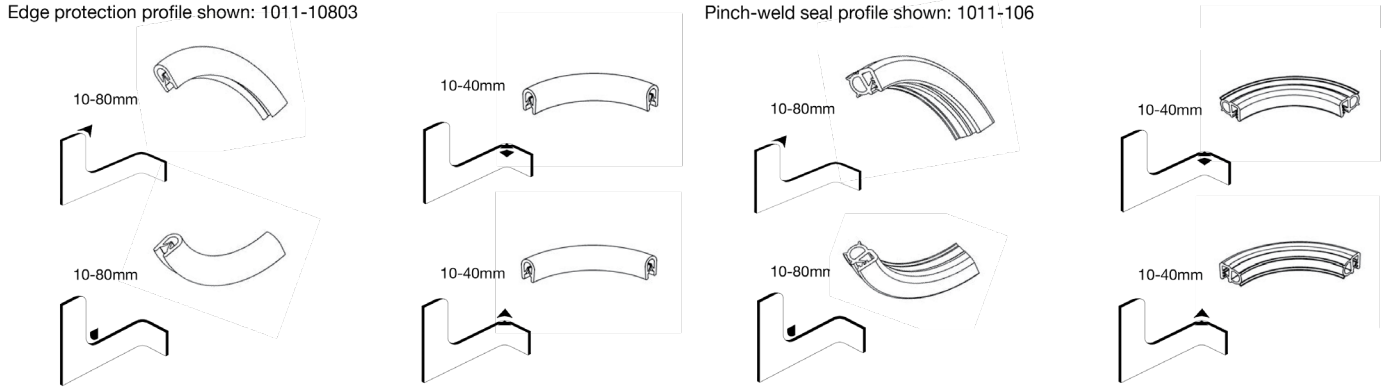
By using either a steel or wire carrier, the edge protection sections will cling well, without the use of splicing tape.
A steel carrier will generally have a slightly higher clamping effect than a wire carrier. However, a wire carrier will gen-erally offer a more pliable bending radius and reduce uneven stands or bulges in application.
The choice of either a steel or wire carrier largely depends on the application situation and the desired appearance.

Most Selectlok pinch-weld seal & edge protection profiles will feature a wire carrier as apposed to a steel carrier.



MINIMUM BENDING RADII

Please note that the minimum bending radii indicated are to be considered as guidelines which, depending on the material, clamping range and application of the profile used, may vary.



SEALING PROFILES

Sealing profiles are a combination of PVC edge protectors with bonded sponge rubber profiles or a co-extrusion of solid and sponge rubber. These profiles have a dual function; they cover sharp or unfinished edges and also offer a sealing function.

The sponge rubber tubes are extremely flexible and are suitable for sealing doors, hatches, and numerous other applications. The assembly is similar to edge protectors.

Manufacturing tolerances:
Soft rubber: DIN ISO 3302-1 E2 | Sponge rubber: DIN ISO 3302-1 E3 | Soft PVC: DIN 16941 3B

APPLICATION FOR THE EDGE PROTECTORS

Edge protection profiles simplify the finishing of edges. They eliminate preparatory and follow-up work, neutralize respectively cover sheet metal edges. Furthermore, their decorative effect is often desired.

The edge protectors consist of a U-shaped metal base, either a steel strip or wire carrier, jacketed with PVC or rubber. Those guarantee a tight grip on the edge, even if radii or bends have to be covered. In some profiles, the clamping effect is heightened by PVC lips incorporated into the PVC jacket.

The edge protectors are pressed onto the edge by hand or with a rubber or thermoplastic hammer. Glues or special attachment aids are not required, installation is simple and quick.

Manufacturing tolerances:
PVC according to DIN 16941

FIRE SAFETY STANDARDS CURRENTLY APPLIED & SPECIAL EPDM COMPOUNDS

FMVSS 302, EG 95/28, ECE-R 118 (General fire safety standard)

Compact rubber: 50° Shore
60° Shore
70° Shore

Sponge rubber: Density 0.4, 0.5, 0.6 & 0.8

DIN 5510-2 (German fire safety standard)

Compact rubber: 60° Shore
70° Shore

Sponge rubber: Density 0.6

NFF 16-101 (French fire safety standard)

Compact rubber: 70° Shore

Sponge rubber: Density 0.6

BS 6853 (British fire safety standard)

Compact rubber: 60° Shore

Uni CEI 11170-3 (Italian fire safety standard)

Compact rubber: 60° Shore

Sponge rubber: Density 0.6

EN 45545 (European fire safety standard)

Compact rubber, Kl. R22/R23 HL3: 60° Shore

Sponge rubber, Kl. R22/R23 HL2: Density 0.8

Compounds according to VDI 6022 (Microbial inertness)

Compact rubber: 50° Shore
60° Shore

Sponge rubber: Density 0.6

Chemical Nomenclature	Natural	Styrol-Butadiene-Rubber (Buna)	Nitrile Rubber (Perbunan)	Chloroprene-Rubber (Neopren)	Ethylene-Propylene-Diene	Fluor-Elastomer (Viton)	Methyl-Silicone Rubber (Silopren)	Poly-Vinyl-Chloride (Vestalit/ Vestolit)
Abbreviation as per ASTM D 1418	NR	SBR	NBR	CR	EPDM	FKM	MQ/MVQ	Soft PVC
Shore A Hardness Durometer (=/+ 5)	40 ~ 90	45 ~ 90	45 ~ 90	40 ~ 90	40 ~ 90	65 ~ 90	30 ~ 80	55 ~ 95
Tensile Strength N/mm^2	4 ~ 15	4 ~ 15	4 ~ 14	5 ~ 15	6 ~ 13	O	O	O
Recoil Eleasticity at 20^{O}C	++	+	O	+	+	O	O	
Abrasion Resistance	++	++	+	+	+	O	O	O
Chemical Resistance (A)	+	+	O	+	++	++	+	++
Oil Resistance (A)	-	-	++	+	-	++	+	+
Petrol Resistance (A)	None	-	+	-	-	++	-	+
Solvent Resistance (A)	-	-	+	+	O	O	+	O
Temperature Stability ^{O}C (C)	-40 ~ +80	-30 ~ +80	-30 ~ +100	-25 ~ +100	-40 ~ +100	-20 ~ +200	-50 ~ +180	-25 ~ +60
Ozone Resistance	O	O	O	++	++	++	++	O
General Weather Resistance	O	+	+	++	++	++	++	+
Gas Impermeability	O	O	+	+	O	O	+	
Resistance to Permanent Deformation	++	+	+	+	+	O	O	O
Adhesion to Metal	++	++	O	+	O	O	O	
Dielectric Properties	++	+	-	O	++			

These indications are merely reference values and of purely informative character

A = In view of the multitude of chemicals, solvents, application temperatures and times, the value quoted may vary in some cases. For example, one type of elastomere which normally shows low resistance properties, might show a very good resist to certain media.
B = At relatively high, resp. low temperatures resistance generally drops.
C = These are borderline values which can vary depending on the composition of the mixture.
++ = Excellent to very good
+ = Good
O = Satisfactory to moderate
- = Low to poor

SPONGE RUBBER - MATERIAL PROPERTIES

Thermal Behaviour							Physical Properties			
Basic Elastomere	Trademark	Lowest application temperature	Highest application temperature				Remaining deformation	Combustion behaviour	Weathering and ozone resistance	Gluing properties
			dry	water	oil	steam				
		° C	°C	°C	°C	°C				
Natural rubber (NR)	Crepe Sheets SMR 5 CV	-40	+80	+70	-	-	++	O	O	++
Ethylene-Propylene-Diene Monomer (EPDM)	Keltan Vistalon Nordel Buna AP	-40	+120	+120	-	+120	+	O	++	O
Polychloropren (CR)	Baypren Neoprene	-25	+100	-	-	-	+	+	+	++
Acryl-Nitrile-Butadien-Rubber (NBR)	Perbunan N	-30	+100	+80	+120	-	+	O	O	+
Styrol-Butadiene-Rubber (SBR)	BUNA EM	-30	+80	+70	-	-	+	O	O	+

Resistance to Fluid Media										
								Organic solutions		
Basic Elastomer	Trademark	Water	Detergents	Acids	Lye solutions	Oils	Petrols	aliphatic hydrocarbons	aromatic hydrocarbons	Kebone
Natural rubber (NR)	Crepe Sheets SMR 5 CV	+	+	O	O	-	-	-	-	O
Ethylene-Propylene-Diene Monomer (EPDM)	Keltan Vistalon Nordel Buna AP	++	+	+	+	-	-	-	-	+
Polychloropren (CR)	Baypren Neoprene	+	+	+	+	O	O	O	-	-
Acryl-Nitrile-Butadien-Rubber (NBR)	Perbunan N	+	+	+	O	+	+	+	O	-
Styrol-Butadiene-Rubber (SBR)	BUNA EM	+	+	+	+	-	-	-	-	O

These indications are merely reference values and of purely informative character

++ =	Excellent to very good	+ =	Good
O =	Satisfactory to moderate	- =	Low to poor

MATERIAL OVERVIEWS

Abbreviation	Operating temperatures	Stability (List of resistance on the folloiwing pages)					Characteristics
		Petroleum Oil	Gasoline	Sulphuric acid (conc.)	Water	Ozone	
Elastomers							
CR	approx. -45 to +100 °C	3	2	3	2	3	Good mechanical properties, weather and ozone resistant. Does not sponta-neously combust.
EPDM EPM	approx. -50 to +150 °C	3	3	1	1	1	Versatile material (sealing). Good stability in hot water, very good aging, weather and ozone resistance.
FPM (FKM)	approx. -20 to +200 °C	1	1	1	1	1	Versatile material, very good oil and chemical resistance, heat resistant
FVMQ Q, MQ MVQ, VMQ	approx. -80 to +175 °C approx. -60 to +180 °C approx. -60 to +200 °C	1 2 2	1 3 3	- 3 3	- 1 2	1 1 1	High thermal resistance, aging, ozone, and weather resistant. Good insulating properties. The material FBMQ also has improved resistance to fuels and oils.
NBR X-NBR (H.NBR)	approx. -30 to +100 °C approx. -25 to +100 °C approx. -30 to +150 °C	1	2	3	1	3	Versatile material. Seals and molded parts with petroleum oil or fuel con-tact. NBR has poor ozone and weather resistance. X-NBR is more wear resistant. H-NBR has improved mechanical properties and is abrasion resistant.
NR	approx. -60 to + 80 °C	3	3	3	2	3	High mechanical stability and elasticity, high resistance to alternating bending, ☒ammable.
SBR	approx. -50 to +100 °C	3	3	2	2	3	Improved abrasion- and aging resistance.Good resistance to brake☒uid.
Thermoplastics							
ABS	approx. -50 to + 70 °C	1	3	1	1	1	High scratch and impact resistance, chemical resistant. Limited colorfastness.
PA	approx. -40 to +100 °C	1	1	3	1	3	Abrasion resistant and durable. High resistance ratings, good emergency running properties.
PVC	approx. -10 to + 60 °C	2	3	3	1	1	Good chemical resistance and mechanical ratings, soft PVC hardens in gasoline and oil, good welding and adhesion properties.

1 = very good resistance, little or no effect (for thermoplastics moisture expansion < 3 % or loss in weight < 0.5 %)
2 = good resistance, low to moderate effect (for thermoplastics: moisture expansion 3 - 8 % or loss in weight 0.5 - 5 %)
3 = not resistant, strong effect to complete destruction (for thermoplastics: moisture expansion 3 - 8 % or loss in weight > 5 %)
= no data available
All values and descriptions are only approximate and are not binding in every application.
No guarantees can be made