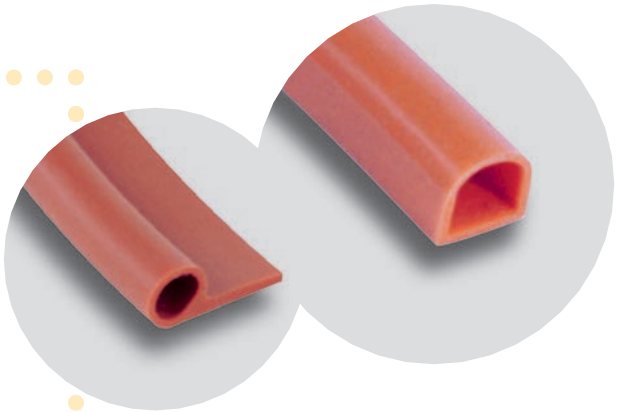
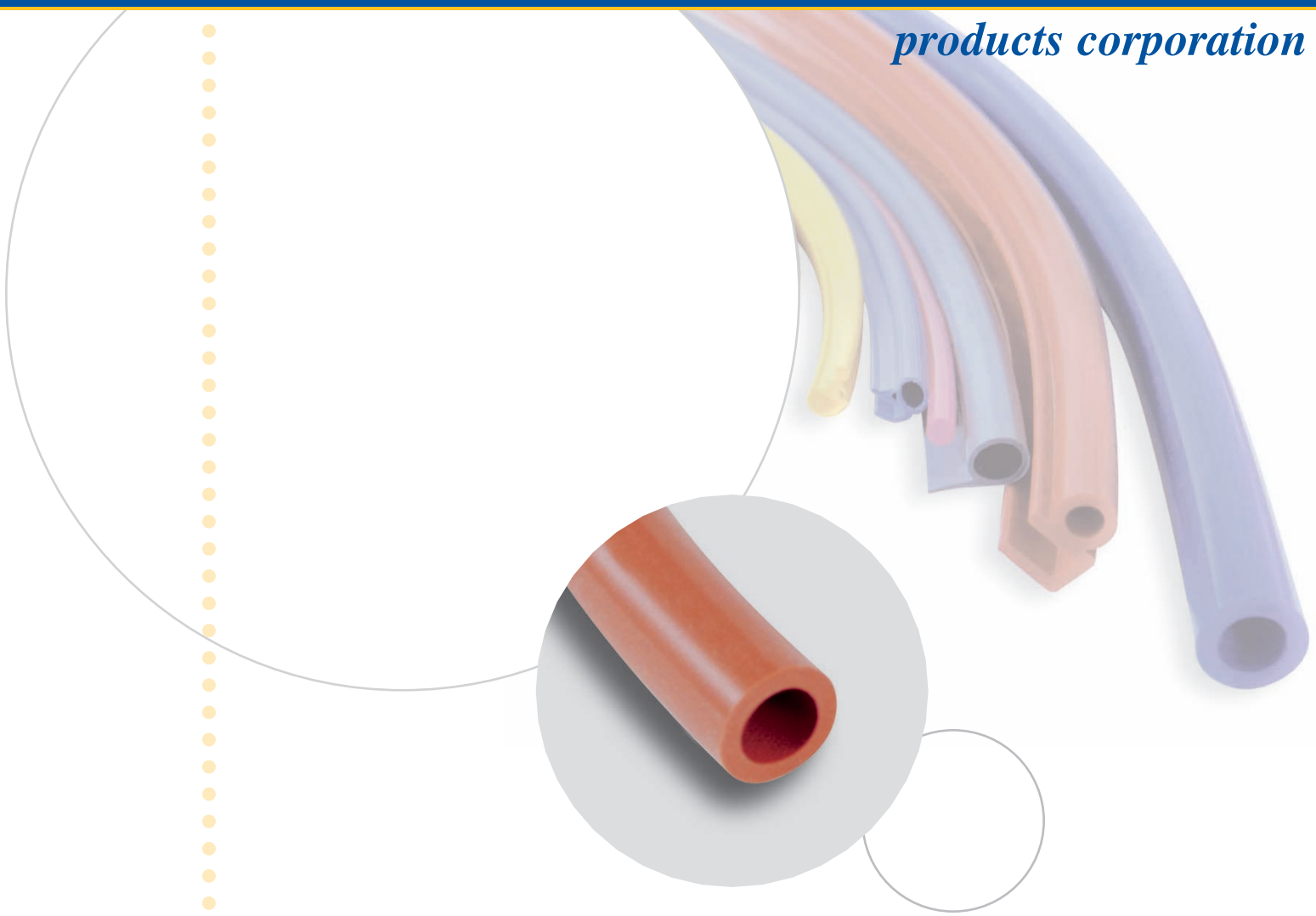


STANDARD and CUSTOM ELASTOMERIC EXTRUSIONS and MOLDED PARTS

V A N G U A R D

products corporation



T U B I N G • S E A L S • G A S K E T S

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Welcome to Vanguard

Vanguard Products Corporation is a full service manufacturing and engineering company providing industry with the highest precision elastomeric fabricated goods available. Offering a full spectrum of extruded rubbery gaskets, seals, and hose, Vanguard now maintains our new standard extrusions product line which is introduced herein. Additionally, we continue to provide our responsive, specialty, custom rubber product design, development and manufacturing services.

Our focus is on engineered high-performance elastomers, such as silicone, fluorosilicone, fluorocarbon (Viton®, Fluorel®, etc.), EPDM, nitrile, conductive, sponge, and many other technical rubbery materials. We begin with in-house custom compound development paying close attention to your individual requirements of physical properties, finished part quality, and cost parameters. If needed, we will design the seal or gasket for you; or, work with your current designs. We then fabricate your extruded or molded article to the most exacting tolerances.

Knowing that our customers' needs are geared frequently towards customization, we offer a full service assembly operation that will finish elastomeric parts into higher order constructions. Our capabilities include precision cutting of extrusions to best industry standards; splicing of o-rings, profile extrusions and mitre-cut frame gaskets; assembly of our gaskets into your device or subassembly; PSA tape application to our gaskets and weatherstripping; customized bagging and packaging; and many others. Challenge us with your need to solve a problem!

With forty plus years of history in the silicones and specialty elastomers arena, Vanguard is your choice for top quality, competitively priced gaskets, seals, hose, and other rubbery fabricated goods. We look forward to providing you with timely, courteous, and competent service with regard to your requirements in elastomers. Our focus is on your evolving needs.

Gasket and Seal Design Basics

With today's manufacturing processes, you can expect highly uniform consistency within a production lot, and from lot-to-lot. To take full advantage of these characteristics, a few simple guidelines should be considered for the continued long-term mechanical effectiveness of your final assembly.

Material Selection
- environmental strengths, limitations
- static or dynamic sealing

Attachment
- groove fit, adhesive, hardware mounting
- compression fit

Cross section profile
- gap sealing (min/max compression) depending on material selected
  - *sponges, foam, hollow shapes @ 10%-30% compression*
  - *dense solid shapes @ 2%-30% compression*
- shape - *exterior perimeter*
  - *interior solid or hollow*

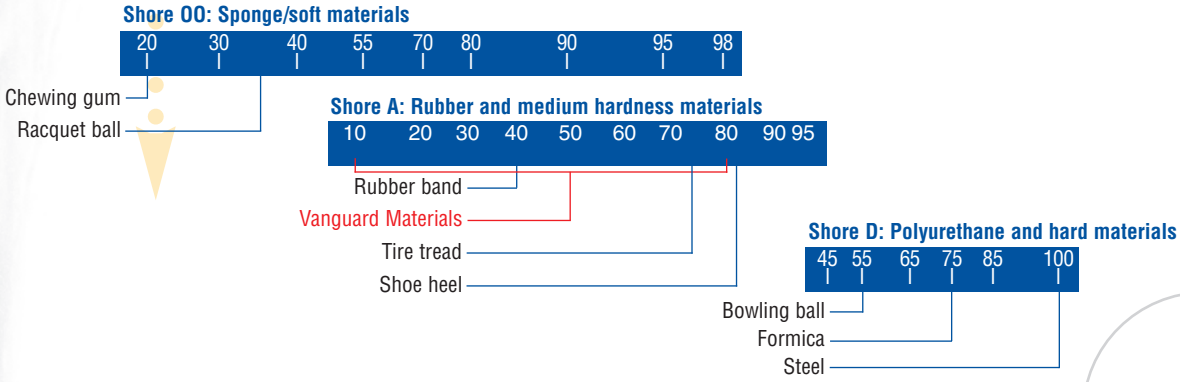
Compression force
- closing force - *durometer low or high (see below)*
  - *solid vs. sponge or foam*
  - *hollow interior to lessen force*
  - *static or dynamic pressure*
- trade offs - *sponges have low closure force; and, dense shapes have higher sealing capability*

Compression set
- allowable percentage of height relaxation
- recovery rate from compressed state to relaxed height

Other
- abrasion resistance
- color matching
- secondary finishing - *holes, notches, die-cutting, etc.*

Durometer

Durometer is the international standard for measuring the hardness of rubber, sponge rubber, plastic and other nonmetallic materials. An indenter probe is pressed into the material and a graduated scale reads the measurement. The harder the material, the greater the reading. Hardened steel is 100 on the scale; most common silicones are between 10 and 80. Different scales allow finer graduated differentiation within the Shore measurement system.



Environmental Factors and Considerations

Gaskets and seals, by their very nature, are critical components. Their function is to “compartmentalize” the environment - keeping something out, or keeping something in a compartment. There are two distinct stages in the life of a gasket or seal: the initial fit and function and, most important, its long-life aging, the ability to withstand the environmental factors acting upon it over time. When proper considerations are followed, the gasket or seal will not be the weakest link among all of the components in a product.

The Material Specifications section, beginning on page 6, describes the strengths and limitations of each material formulation. In any gasket or seal application there are usually two or more critical environmental factors to be addressed.

Temperature extremes - heat, cold
Weather - water, ozone, sunlight (ultraviolet) aging
Chemical compatibility - oils, alkalis, acids
Flammability - UL specifications, heat resistance
Organic materials - fungus resistance, odor, tastelessness
Impermeability - exposure to gases
Biocompatibility - food contact

Seal Types, Static and Dynamic

Each seal (or gasket) can be classified into one of two types with regard to the loading applied to it.

Static Seals

When there is very little or no motion of the mating assembly parts upon the seal, a static condition exists. Usually just an initial compression or periodic (open and close) compressions typify this type of seal; i.e. a liquid seal in a hose joint, a door seal on a home. Design Considerations are rather straightforward.

- When compressed, as with an O-ring or face gasket, pressure acts in essentially a perpendicular direction relative to the face, squeezing it between two opposing surfaces to eliminate gaps.
- Outward expansion results in the parallel direction as a pressure relief, and this profile change needs to be accommodated in the mounting surface design.
- Compression forces need to be assessed. Various design elements can be introduced if too high; i.e., lower durometer, hollow shapes, sponge/foam and/or thin walls.
- Compression set, or the percentage of relaxation of the dimensions versus the original uncompressed dimensions.
- Recommended compression range is 10% - 30%, and no more than 50%.

Dynamic Seals

Where repeated motions act upon the seal as in a circumferential, axial or angular direction, a dynamic condition exists. Repeated actions upon the seal, either regularly or periodic, typify this type of seal; i.e. a piston ring seal or shock absorption mechanism.

Design Considerations are more complex than static seals, primarily resulting from the changing stress levels. In addition to the static seal considerations, the environment may require:

- Abrasion resistance becomes important and is affected by the mating surface finishes.
- Recovery speed after compression to the original released height.
- Compression set, or the percentage of relaxation of the dimensions versus the original uncompressed dimensions.
- Temperature changes, thermal cycling.
- Distortion: squeeze, stretch - ability to recover.
- Physical strength: tensile strength, tear resistance.

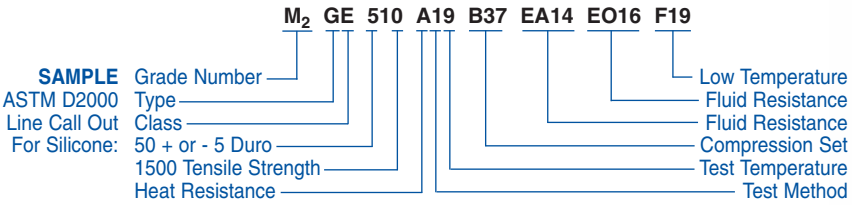
Tubing

Tubing can often be used as a seal (static or dynamic), or to transport fluids. Many of the same considerations need to be made as with seals. Additionally, factors of temperature resistance, service pressure, flexibility, chemical resistance, taste, and bacteria/mold support should be considered.

Choosing the Right Material

The complete range of properties found in the family of synthetic elastomers are usually lacking in any one type of material. Each formulation has a primary performance advantage, and may also provide high performance in many other areas.

To assist in making an initial material choice, review the resistance properties and the physical properties below. More specific details for each material can be found in the pages following, or by contacting our factory applications staff.



For your convenience, we show a typical ASTM D2000 line call-out for Vansil® silicone materials for your review. For details of specifying your materials via the ASTM method, please contact us.

Common Name	VanSil®	Silicones VanProSil®	Silicone (general purpose)	Fluoro-silicone	Fluoro-carbon	Ethylene-propylene	Nitrile	Epichloro hydrin	Isoprene	Chloro-prene	Butyl	Natural
Designation ISO-1629: 1987E	VMQ	VMQ	MQ, VMQ	FVMQ	FPM	EPDM	NBR	ECO	IR	CR	IIR	NR
ASTM D2000 designation	GE	FC	FE	FK	HK	AA, BA, CA	BF, BG, CH	CH, DJ	AA	BC, BE	AA, BA	AA
Physical Properties												
Shore A range	20-80	10-75	30-80	40-80	50-90	30-90	30-90	40-90	40-90	20-90	30-80	20-90
Max. service temp., ˚F	500˚F	550˚F	450˚F	450˚F	400˚F	300˚F	250˚F	300˚F	200˚F	220˚F	250˚F	200˚F
Min. service temp., ˚F	- 100˚F	- 100˚F	- 70˚F	- 80˚F	- 10˚F	- 40˚F	- 45˚F	- 20˚F	- 20˚F	- 10˚F	- 20˚F	- 20˚F
Compression set resistance	A	A	A-B	A	A-B	A-B	B	B	B	B	C	B
Resiliency	B	A	B	B-C	C-D	B	C	C	A	A	B-C	A
Flame resistance	B	B	B-C	B	A	C	NR	D	C	B-C	C	C
Ozone resistance	A	A	A	A	A	A	NR	B	B	C-D	B-C	B
Weather resistance	A	A	A	A	A	A	C	B	D	B	A	D
Electrical insulation	A	A	A	A	C	B	C	C	C	NR	B-C	C
Abrasion resistance	C	B	C	C	B	B	A-B	A	D	B	C	D
Permeability to gases	Moderate	Moderate	Moderate	Moderate	Low	Low	Low	Very Low	Low	Low	Extr. Low	Low
Tensile Strength	Moderate	Mod-High	Low-Mod	Mod-High	High	Moderate	Mod-High	Mod-High	Mod-High	Moderate	Mod-High	Mod-High
Tear Strength	Moderate	High	Low-Mod	Mod-High	Mod-High	High	Moderate	Moderate	Moderate	Moderate	Mod-High	Mod-High
Chemical Resistance												
Oil resistance	C	C	C	A	A	NR	A	A	NR	B	NR	NR
Fuel resistance	C	C	C	A	A	NR	A-B	A	NR	C	NR	NR
Alcohol resistance	B	B	B	B	A	A	D	A-B	B	A	A	B-C
Alkali resistance	C	C	C	C	C	A-B	C	B	C	A	A	C
Acid resistance	C	C	C	C	A	B	D	B	NR	B	B	NR
Water resistance	A	A	A	A	A	A	A	B	B	A	A	B
Steam resistance	B	C	C	B-C	A	A	NR	D	NR	NR	B	NR
Animal / Vegetable oils	B	B	B	A	A	B	A	A	C	B	C	C
Aliphatic Hydrocarbon solvents	C	C	C	A	A	D	A	A	NR	B-C	D	NR
Aromatic Hydrocarbon solvents	C	C	C	A	A	D	D	D	NR	C-D	D	NR
Oxygenated solvents	C	C	C	C	D	A-B	D	C-D	C	C-D	B	C
Food contact suitability	A	A	A-B	NR	C-D	B	B-C	NR	NR	NR	NR	NR

A = Excellent **B = Good** **C = Fair** **D = Poor** **NR = Not Recommended**

Silicone

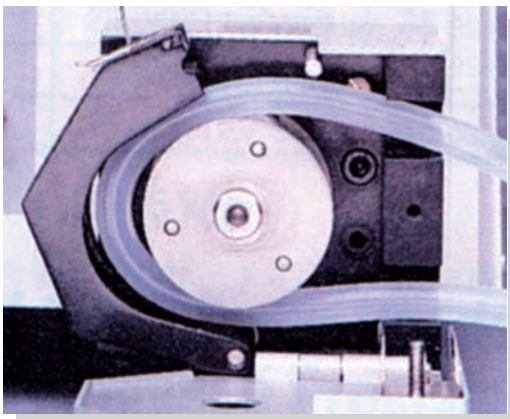
Silicones are among the most versatile and unique elastomers in the market today. Typically, silicones are popular due to their broad temperature latitude. For instance, certain silicones will resist temperatures as high as 300˚C. On the other hand, silicones when exposed to extreme cold will retain their suppleness and flexibility to -70˚C. Additionally, silicone can be formulated to have very low compression set properties, which is highly desirable for environmental and static seals. As an electrical insulation material, silicone is superior. And, of special interest, silicone can even be made electrically conductive via formulation. Its resistance to oxidation, UV exposure, and ozone makes it a leading candidate for many outdoor applications. Further, due to its physiological inertness, silicone is the choice for handling fluids intended for human consumption. The elastomer is virtually odorless, tasteless and non-toxic when properly selected. Silicone in its raw state is semi-translucent and can be pigmented in a wide array of colors.

Vansil®

Vansil® is a family of general purpose proprietary silicone compounds used as the materials for tube, D-shape and P-shape standard profiles shown on pages 11-12. Properties of low compression set, resistance to weather and temperature extremes make it a good choice for environmental gaskets. Resistance to temperature, translucence, along with certification by NSF International make Vansil® appropriate for food contact and with certain chemical compounds.

Vansil® is the premier choice for cost containment; yet, it offers top quality physical characteristics. Choose Vansil® for all of your general requirements for silicone performance, and expect to be pleased with the decision.

Vanprosil®



Vanprosil® is our professional line of silicone products, offering several key advantages over our Vansil offerings. Vanprosil® offers some of the highest and best physical properties of the silicones family. It has superior tensile strength and high resistance to tearing. It is extremely supple, flexible, and exhibits no odor or taste. It has been tested and passes the USP Class VI pharmocopia standards. The level of clarity is excellent. Food grade and medical applications are common for Vanprosil®. Peristaltic pump tubing is a specialty as well. Choose Vanprosil® for the best all-around performance in a silicone elastomer.

Sponge - open cell, closed cell

Sponge is a cellular rubber material resembling a natural sponge in structure and is made by mixing agents into the rubber to produce gas during vulcanization. Two types; open cell and closed cell, can achieve considerable weight and cost savings as well as dramatic decreases in compression/deflection forces. Available in many of the materials shown herein.

Examples of open cell and closed cell structures, respectively, are illustrated when comparing a slice of bread (open cell) and a group of balloons (closed cell).

Fluorosilicone

Fluorosilicone elastomers are basically specially prepared silicones in which fluorine substitutions are made on the polymer chain. This substitution provides enhanced fluid resistance particularly to fuels and oils. It has the same superior low temperature flexibility as silicone. A limitation is that high temperature service exposure should be limited to 175ºC. Typically, fluorosilicone is used in O-rings, although due to it's unique fluid resistance, it is even found in some dynamic applications. Further, in military environments, it is preferred for it's fluid resistance and extended high/low temperature profile. Fluorosilicone can also be compounded for very low compression set and oxidative stability.

Fluorocarbon

Fluorocarbon elastomers are essentially highly fluorinated hydrocarbon polymers. Typical trade names of fluorocarbons are Viton® (Dow-Dupont) and Fluorel® (3M). The high degree of fluorination results in an exceptionally stable elastomer. These elastomers are highly resistant to chemical attack, flame, oxidation, sunlight and ozone. The automotive industry strongly favors fluorocarbon for areas in contact with fuels and oils like, O-rings, seals, diaphragms and fuel hose. These products are heat stable up to 200ºC under continuous service applications. On the other extreme, fluorocarbons are useful at temperatures as low as -20ºC; with proper formulation, one can extend the service temperature to -40ºC, but only in static sealing applications. They can be designed for low compression set requirements with a tailored compound. Another nice feature of fluorocarbon elastomers is their imperviousness to gases, approaching that of the butyl family.

EPDM

EPDM elastomers are terpolymers of ethylene, propylene and a non-conjugated diene polymers. Generally a very cost-effective elastomer, EPDM exhibits exceptional electrical insulative properties making it a top candidate in wire and cable jacketing. As a highly stable polymer, EPDM resists aging from weather, ozone, water and certain chemical exposures. In fact, its resistance to water and engine coolants make it the choice for automotive coolant hose. Its low cost allows its use in such consumer goods as garden hose. Its superior UV resistance has landed it in commercial rubber roofing where sunlight exposure would be punishing to most elastomers. This adaptable material is available in tubing, profile extrusions and moldings in a variety of hardnesses and properties. EPDM is usually black in color, although we offer it in other colors as well. For your next door, window seal or gasket application, consider EPDM elastomers.

Nitrile

Nitrile elastomers are co-polymers of acrylonitrile and butadiene. The elastomer is designed with varying levels of acrylonitrile (ACN). The higher the content of ACN in the polymer design, the better the resistance to gasoline and aromatic oils. The lower the content of ACN, the lower the resistance to these fluids becomes. However, the lower the ACN elastomers exhibit improved low temperature flexibility and resistance. Generally, nitriles are the most extensively used polymers for environments where fuel and oil exposure are the norm, such as seals, gaskets, diaphragmatic and oil field products.

Select a general purpose nitrile, or review custom applications with our engineers for enhanced properties such as compression set and chemical resistance.

Epichlorohydrin

The epichlorohydrin elastomer is a copolymer of epichlorohydrin and ethylene oxide. Its epichlorohydrin backbone is a saturated polyether with highly polar chloromethyl pendant groups. Principal attributes of epichlorohydrin include, excellent fuel and oil resistance, ozone resistance, resistance to aging in air, flame resistance and fairly broad temperature range. In particular, the automotive industry values this polymer for hose, seals and gaskets due to its fuel resistance. The oil-field market is another natural for epichlorohydrin. Its low temperature performance has made it of interest to the military for hose, seals and gaskets. It is of interest to the electronics market as it can be formulated to be semiconductive in its electrical properties. Be aware that epichlorohydrin can be corrosive to metals and therefore must be kept away from such surfaces in application.

Isoprene

Isoprene is a man-made, synthetic version of natural rubber. The principal backbone of isoprene is cis-1,4 polyisoprene. Isoprene, like natural rubber, exhibits very high tensile strength, good hysteresis and good tack. A major advantage of isoprene rubber is that it does not contain the non-rubbery contaminants that natural rubber brings along with it. It is also a much more consistent repeatable polymer from lot to lot. Uses of isoprene are widespread, from baby bottle nipples to tires; pharmaceutical supplies to motor mounts; rubber bands to shoes.

Chloroprene

Chloroprene (or by its duPont trade name Neoprene®) is a cost effective material with a broad physical property profile which explains its use in a wide scope of applications. It has relatively good resistance to ozone, cracking, heat aging and chemical attack. Specifically, Chloroprene is resistant to silicate esters, silicone oils, aliphatic hydrocarbons, and refrigerants such as Freon®. It can be formulated to exhibit low flammability as well as the ability to self-extinguish. It is not the best selection for electrical insulative properties, or for low temperature applications.

Chloroprene's physical toughness has contributed to its broad use in wire and cable sheathing, automotive hose, garden hose, and belting. Consumer applications include scuba wet suits, shoe soles and coated fabrics.

Natural Rubber

Natural rubber is derived from the Hevea Brasiliensis tree which was indigenous to the Amazon Valley. The Hevea tree is tapped and the latex sap collected for further processing. In order to meet the demands of the Western industrial boom, the Hevea was propagated and sent to Asian countries for market expansion. Today, major producers are large estates in Malaysia, Indonesia and Thailand. Its major features are high tensile strength and high tear, abrasion and fatigue resistance. High resiliency allows low heat buildup in the rubber, making it an ideal candidate for tires and other dynamic applications. It is a choice candidate for vibration mounts, bridge bearings and pharmaceutical closures. Other uses include latex products: rubber gloves, carpet backing and adhesives. Principal drawbacks are poor ozone and weather resistance and two year service life in outdoor environments. Its medical use is limited due to the presence of proteins, amino acids and other non-rubber components thought to contribute to allergic reactions in certain individuals.

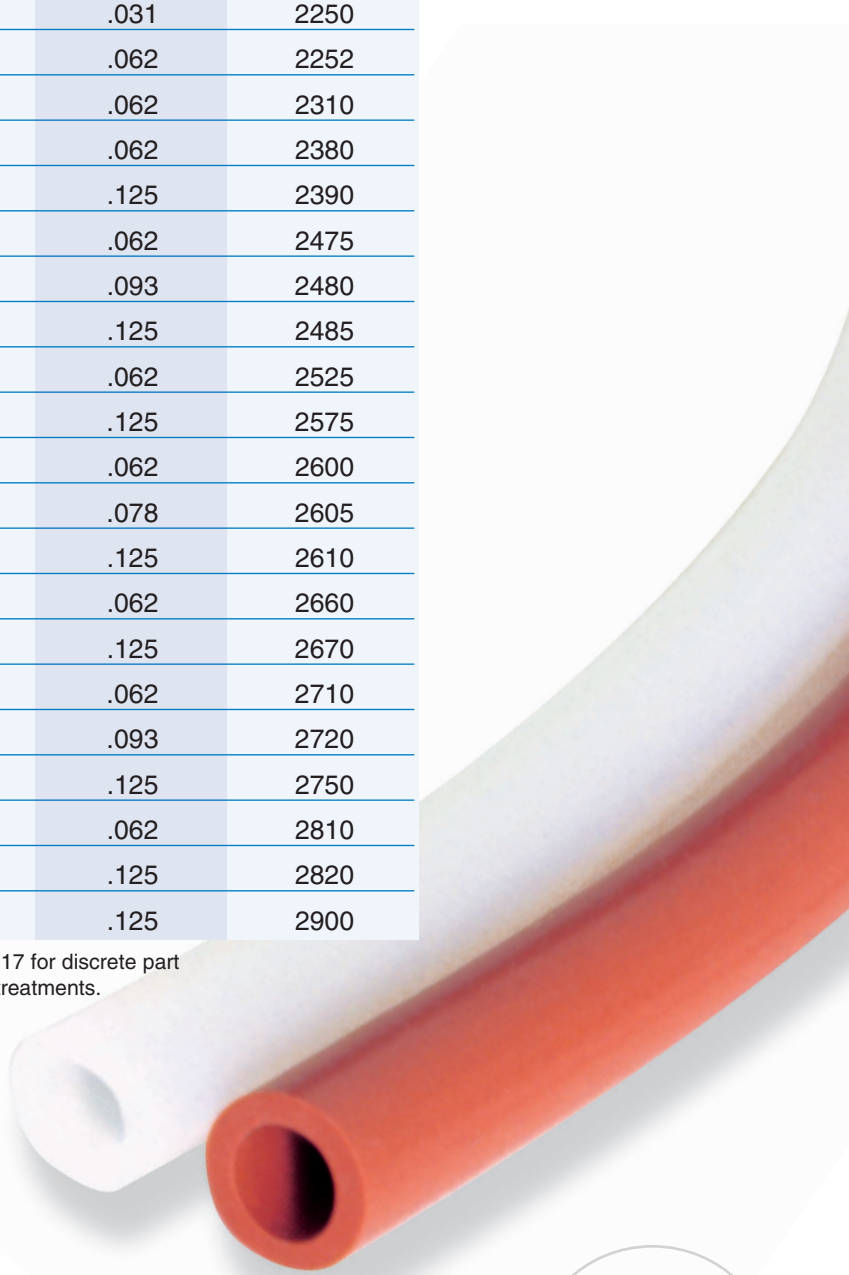
Tube

Excellent general purpose silicone rubber tubing for wide temperature ranges and environmentally resistant applications.

Durometer Shore A 50±5 medium hardness available in natural (see through) or red colors as standard.

I.D	O.D	WALL	PART NUMBER Natural & Red
.062	.125	.031	2250
.062	.187	.062	2252
.093	.218	.062	2310
.125	.250	.062	2380
.125	.375	.125	2390
.187	.312	.062	2475
.187	.375	.093	2480
.187	.437	.125	2485
.250	.375	.062	2525
.250	.500	.125	2575
.312	.437	.062	2600
.312	.468	.078	2605
.312	.562	.125	2610
.375	.500	.062	2660
.375	.625	.125	2670
.500	.625	.062	2710
.500	.687	.093	2720
.500	.750	.125	2750
.625	.750	.062	2810
.625	.875	.125	2820
.750	1.00	.125	2900

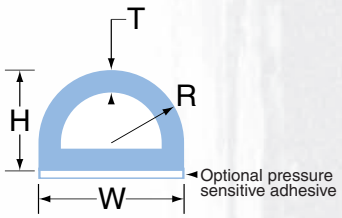
See “Ordering Information” on page 17 for discrete part number nomenclature and optional treatments.



D-shape

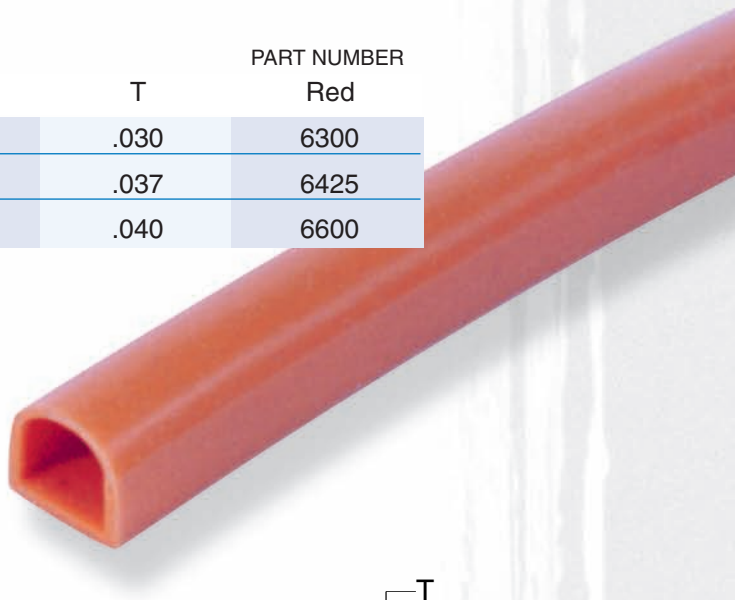
Popular shape easily substitutes for many custom shapes. Stable mounting base includes pressure sensitive adhesive option.

Durometer Shore A 50±5 and red color as standard.



H	W	R	T	PART NUMBER Red
.187	.172	.094	.030	6300
.250	.375	.188	.037	6425
.375	.359	.187	.040	6600

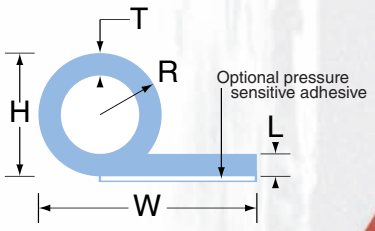
See “Ordering Information” on page 17 for discrete part number nomenclature and optional treatments.



P-shape

Wide lower mounting base assures stable mounting for many environmental sealing situations. Optional pressure sensitive tape mounting.

Durometer Shore A 50±5 and red color as standard.



H	W	L	R	T	PART NUMBER Red
.125	.375	.040	.062	.023	5150
.187	.375	.040	.094	.028	5200
.250	.500	.050	.125	.029	5300
.375	.625	.055	.188	.040	5500
.500	.875	.065	.250	.050	5700

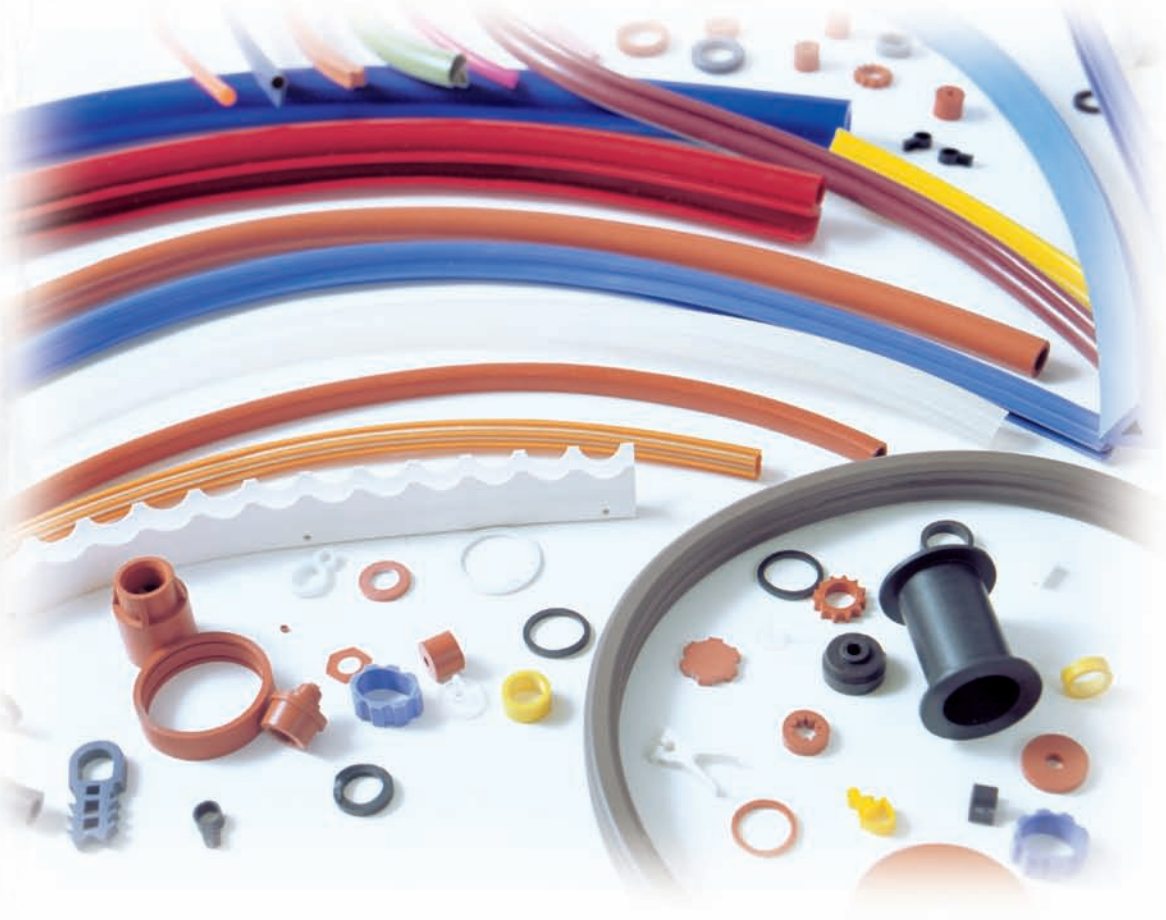
See “Ordering Information” on page 17 for discrete part number nomenclature and optional treatments.

Custom Extrusions and Moldings

Your sealing needs most often require special attention to the exact proprietary specifications of your product - without compromise. Our business is founded on just that. Rubber Manufacturers Association Precision Tolerances are our standard; tighter tolerances are commonly available.

"Custom" is not a scary word with connotations of high tooling costs, special preparations and long leadtimes.

Our engineering and manufacturing systems are organized for quick turnaround prototyping at minimal budget considerations.



Custom Extrusions

Virtually any shape can be made. Your Imagination is the only limitation.

Custom Molded Parts

Boots, grommets, bumpers, feet, elbows, bellows, valves, sheets and similar shapes.

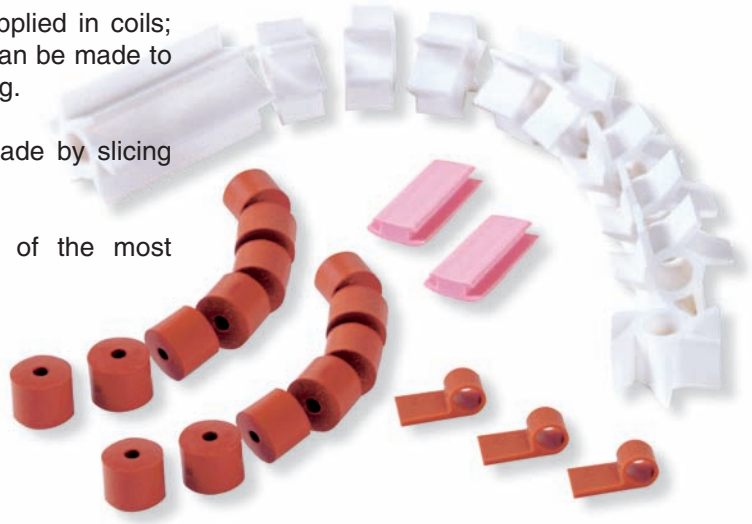
Custom Finishing

Cut Lengths, Taping

Extruded lengths are typically 100 ft. and supplied in coils; however, finished shorter or longer lengths can be made to your specifications along with special packaging.

Cut O-rings, washers and thin seals are made by slicing sections from full length coils.

Pressure sensitive adhesive tape is one of the most common attachment methods.



O-Rings Extruded, Spliced, Molded

O-rings are made in three ways:

Precision Cut Tubing (Washers): Extrusions of any circumferential profile are cut to desired thickness. This approach is most practical up to a 1.5" cross section and for economical volume production.

Spliced O-rings: Large diameter O-rings are made by end-to-end splicing of lengths of tubing equal to the desired circumference. Diameters up to 10 ft. are practical.

Molded O-rings: Small to mid-size diameter O-rings up to 24" are practical for molding using a dedicated tool, usually associated with higher production quantities.

Custom Finishing

Other - Splices, Mitres, Assemblies

Extruded profiles can be made into frames and complex assemblies through our splice bonding technology. We've done thousands of such treatments and may just have the right idea for your application. Some of the most common are:

- Mitre corner frames
- Intricate webs
- Die-cut notches
- Bonding to film
- Assembly to your components
- Die-cuts from sheets, strips

Color Matching

General color matching can be specified by supplying a color sample or specifying a distinct PMS (Pantone Matching System) number.

Specific color matching commensurate with your end product requirements can be done in the same way, but may require sample testing to attain exactness.

Ordering

All stock profile products shown on pages 11 and 12 are available from inventory on a quick delivery basis. (*) Indicates the material options of our standard part numbers.

To construct a discrete part number for your application, follow the guidelines below.

To include options, characteristic suffix descriptors are added to the basic part numbers found on pages 11-12.

Part# 5200-GE-D50-NAT-NPS-COI-50

Part Number from Chart on pages 11 and 12

Material

- GE - VanSil® *
- FC - VanProSil®
- NR - Natural Rubber
- BC - Chloroprene (Neoprene)
- CH - Epichlorohydrin
- CA - EPDM
- FK - Fluorosilicone
- HK - Fluorocarbon
- BA - Butyl
- AA - Isoprene

Durometer

- Shore A 30
- Shore A 50 *
- Shore A 60
- Shore A 70

Color

- Natural (Tubes Only) *
- Red *

Mounting Tape

- NPS - No Pressure Sensitive Tape
- PSA - Pressure Sensitive Tape (min width 0.1")

Packaging

- SPL - Spooled on a Reel
- CTL - Cut to Length
- COI - Coiled Loosely
- BND - O-Rings, Bonded

Length in inches

- 600 (50 ft Long)
- 1200 (100 ft Long)
- Custom Length (inches)

Rubber Manufacturers Precision Tolerances

High Precision cross sectional tolerances are standard for all production of extruded parts regarding outside diameters (O.D.), inside diameters (I.D.), with height and general dimensions.

Schedule 2
Cross Section Tolerances for Group 2 – Compounds Only

High Precision
RMA – Class A – DWG Designation A

DIMENSION (inches) Above - included	TOLERANCE (inches)
0.00 - 0.10	± 0.010
0.10 - 0.16	± 0.013
0.16 - 0.25	± 0.016
0.25 - 0.40	± 0.020
0.40 - 0.63	± 0.025
0.63 - 1.00	± 0.032

Use ± 2-3/4% for dimensions over 1.00 inch.

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