Ask the expert...

UK GASKET & SEALING ASSOCIATION

bsi. ISO 9001:2015 Quality Management

Certificate No. RS 27920

J-FLEX

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Providing solutions for demanding requirements the world over

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INTRODUCTION

Not sure which type of rubber product you need?

No problem! Industry experts J-Flex have produced this technical guide to help you identify the best solution(s) for your specific circumstances.

We often find that our customers do not always give us the complete specification for the rubber for the particular purpose it is required.

It should always be borne in mind that we have some hundreds of different natural and special synthetic rubber compounds listed and available for use.

From the information we receive about any particular product, we have to select the correct quality. In many cases there are only shades of difference between which can ensure a final product being either the correct one for the job or one which only gives reasonably satisfactory service.

There are, of course a number of occasions when the bare mention of the type of product will indicate the exact quality due to our long experience of manufacturing that particular type of product for that particular type of Industry.

A further reason for asking you to consider all of the following items of information is that it is surprising how often one small yet relevant fact can be left out of the general working conditions applicable to a particular rubber product. That small fact may seem unimportant to you but quite often it can be crucial to us when selecting the correct quality.

See the Rubber Guide (Pages 12—13)

YOUR TEN POINT CHECKLIST

When it comes to industrial rubber and making sure you have the solution right for you, it pays to consider carefully the ten questions highlighted below.

The more information you are able to supply regarding your particular circumstances, the quicker and more accurately J-Flex will be able to provide a solution and the right solution for you.

☐ **1. Be Ultra Specific**

What is the precise function of the article or material?

Think about how the industrial rubber component is going to be used and what function it will need to perform. It's important to provide as much detail as possible.

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☐ **2. Know and Confirm the 'Usual' Operating Temperature**

What will be the operating temperature?

Consider carefully what the normal operating temperature or temperature range the rubber solution will be subjected to. What are the likely maximum and minimum temperatures likely to be encountered and for what periods?

It is also useful to consider whether different parts will be at different temperatures. For example will the inside and outside of a hose be conveying a hot liquid?

_____

_____

☐ **3. Consider and Advise on Exposure to Light, Radiation and Gases**

What is the likely exposure to light, radiation and gases?

Will the rubber be subjected to sun or strong light, atomic radiation, outdoor air, corrosive gases like chlorine or atmospheres containing ozone?

Knowing what the exposure will be is vital to ensuring the right industrial rubber solution is specified.

_____

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☐ 4. **Exposure to Liquids**

What liquids if any will the rubber be exposed to?

Will the rubber be exposed to any of the following liquids?

- Water (fresh or sea) or rain
- Anti-freeze solutions
- Liquid fuels
- Lubricating oils or greases
- Hydraulic fluids
- Refrigerants
- Corrosive chemicals, such as acids, strong alkalis or hypochlorites, etc

Also it is useful to consider whether the rubber will be exposed to the liquid on a continuous or intermittent basis.

_____

_____

☐ **5. Abrasion or Cutting Needs**

Will the rubber be subjected to abrasion and cutting?

It is useful to know if the rubber will be exposed to any rubbing, abrasive or cutting action. If the rubber will be it is also useful to have details, including those of any materials producing abrasion.

_____

_____

☐ **6. Electrical Requirements - What electrical requirements exist?**

If there are any electrical requirements, it is useful to know what these are. We need to make sure that the industrial rubber can meet these requirements. For example, insulation resistance, dielectric strength (break-d own strength), dissipation of static charges (anti-static or conductive rubber) or low dielectric power loss.

_____

_____

☐ **7. Types of Surfaces - What will the rubber be in contact with?**

Here, it is useful to think about what surfaces the rubber will be in contact with, as well as considering whether stain resistance is important.

_____

_____

☐ **8. Flame Resistance - Is flame resistance required and if so to what degree?**

Different industrial rubbers react in different ways to flames and it is therefore important to have an understanding of what level of flame resistance is required.

_____

_____

☐ **9. Sample Availability - Are samples available for review?**

_____

_____

☐ **10. Exact Requirements**

What are their exact requirements and potential?

_____

_____

Whatever your requirements, industrial rubber specialist J-Flex can help you specify the right industrial rubber products for your circumstances.

Check out the download area of our website www.j-flex.co.uk for other product information, data sheets and more.

Please note: This guide is intended to assist understanding of the most frequently used terms from the rubber industry. The information contained should be used in conjunction with the national and international standards and legislation relating to properties and safe application of rubber. Ultimately it is the direct responsibility of the customer to make the final decision as to the suitability of a rubber material for a particular application.

SHEETING PRODUCTS

Starting with Sheet Products there are very few variables?!?!

1) Type of material required
2) If not sure - what does it do?
3) Colour required
4) Hardness
5) Thickness / Tolerances
6) Standard Roll Width
7) Roll Length or Cut Length required
8) Special requirements e.g. surface finish etc.

Brochures available upon request

MOULDINGS

1) Drawings or full dimensions with tolerance.

2) Surface finish required.

3) Is the complete elimination of flash or the position of the flash line important?

4) If metal or fabric parts are included, is the bond strength important? If metal parts, state if free issue, also type and specification of metal.

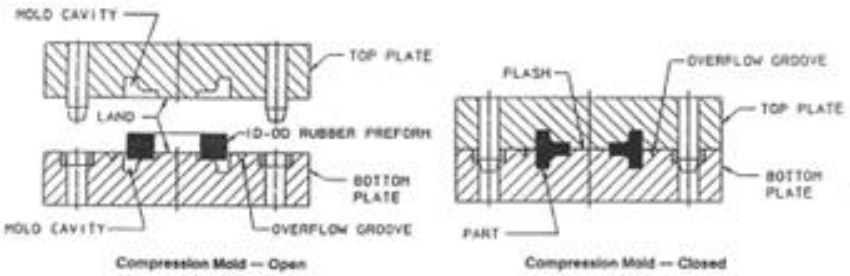
5) Stressing conditions, i.e. whether in shear, tension, compression, bending, etc.; the normal (static) stress or deformation; frequency and amplitude of any periodic deformations; magnitude of any shock loading.

6) Any special assembly conditions.

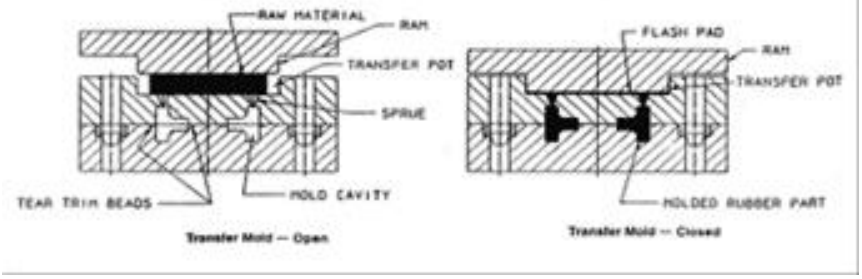
Brochure available upon request

MOULDING TECHNIQUES

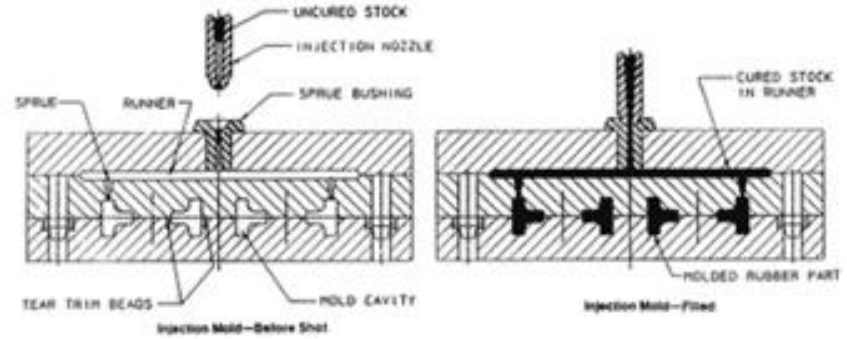
COMPRESSION MOULDING



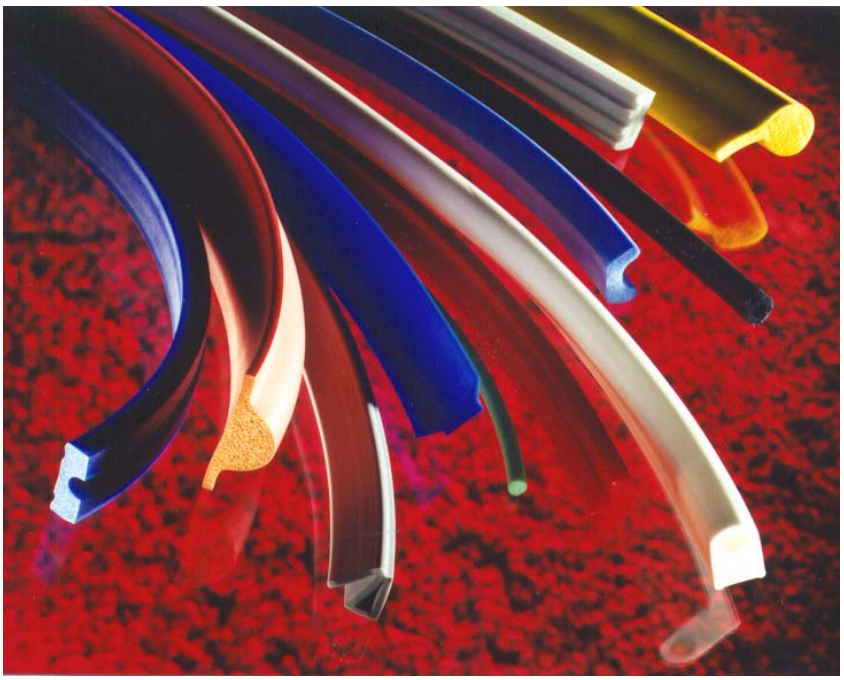
TRANSFER MOULDING



INJECTION MOULDING



EXTRUSIONS



Using only premium grade materials J-Flex are able to supply an infinite variety of extruded profiles ….

…….. accurately and efficiently.

Mainly produced in Silicone Rubber (solid and sponge) we offer wide experience in sections for sealing; silencing; insulating; channelling and protection.

With over 2000 existing profile dies at our disposal, we can almost certainly assist when you are designing original equipment or replacing obsolete spares.

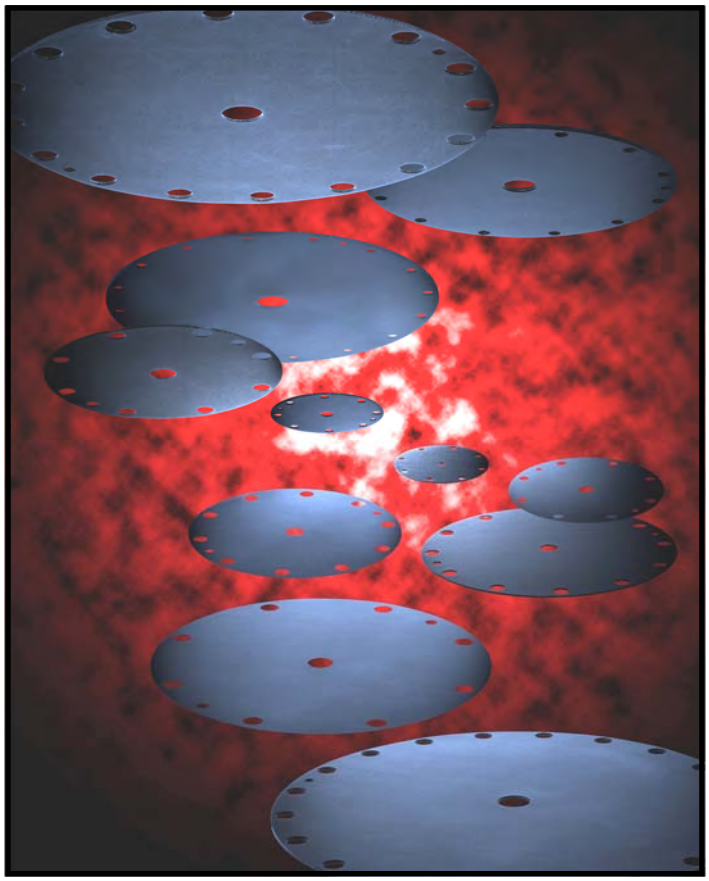
Extrusions are designed as simple tubing's; sleevings; strips; cords or complex profiles to precisely match your specifications, sizes or prints.

All J-Flex products can be supplied in long lengths or cut to size, with or without high temperature adhesive backing. Some Viton™, EPDM, Neoprene and TPR Grades are also available.

J-Flex can help from the initial concept of your extruded profile requirements right through to the manufacture and supply.

Ask for our Brochure and comprehensive Guide to Rubber Extrusions

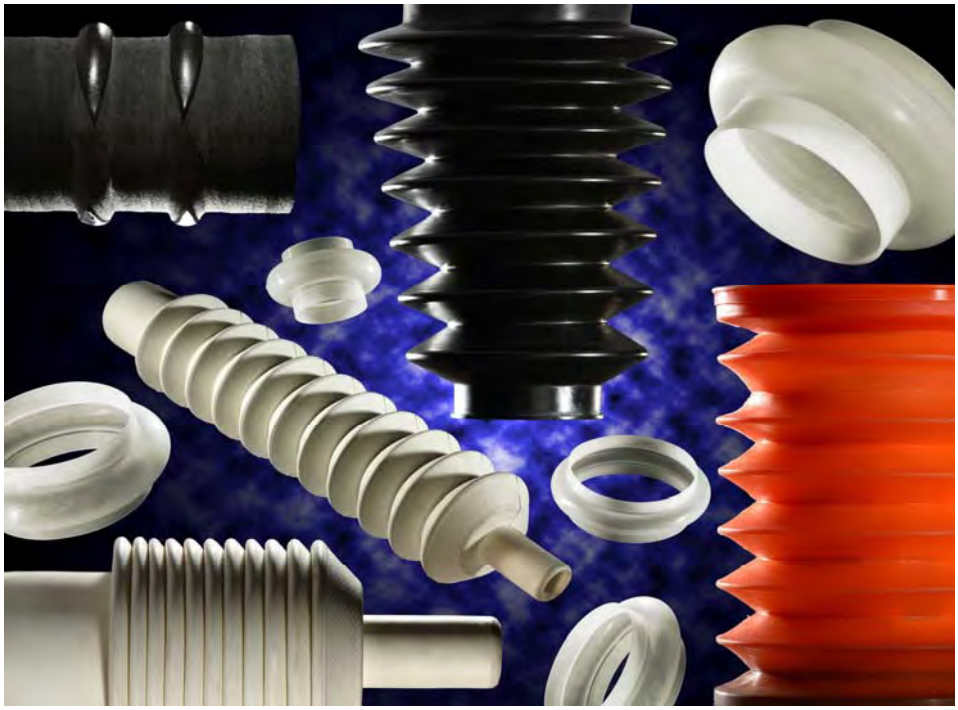
SEALS, PACKINGS, DIAPHRAGMS AND GASKETS



1) Drawings or full dimensions, with tolerances of rubber component.
2) Material and finish of working face.
3) Application:
   a) dynamic or static;
   b) if dynamic, state whether rotary or reciprocating and also rate per minute.
4) Medium to be sealed.
5) Pressure on seal: state range and direction of pressure.
6) Any specialised requirements.

Further information available upon request

BELLOWS, FLEXIBLES, COMPENSATORS



Normally custom made to customers specific requirements :-

- **Bellows** - Moulded or Hand Fabricated
- **Expansion Joints** - Hand Fabricated or Sewn
- **Sleeves** - Mandrel Built or Fabricated from Sheet
- **Flexibles** - Fabricated from Sheet or Mandrel Built
- **Gaskets** - Moulded or Sewn
- **Socks / Cones** - Fabricated from Sheet or Mandrel Built
- **Inflatable Seals** - Fabricated Sections

Let J-Flex handle your flexible requirements

Ask for a full information pack about these products today!

RUBBER GUIDE

Material	Chemical Group	Common Uses	Feature Summary	Generally Resistant to	Generally Attacked by	Temperature Range
AFLAS™ (TFE/P)	Fluorinated Copolymer	Seals for oilfield, aerospace, chemical and general engineering	High temp & chemical resistance	Steam, amines & amine corrosion inhibitors, caustics, high pH media, wet sour gas, oil	Aromatic hydrocarbons, chlorinated solvents, ethers, limited in low temperatures	-20° - + 200°C
BUTYL (IIR)	Isobutylene, Isoprene, polymer	Effective vacuum sealing and for hydraulic systems.	Low permeability to gases, excellent resistance to ozone & sunlight.	Water & Steam	Petroleum solvents, coal, tar, solvents, aromatic hydrocarbons	-40° - + 110°C
EPICHLOROHYDRIN (ECO)	Epichlorohydrin polymer & copolymer	Air conditioning, petroleum industry	Excellent resistance to hydrocarbon oils and fuels, low solvent and gas permeability, weather resistant.	Similar to Nitrile with ozone resistance	Ketones, esters, aldehydes, chlorinated and nitro hydrocarbons	-30° - + 120°C
ETHYLENE-PROPYLENE (EPDM)	Ethylene Propylene copolymer and terpolymer	Outdoor, automotive braking and coolant systems, (drinking) water applications	Resistance to polar solvents and keytones, as well as steam, hot water, silicone oils and greases, dilute acids and alkalis, alcohols and brake fluids	Water, steam & brake fluids	Mineral oils and solvents, aromatic hydrocarbons	-50° - + 130°C (150°C Intermittent)
FLUOROELASTOMER FKM / FPM #1 e.g. Viton™ A (Viton™ -Dyneon®)	Standard fluorocarbon dipolymer 66% fluorine	Seals for aircraft engines, automotive fuel handling systems , oilfield, chemical processing, power generation	Highly resistant to swelling, weather, acids, silicone fluids and greases, low gas permeability.	All aliphatic, aromatic & halogenated hydrocarbons, acids, animal & vegetable oils	Ketones, low molecular weight esters & alcohols & nitro-containing compounds	-20° - + 200°C
FLUOROELASTOMER FKM / FPM #2 e.g. Viton™ 'B' & GF (Viton™ -Dyneon®)	Standard or specialty type Terpolymer fluorocarbon. Typically >66% fluorine	Seals for aircraft engines, automotive fuel handling systems, oilfield, chemical processing, power generation	Highly resistant to swelling, weather, acids, silicone fluids and greases, low gas permeability.	All aliphatic, aromatic & halogenated hydrocarbons, acids, animal & vegetable oils	Ketones, low molecular weight esters & alcohols & nitro-containing compounds	-20° - + 200°C
HYPALON® (CSM)	Chlorosulphonated polyethylene with improved acid & ozone resistance	Applications where there is likely to be heavy weather conditions or exposure to hot liquids or gases	Resistant to corrosive or oxidising chemicals, weather, Freon® refrigerants. Tougher than silicone or EDPM	Similar to Neoprene	Concentrated oxidising acids, esters, ketones, chlorinated, aromatic & nitro hydrocarbons	-25° - + 130°C

Material	Chemical Group	Common Uses	Feature Summary	Generally Resistant to	Generally Attacked by	Temperature Range
NATURAL RUBBER (NR)	Polyisoprene	Food and beverage seals, non-hydraulic seals.	Low compression set, high tensile strength, resilience, abrasion and tear resistance. Good friction surface and adhesion to metals.	Most moderate wet or dry chemicals, organic acids, alcohols, ketones, aldehydes	Ozone, strong acids, fats, oils, greases, most hydrocarbons	-60° - + 75°C
NEOPRENE (CR)	Chloroprene polymer	Transportation, oil processing, refrigeration, food and beverage industries.	Oil resistant substitute for natural rubber. Good weathering, Freon® and ammonia resistant, outstanding toughness, cost effective.	Moderate chemicals & acids, ozone, oils, fats, greases, many oils, and solvents.	Strong oxidising acids, esters, ketones, chlorinated, aromatic & nitro hydrocarbons	-40° - + 100°C
NITRILE (NBR)	Butadiene, Acrylonitrile copolymer	Widely used in seal industry, oil resistant applications, low temperature uses, off-road equipment, automotive, marine, hydraulic applications.	Wide working temperature range, oil and hydrocarbon fuel resistant. Available in FDA compliant grades.	Many hydrocarbons, fats, oils, greases, hydraulic fluids, chemicals.	Ozones, ketones, esters, aldehydes, chlorinated & nitro hydrocarbons	-20° - + 100°C
HYDROGENATED NITRILE (HNBR)	Butadiene, Acrylonitrile copolymer + Hydrogen	Oil resistant applications, oil well, automotive fuel handling and general industrial applications.	Enhanced temperature tolerance, strength and chemical resistance. Abrasion, steam and oil additive resistant.	Similar to NBR but with improved chemical resistance & higher service temperature	Ozones, ketones, esters, aldehydes, chlorinated &n nitro hydrocarbons	-30° - + 125°C (160°C Intermittent)
SILICONE (VMQ)	Organic silicone polymer	Seals and gaskets in extreme temperatures. Food and beverage, pharmaceutical, medical industries.	Flexibility retention, low compression set, dry heat resistance. Weather and fungus resistant, non-toxic, neutral odour and taste.	Moderate or oxidising chemicals, ozone, concentrated sodium hydroxide	Many solvents, oils, concentrated acids, dilute sodium hydroxide.	-60° - + 200°C

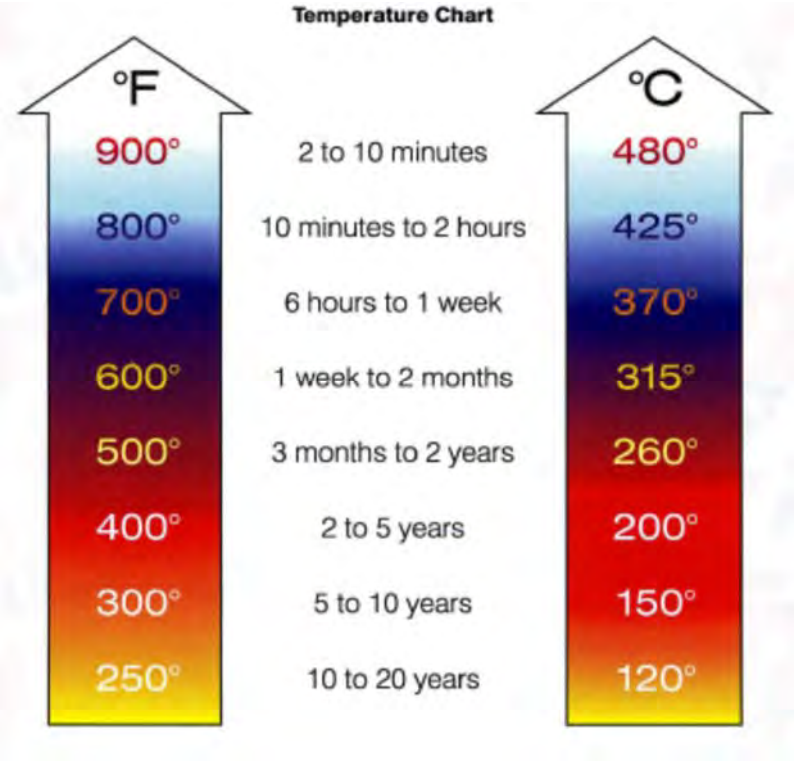
Guide to the identification of different polymers by burning on direct flame.

Our tests and observations were conducted by taking sheeting samples.

Sample Ref.	Polymer	Characteristics on Burning	Characteristic Smell	Fume Colour	Extinguish characteristic
01	Natural Rubber	Continuous burning	Distinctive smell - organic matter hair	Black fumes	Material melts after burning and residue is tacky
02	Nitrile Rubber	Continuous burning with minor crackling	Acrylic pungent unpleasant smell	Black fumes giving black soot	Residue is tacky
03	PVC-Nitrile	Burns continuously on flame with minor crackling	Bread burning like smell	Minor bluish colour at base	No stickiness on surface
04	Chloroprene (Neoprene)	Inconsistent burning on flame	General plastic burning smell	Copious pale yellow fumes	Self extinguishing immediately after removal from flame, no stickiness on surface, charred
05	Styrene Butadiene Rubber (SBR)	Burns continuously with minor crackling on flame	Unpleasant wax burning smell	White fumes	Not easily extinguishable. Residue non-tacky
06	Chlorosulphonated Polyethylene (Hypalon)	Continuous burning on flame	Sulphur burning type smell	Blue outline of flame	Stickiness observed after burning
07	Ethylene Propylene Diene Monomer (EPDM)	Continuous burning	Polyethylene burning smell	Black fumes	Melts and goes tacky & charred
08	Silicone	Inconsistent burning	Mild sweet smell (Peroxide)	White fumes	Self extinguishing immediately after removal from flame, goes to a white ash
09	Viton™ FKM	Very difficult to ignite - flame resistant, self extinguishing	Mild sweet smell (cinnamon)	White fumes	Self extinguishing - charred. However, if it does burn be careful of hydrogen fluoride fumes

- Beware when burning very cheap commercial materials.
- Please bear in mind that whilst this information is believed to be reliable, no representation, guarantees or warranties of any kind are made to its accuracy or suitability for any purpose.

LIFE EXPECTANCY OF SILICONE RUBBERS



Thermal Stability

General purpose silicone's physical properties are not adversely affected by prolonged exposure to temperatures from -60°C to +200°C.

In addition, it can withstand intermittent exposure to even higher temperatures – see chart. Silicone far outdistances other elastomers in resistance to thermal degradation and outperforms other elastomers in general service life, compression set resistance, electrical strength and non-stick properties. Silicone also has good chemical and fluid resistance.

For every 10 degrees higher than the recommended working temperature your product works at you **will** reduce its life expectancy by 50%. For example a 200°C rated material has a life of 2 years, but it is seeing 210°C and another process at 230°C, the life at 210°C is now 1 year and at 230°C is now 3 months.

This information may not relate to your particular working temperature. We give no guarantee of satisfactory results from reliance upon information contained above, and we disclaim all liability for any resulting loss or damage.

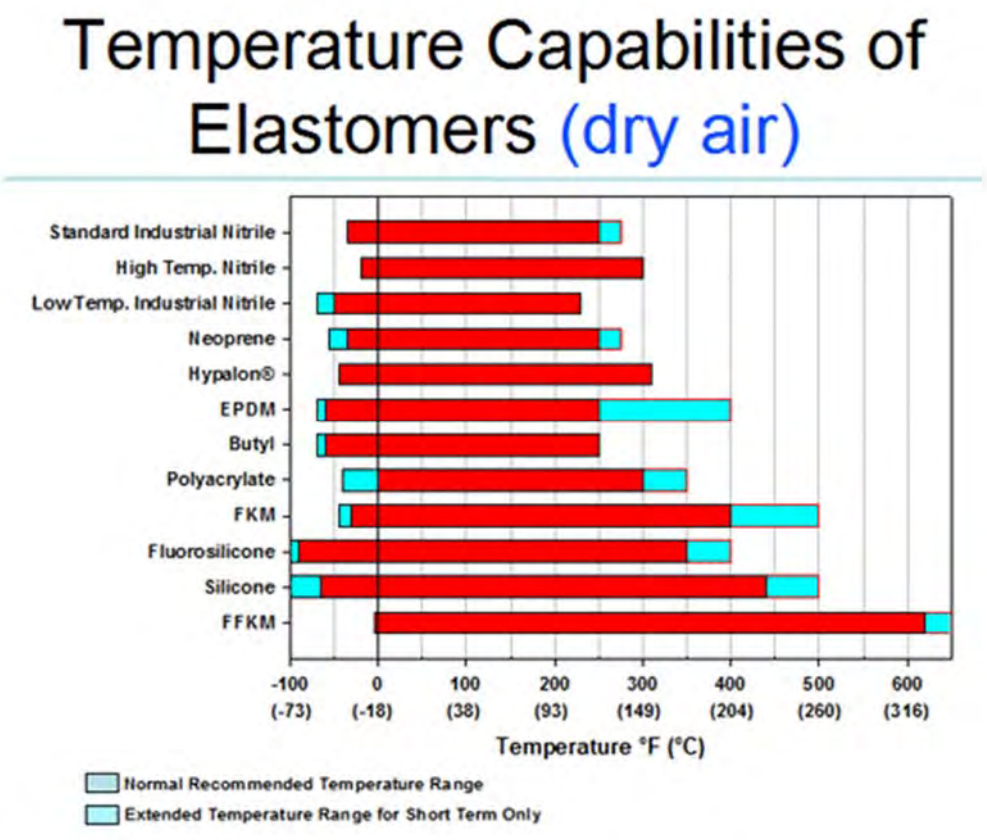
Silicone Sheeting • Profiles • Tubing • Cords
Gaskets • Joints • Mouldings • Sponge Products

TEMPERATURE CAPABILITIES OF ELASTOMERS (Dry Air)

Material Reference

The chart below is intended to help in the material selection stage of designing rubber parts / products. Rubber compounding is a very broad and technical field, since basic rubbers or elastomers are mixed with various chemicals and ingredients (and even with each other) to obtain desired physical properties.

A wide variety of basic polymers (rubbers) are available, and a literally infinite array of compounds exhibiting unique physical properties as well as chemical, fluid and temperature resistances are possible. This chart, therefore, deals only with very general features of the most common basic rubber or elastomer compounds but more specific information is available upon request.



With regard to our own special Viton™ / FKM:-

Temperature Range: 200°C (5,000 hours) 232°C (3,000 hours)
260°C (1,000 hours) 288°C (240 hours)
316°C (48 hours)

Low Temperature: -18.9°C in accordance with TR10 test value

ANTISTATIC
ELECTRICALLY CONDUCTIVE
INSULATIVE

The build-up of a static charge can be damaging or create danger to personnel or equipment in scenarios such as flammable environments and electronic clean rooms amongst others. J-Flex has various products and materials that help protect against such dangers.

In general terms, volume resistivity test data will allow the material to be classified into the following three zones:-

– If the value is between 10,000 Ω and 100,000,000 Ω
(1 x 10^4 Ω to 1 x 10^8 Ω)
then the material is deemed to be **ANTI STATIC**

– If the value is below 10,000 Ω (ten thousand ohms or 1 x 10^4 Ω)
then the material is deemed to be **CONDUCTIVE**

– If the value is above 100,000,000 Ω (100 MΩ or 1 x 10^8 Ω)
then the material is deemed to be **INSULATIVE**

Sheeting • Profiles • Tubing • Cords

Gaskets • Joints • Mouldings • Sponge Products

CHEMICAL COMPATIBILITY TABLE

Exposure Rating Guide:

- ● Good
- ▲ Fair (Usually OK for static seal.)
- ♦ Questionable (Sometimes OK for static seal.)
- ■ Poor

Blank Insufficient data at time of publication.

All recommendations for 23°C temperature

	Aflas™	Buna-N (Nitrile)	Butyl	Chemraz®	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon	Fluorosilicone	Hypalon®	Kalrez®	Natural Rubber	Neoprene®	Nitrile, Hydrogenated	Polyacrylate	Polysulfide	Polyurethane, Cast	Polyurethane, Millable	Silicone	Styrene Butadiene	Teflon®, Virgin	Vamac®
Acetaldehyde		■	●		●	■				♦		■		■			■	●		●	
Acetamide	●	●	●	●		●	▲	●	▲		■	●	●	■	■		■	♦	■	●	●
Acetic Acid, Glacial	■	■	●	▲	■	●	■	■	♦	●	■	▲	▲	■	▲	●	■	●	▲	●	■
Acetic Anhydride	●	●	●	▲	■	●	■	■	●	●	■	●	■	■	♦		■	♦	■	●	♦
Acetone	■	■	●	●	■	●	■	■	■	●	♦	■	■		●	■	■	■		●	■
Acetophenone		■	●	●	■	●	■	■	■		■	■		■	■		■	■	■	●	
Acetyl Chloride	●	■	■	●	■	■	▲	●	♦		■	■	■	■	■		■	♦	■	●	
Acetylene Gas		●	●	●	▲	●	●	♦	♦	♦	▲	●			♦		▲	♦	♦	●	
Acrylonitrile		■	■	●		■	■	■	♦	●	♦	●	■	■	■		■	■	♦	●	
Air, Below 200°		●	●	●		■		●	●		♦	■		●	▲		●	●	▲	●	●
Alkazene		■	■	●	■		▲	▲	■		■	■		■	▲		♦	■	■	●	
Aluminum Acetate		▲	▲	●	▲	●		■			●	▲		■	■		■	■		●	
Aluminum Chloride		●	●	●	●	●		●	●	●	●	●	●	●	■		▲	▲	●	●	●
Aluminum Fluoride		●	●	●	●	●	●	●	●		▲	●	●		■		■	▲	●	●	
Aluminum Nitrate		●	●	●	●	●	●		●		●	●			▲		♦	▲	●	●	
Aluminum Sulfate		●		●		●	●	●	●	●	●	●		■			▲	●	▲	●	●
Ammonia, Gas, Hot		▲	■	●		▲	■	■	▲	●	■	▲	■	■	■		■	●	■	●	■
Ammonia, Gas, Cold		●	●	●		●	■		●	●	●	●	●	■	●		▲	●	●	●	■
Ammonia, Anhydrous		▲	●	▲		●	■	■		●	■	●	▲	■	■		■	♦	■	●	■
Ammonium Carbonate	●	▲	●	●	▲	●	●		▲	●	●	●	■				●	♦	●	●	
Ammonium Chloride	●	▲	●	●	●	●	●	■	●		●	●	●	●	●		▲	♦	●	●	●
Ammonium Hydroxide, Concentrated		♦	●	●	▲	♦		●	●	●		●		■	■		■	●	■	●	■
Ammonium Nitrate	●	●	●	●	●	●	●	♦	●	●	●	●	●	▲	▲			♦	●	●	
Ammonium Persulfate Solution		●	●	●		▲	●		●		●		■	■			■	■	■	●	
Ammonium Phosphate			●	●	●	●	●		■	●	●	●	●			●		▲	●	●	●
Ammonium Sulfate		●	●	●		●	●	●	●	●	●	●		■	■		●	●	▲	●	●
Amyl Acetate		■	▲	●	■	●	■	■	■	●	■	■	■	■	■		■	■	■	●	■
Amyl Alcohol		▲	▲	●	●	●	●	●	●	●	●	●	▲	■	▲	♦	■	■	▲	●	
Amyl Borate		▲	■	●	●	■						●	●		●			■	■	●	
Amyl Chloronaphthalene		♦	■	●		■	●	▲	■		■	■	■	■	♦		■	■	■	●	
Aniline	●	■	●	●		●	●	♦	■	●			■	■			■	▲	■	●	
Aniline Oil		■	▲	●		▲	■	♦	■		■	■	■	■	▲		■	■	■	●	
Animal Oil		●	▲	●	●	●	●	●	■		■	▲	●	●	■		▲		■	●	●
Argon		●	▲	●		●	●	▲	■	●	■	■	●	▲			♦	▲		●	
Arachlor 1248		♦	▲	●		▲	●	▲	■		■	■	♦	■	■		▲	▲	■		

Exposure Rating Guide:

- ● Good
- ▲ Fair (Usually OK for static seal.)
- ♦ Questionable (Sometimes OK for static seal.)
- ■ Poor

Blank Insufficient data at time of publication.

All recommendations for 23°C temperature

	Aflas™	Buna-N (Nitrile)	Butyl	Chemraz®	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon	Fluorosilicone	Hypalon®	Kalrez®	Natural Rubber	Neoprene®	Nitrile, Hydrogenated	Polyacrylate	Polysulfide	Polyurethane, Cast	Polyurethane, Millable	Silicone	Styrene Butadiene	Teflon®,Virgin	Vamac®
Aromatic Fuel 50%		▲	■	●		■	●	▲	■	●	■	■	▲				■	■	■		■
Askarel Transformer Oil		▲	■	●		■	●	▲	■		■	■	▲	■			■	■	■	●	
ASTM Fuel A		●	■	●	●	■	●	▲	▲		■	▲	●	●	●		●	■	■	●	●
ASTM Fuel B		♦	■	●	●	■	●	▲	■		■	■	●	■	▲		■	■	■	●	
ASTM Fuel C		♦	■	●		■	●	▲	■		■	■	▲	■	▲		■	■	■	●	■
ASTM Fuel D		♦		●		■	●					■	▲	■			▲	■	■		
ASTM Oil One	●	●	■	●	■	●		●	▲		■	●	●	●	●	▲	●	●	■	●	●
ASTM Oil Two		●	■	●		■	●	●	■		■	●	●	●	♦		▲		■	●	●
ASTM Oil Three	●	●	■	●		■	●	●	♦		■	♦	●	●	♦	▲	●	▲	■	●	▲
ASTM Oil Four		▲	■	●		■	●	▲	■		■	■	▲	▲	♦		■	■	■		●
Automatic Transmission Fluid	●	●	■	●		■	●		♦		■	▲	●	●			▲	■	■	●	■
Automotive Brake Fluid			▲	●		●	■	■	▲			▲			■		■	●	●		
Beer		●	●		●	●	●	●	●	●	●	▲		■	■			●	●	●	▲
Benzaldehyde	●	■	▲	▲	■	●	■	■	■		■	■	■	■	■		■	■	■	●	■
Benzene	▲	■	■	●	■	■	▲	▲	■	●	■	■	■	■	♦	♦	■	■	■	●	■
Benzene Sulfonic Acid		■	■	●		■	●	▲	▲		■	▲		■	■		■	■	■	●	
Benzine (Ligroin)		●	■	●		■	▲	●	♦	●	■		●	●	●		♦	■	■	●	■
Benzoic Acid		■		●			●	▲		♦		●		■	▲		■		■	●	
Benzophenone		♦	▲	●		▲	●	●						■	▲		■	■	■		
Benzyl Alcohol	●	■	▲	●	■	▲	●	▲	▲		■			■	■		■		■	●	
Benzyl Benzoate		■	▲	●		▲	●	●	■		■		■	■	■				■	●	
Benzyl Chloride	●	■	▲	●		■	●	▲	■		■	■		■	■			■	■	●	
Bleach Liquor	●	♦	●	●		●	●	▲	●	●			▲	■	■	●	■	▲		●	
Borax Solutions		▲	●	●		●	●	▲	●	●	▲	●	●	▲	■		●	▲	▲	●	●
Boric Acid		●	●	●	●	●	●	●	●	●	●	●	●	■	■		●	●	●	●	●
Brake Fluid	●	■	●		■	●	■	■			■	■	▲	■	▲	■			●	●	■
Bromine Gas	●	■	■	●		■	●	▲	■	●	■	■		■	▲		■	■	■	●	
Bromobenzene		■	■	●	■	■	●	▲	■		■	■	■	■	♦		■	■	■	●	
Bunker Oil		●	■	●		■	●	●	■		■		●	●	●		▲		■	●	
Butadiene Monomer		♦		●	■		▲	▲		●	■			■	♦		■	■	■	●	
Butane		●	■	●	●	■	●	▲		●	■		●	●	●			■		●	▲
Butter		●	♦	●	●	●	●	●	▲		■	▲	●	●	■			▲	■	●	●
Butyl Alcohol		●	▲	●		▲	●	●	●	●	●	●	●	■	▲			▲	●	●	●
Butyl Carbitol		■	●	●		●	♦	■			■	♦	■	■	■		■	■	■	●	
Butyl Cellosolve		♦	●	●		●	■	■			■	■	♦	■	▲	▲	■	■	■	●	

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	Aflas™	Buna-N (Nitrile)	Butyl	Chemraz®	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon	Fluorosilicone	Hypalon®	Kalrez®	Natural Rubber	Neoprene®	Nitrile, Hydrogenated	Polyacrylate	Polysulfide	Polyurethane, Cast	Polyurethane, Millable	Silicone	Styrene Butadiene	Teflon® Virgin	Vamac®
Butyraldehyde		■	▲	■		♦	■	■			■			■	♦	■	■	■	■	●	■
Calcium Carbonate		●	●	●		●	●	●	●	●	●	●	●	■	■		■		●	●	●
Calcium Chloride	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Calcium Hydroxide	●	●	●	●	●	●	●	▲	●	●	●	●	■	■			●	●	●		
Calcium Hypochlorite	●	♦	●	●	▲	●	●	▲	●	●		♦	▲	■	■			▲	●	●	▲
Calcium Nitrate	●	●	●	●	●	●	●	●	●		●	●	●	●	●			▲		●	
Calcium Sulfide	●	●	●	●	▲	●	●	●	●			●	●	■	■		●	▲		●	
Carbitol 2		▲	●	●		▲	▲	▲	▲			♦		■	▲		■	▲	▲	●	
Carbolic Acid (Phenol)		■	▲	●	♦	■	●	▲			■	■	■	■	■		■	■	■	●	■
Carbon Disulfide	●	■	■	●		■	●	▲	■	●	■	■	■	■				■	■	●	
Carbon Monoxide		●	●	▲	▲	●	●	▲	●	●	♦	●	●		■		●	●	▲	●	●
Carbon Tetrachloride	■	■	■	●	▲	■	●	♦	■	●	■	■	▲	■	■		■	■	■	●	■
Carbonic Acid		▲	●	●	●	●	●	●	●	●	●	▲	●	●	●	♦	●	●	▲	●	
Castor Oil	●	●	▲	●	●	▲	●	●	●		●	●	●	●	♦		●	●	●	●	
Cellosolve		■	▲	●		▲		■			■	■		■	▲		■	■	■	●	■
China Wood Oil, Tung Oil		●		●		■	●	▲	●		■	●	●	●	♦		♦	■	■	●	▲
Chloracetic Acid		■	▲	●		▲	■	■	▲		■	●	■	■	■		■		■	●	
Chlordane		▲	■	●		■	●	▲	♦		■	♦	▲					■	■		
Chlorinated Solvents		■	■	●		■	●	●	■	●	■	■	■	■	■		■	■	■	●	
Chlorine Dioxide		■	■	♦		■	●	▲	■		■	■	■	■	■		■	♦	■	●	
Chlorine, Wet	●	■	■	♦	▲		●	▲	■	●	■	■	♦	■	♦		■	■	■	●	■
Chlorine, Dry		■	■	▲	▲		●	●		●		■	♦	■	■		■	■	■	●	■
Chlorine Trifluoride		■	■	♦	■	■	■		■		■	■	■	■	■		■	■	■	●	
Chloroform	■	■	■	●		■	▲		■	●	■	■	■	■	■		■	■	■	●	■
Chlorosulfonic Acid	●	■	■	●		■	■	■	■	●	■	■		■	■		■	■	■	●	■
Chrome Plating Solution		■	■	●		■	●	▲	■		■	■	■	■	■		■	▲	■	●	
Chromic Acid	●	■		▲		■	●	●	▲	●		■		■	■			●	■	●	■
Citric Acid	●	●	●	●	●	●	●	●	●	●	●	●	●		■		●	●	●	●	●
Cod Liver Oil		●	●	●		●	●	●	▲	●	■	▲	●	●	■		●	▲	■	●	
Coffee		●	●			●	●	●	●		●	●		■	■		■	●	●		●
Coolanol Monsanto		●	■	●		■	●	▲	▲		■	▲	●	■	■		■	■	■		
Corn Oil		●	▲	●	●		●	●	▲	●	■		●	●	■		●	●	■	●	●
Creosote, Coal Tar		▲	■	●	■	■	●	●	■	●	■			●	♦			■	■	●	■
Creosylic Acid	●	■	■	●		■	●		■	●	■	■	●	■	■		■		■		
Crude Oil (Asphalt Base)		▲		●		■	●	▲		●		♦	●	●			●	■	■	●	●

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Cyclohexane	●	●	■	●		■	●	▲		●	■	■	●	▲	●	●	▲	■	■	●	♦
Denatured Alcohol		●	●	●	●	●	●	●	●		●	●	●	■	●		■	●	●	●	●
Di-ester Lubricant MIL-L-7808		▲	■	●		■	●	●	■		■	■	▲	▲	▲		■	■	■	●	
Diacetone Alcohol		■	●	●	■	●	■	■		●			■	■	▲		■		■	●	
Diacetone		■	●	●		●	■	■	■			■		■	▲		■	■	■	●	■
Dibenzyl Ether		■	▲	●	■	♦	■		■		■	■	■		▲		▲		■	●	
Dibutyl Phthalate		■	♦	●	▲	●		♦	■	●	■	■	■	■	▲		■	▲	■	●	■
Dichloro-Butane	●	▲	■	●		■	●	▲	■		■	■	▲	■	♦		■	■	■	●	
Diesel Oil	●	●	■	●	●	■	●	●	♦	●	■		●	▲	●			■	■	●	●
Diethylamine		♦	▲	●		▲		■	♦		▲	▲		■	▲		♦	▲	▲	●	
Diethylene Glycol		●	●	●	●	●	●	●	●	●	●	●		■			■	▲	●	●	
Dimethyl Formamide		♦	▲	▲		▲	■	■	■		■	■		■	▲		■	♦	■	●	
Dimethyl Phthalate		■	▲	●		▲	●	▲	■	●	■	■	■	■	▲		■		■	●	■
Dioxane	■	■	▲	●		▲	■	■	■		■	■	▲	■	■		■	■	■	●	
Diphenyl	●	■	■	●		■	●	▲	■	●	■	■	■	■	▲		■	■	■	●	
Dow Corning 550		●	●	●		●	●	▲	●		●	●	●	●	●		●	♦	●	●	●
Dow Guard		●	●	●		●	●	●	●		●	●	●	♦			♦	●	●		
Dowtherm A	●	■	■	●		▲	●	●	♦	●	■	■	■	■	■		■	●	■	●	
Elco 28 Lubricant		●	■	●		■	●	●	■		■	♦	●	●	▲		●	▲	■		●
Epoxy Resins			●	●		●	■					●									
Ethane		●	■	●		■	●	▲	▲	●	■	▲		●	●		♦	■	■	●	
Ethanol		●	●	●	●	●	●	●	●	●	●	●	●	■	●		■	▲	●	●	
Ethyl Acetoacetate	■	▲	●		▲	■	■	■		♦	■		■	▲		■	▲	♦	●		●
Ethyl Alcohol	●	●	●	●	●	●	●	●	●	●	●	●	●	■	●	●	■	▲	●	●	
Ethyl Benzene	●	■	■	●	■	■	●	●	■	●	■	■	■	■	■		■	■	■	●	
Ethyl Benzoate	▲	■	■	●			●	●	■	●	■	■	■	■	▲		■	■	■	●	
Ethyl Cellulose		▲	▲	●		▲	■	■	▲		▲	▲		■	■		▲	♦	▲	●	
Ethyl Chloride		●	●	●	▲	●	●	●	■	●	■	■	●	♦	■		♦	■	▲	●	■
Ethyl Chlorocarbonate		■	■	●		■	●	▲	■	●	■	■	■	■	■		■	■	■	●	
Ethyl Ether		♦	■	●	▲	■	■	■	■	●	■	■	■	■	▲			■	■	●	♦
Ethyl Formate		■	▲	♦	■	▲	●	●	▲	●	■	▲	■		■				■	●	
Ethyl Hexanol		●	●	●		●	●	●	●	●	●	●		■	▲		■	▲	●	●	●
Ethyl Mercaptan		■	■	●	■						■				■		●	♦	■	●	
Ethyl Oxalate		■	■	●	■		●	▲	■			■		■	●		●	■	■	●	
Ethyl Pentachlorobenzene		■	■	●	♦	■	●	▲	■		■	■		■	■		■	■	■	●	

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Ethyl Silicate		●	●	●	●	●	●	●	▲		▲	●			▲		■		▲	●	
Ethylene		●	▲			■	●	●	●	●				▲			▲		■	●	
Ethylene Chloride		■	■	●		■	▲	■		●	■	■		■	▲		■	■	■		
Ethylene Diamine		▲	●	▲	●	●	■	■	▲	●	▲	●	●	■	■		■	●	▲	●	
Ethylene Dichloride	●	■	♦	●	■	■	▲	■		●	■	■		■	■		■	■	■	●	■
Ethylene Glycol	●	●	●	●	●	●	●	●	●	●	●	●	●	■	♦	▲	▲	●	●	●	●
Ethylene Oxide		■	■	♦	■	▲	■	■	■	●	■	■		■			■	■	■	●	■
Ethylene Trichloride		■	♦	●		■	●	♦	■	●	■	■	■	■	■		■	■	■	●	■
Formaldehyde	●	●	●	●	▲	●	●		▲	●		■			▲		♦				
Freon 11 (MF)		▲	■	▲		■		▲	●	●	■	■	▲		●			■	■	●	♦
Freon 12		●				♦				●			●				●		●	●	
Freon 13		●	●	▲	●	●	●	■	●			●			●		♦	■	●	●	
Freon 21		■	■	●	▲	■	■		■		■				■			■	■	●	
Freon 22		■	■	●	●	●			●	●		●		▲	■		■	■	●	●	■
Freon 31		■	●	▲		●	■		▲		▲	●			♦				▲	●	
Freon 32		●	●	●		●	■		●		●	●			●				●	●	
Freon 112		▲	■	▲		■	●		▲		■	▲	▲		●	●	▲	■	■	●	
Freon 113		●	■	♦	●	■	▲	■	●	●	■	●	●	●			▲	■	▲	●	♦
Freon 114		●		♦	●	■	●	▲	●	●		●	●		●		●	■	●	●	
Freon 114B2		▲	■	♦		■	▲		●		■	●	▲		▲			■	■	●	
Freon 502 (F22+F316)		▲	●	▲		●	▲				●	●							●		
Freon C318		●	●	♦		●	●		●		●	●	●		●				●	●	
FREON R134A																					
Freon TF	■	●	♦		●	■	▲	■	●	■	■	●	●		●			■	▲	●	♦
Fuel Oil		●	●	●	●	■	●	●	♦	●	■	▲	●	●	●			■	■	●	●
Furan		■	■	●		■			■		■	■	■	■	▲		■	■	■	●	
Furfural	●	■	●	▲	■	▲	■	■		●	■		■	■			■		■	●	■
Furfuryl Alcohol		■	▲	●		▲		■	■		■	■	■	■	■		■	■	■	●	
Gallic Acid		▲	▲	●		▲	●	●	▲		●	▲	▲	■			■		▲	●	
Gasoline, Automotive	▲	●	■	●	●	■	●	●	■	●	■	■		■	●	●		■	■	●	■
Gelatin		●	●	●	●	●	●	●	●	●	●	●		■				●	●	●	●
Glucose		●	●	●	●	●	●	●	●	●	●	▲	●		■			●	●	●	●
Glycerin		●	●	●	●	●	●	●	●	●	●	●		■	▲			●	●	●	●
Glycols, General		●	●	●	●	●	●	●	●	●	●	●		■	●		■	●	●	●	●
Grease, Petroleum Base		●	■			■	●	●	■		■			●	●		●	■	■	●	

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Helium		●	●	●		●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Heptane	▲	●	■			■	●	●	▲	●	■	▲	●	●	●		▲	■	■	●	●
Hexane	●	●	■		●	■	●	●	▲	●	■	▲		●	●	●	▲	■	■	●	●
Hexyl Alcohol		▲	♦	●		▲	▲	▲	▲	●	●	▲		■	●		■	▲	●	●	●
Hydraulic Oil, Petroleum Base		●		●	●	■	●	●	▲		■	▲	●		●			♦		●	●
Hydrazine	●	▲	●	▲		●	■	■	▲	●	■	▲			■		■		▲	●	
Hydrobromic Acid		■		●			♦	●	●	▲	■						■		●		
Hydrobromic Acid, Gas		■	●			●	●	■			▲			■			■	■	♦	●	
Hydrochloric Acid	●	■	●	●	■	♦				●		■		■	■	●	♦		■		
Hydrocyanic Acid		▲	▲	●		●	●	▲	●		▲	▲	▲	■	■		■		▲	●	
Hydrofluoric Acid	●	■		●			■	■		●				■	■		■			●	
Hydrogen Gas		●	●	●		●	●	♦	●		▲	●		▲			●	♦	▲	●	●
Hydrogen Peroxide	●	■		▲	▲			▲	▲	●		▲	■					■	●		
Hydroquinone		■	■	▲			▲	▲			▲	■	■	■	♦				■	●	
Iodine		▲	▲	●		▲	●	●	▲	●	■	■	●				■	♦	▲	●	●
Iso Octane	●	●	■	●	■	●	●	▲	●	■	▲	●	●	●		▲	■	■	●	●	●
Isobutyl Alcohol		▲	●	●		●	●	▲	●	●	●	●	▲	■	▲		■	●	●	●	●
Isopropanol		●	●	●	●	●	●	▲	●	●	●	▲	▲	■	●		■	●	●	●	●
Isopropyl Acetate		■	▲	●		▲	■	■	■	●	■	■	■	■	▲		■	■	■	●	■
Isopropyl Chloride		■	■	●		■	●	▲	♦	●	■	■	■	■	■		■	■	■	●	
Isopropyl Ether	■	▲	■	●		■	■	♦	♦	●	■	■	▲	♦	●		▲	■	■	●	■
JP 3 MIL-J5624		●	■	●	●	■	●	▲	■	●	■	■	●	▲	▲		♦	■	■	●	
JP 4 MIL-J5624		●	■	●	●	■	●	▲	■	●	■	■	●		▲		♦	■	■	●	
JP 5 MIL-J5624		●	■	●	●	■		▲	■	●	■	■	●		▲		▲	■	■	●	
JP 6 MIL-J25656		●	■	●	●	■	●	▲	■	●	■	■	●	▲	▲		♦	■	■		
Kerosene	●	●	■		●	■	●	●		●	■	♦	●		▲	●		■	■	●	♦
Lacquers		■	■	●	■	■	■	■	■	●	■	■	■	■	●		■	■	■	●	
Lacquer Solvents	■	■	■	●	■	■	■	■	■		■	■	■	■	●		■	■	■	●	■
Lard, Animal Fat		●	♦	●	●	▲	●	●	▲	●	■	▲	●	●	■			▲	■	●	●
Lindol, Hydraulic Fluid (Phosphate Ester Type)		■	●	●		●	▲	♦	■	●	■	■	●	■	■		■	♦	■	●	■
Linoleic Acid		▲	■	●		■	▲		■		■		▲		■			▲	■	●	
Linseed Oil	●	●	▲	●		♦	●	●	▲	●	■	●	●	●	▲		▲	●	■	●	
Liquefied Petroleum Gas (LPG)		●	■	●	●	■	●	▲		●	■		●		●			■	■	●	●
Lubricating Oils, Petroleum Base		●	■	●	●	■	●	●	■		■	▲	■	●	♦		▲		■	●	●
Lye		■	●	●	▲	●	▲	▲	●	●	▲	●	▲	■			▲	●	▲	●	

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	Aflas™	Buna-N (Nitrile)	Butyl	Chemraz®	Epichlorohydrin	Ethylene-Propylene	Fluorocarbon	Fluorosilicone	Hypalon®	Kalrez®	Natural Rubber	Neoprene®	Nitrile, Hydrogenated	Polyacrylate	Polysulfide	Polyurethane, Cast	Polyurethane, Millable	Silicone	Styrene Butadiene	Teflon®,Virgin	Vamac®
Malathion		▲	■	●		■	●	▲			■						■	■	■		
Maleic Acid		♦	■	●		■	●		■	●	■	■	■	■	▲			■	■	●	●
Mercuric Chloride		●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	
Mercury		●	●	●	●	●	●		●	●	●	●	●		●		●	●	●	●	●
Methane		●	■	●	●	■	●		●	●		▲	●	▲	▲		♦			●	●
Methanol		▲	■	●		●		●	●	●	●	●	●	▲			♦	●		●	●
Methyl Acetate		■	▲	●	■	▲	■	■		●	■		■		▲		▲	■		●	■
Methyl Acrylate		■	▲	●		▲	■	■	■	●	■	■		■	▲		■	■	■	●	■
Methyl Alcohol	●	●	▲	●		●	♦	●	●	●	●	▲				●	▲	●		●	●
Methyl Bromide		▲		●			●	●	■	●		■	▲	♦			■		■	●	
Methyl Butyl Ketone		■	●	●		●	■	■	■	●	■	■	■	■	●		■	■	■	●	■
Methyl Cellosolve	●	♦	▲	●		▲	■	■		●	■	▲	♦	■			■	■	■	●	■
Methyl Chloride	●	■	■	●		■	●	▲	■	●	■	■	■	■	■		■	■	■	●	■
Methyl Ether		●		●		●	●	●	♦	●		♦	●	■	●			●	●	●	
Methyl Ethyl Ketone (MEK)	■	■	●	●	■	●	■	■	■	●	■	■	■	■	▲	■	■	■	■	●	■
Methyl Isobutyl Ketone (MIBK)	■	■	♦	●	■	▲	■	■	■	●	■	■	■	■	▲		■	■	■	●	■
Methyl Mercaptan			▲			●									▲					●	
Methyl Methacrylate		■	■	●		■	■	■	■		■	■	■	■	▲		■	■	■	●	■
Methyl Oleate		■	▲	●		▲	●	▲	■		■	■	■						■	●	
Methyl Propyl Salicylate	▲	■	▲			▲	▲		■		■	■								●	
Methylacrylic Acid			▲	●		▲	▲				■	▲								●	
Methylene Chloride		■	■	●			▲	▲	■	●	■	■		■	■		■	■	■	●	■
MIL-F-25558 (RJ-1)		●	■	●	●	■	●	●	▲	●	■	▲	●	●	●		■	■	■		
MIL-F-25656		●	■			■	●	▲	■		■	■		▲			▲	■	■		
MIL-G-25760		▲	■			■	●	▲	▲		■	▲		▲			▲	■	■		
MIL-H-5606	●	●	■			■	●	●	▲	●	■	▲		▲		●	▲	■	■		
MIL-H-7083		●	●			●	▲	●	▲		▲	▲		■			■	●	▲		
MIL-J 5624 JP-3, JP-4, JP-5		●	■	●	●	■	●	▲	■	●	■	■	●	▲	▲		♦	■	■	●	
MIL-L-25681		▲	●			●	●	▲	▲		▲	▲		▲			♦	■	▲		
MIL-R-25576 (RP-1)		●	■	●	●	■	●	●	♦		■	♦	●	●	●			■	■		
MIL-S-3136, Type 1 Fuel		●	■			■	●	●	▲		■		▲	●			●	■	■		
MIL-S-81087		●	●			●	●	●	●		●	●	●	●				♦	●		
Milk		●	●			●	●	●	●	●	●	●		■	▲			●	●	●	●
Mineral Oils		●	■	●	●	■	●	●	●		■	●	●	●	▲	●	●	▲	■	●	●
Monovinyl Acetate		■	●			▲		●	♦		■	■		■			■	■	■	●	

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N-Hexaldehyde		■	▲	●	●		■	■	♦		■	●			▲		▲	▲	■	■	
N-Octane		▲	■	●		■	●	▲	■		■	■		■	■		■	■	■	●	
Naphtha	●	●	■	●	●	■	●	■	■	●	■	■	▲	▲	▲	●		■	■	●	■
Naphthalene	●	■	■	●		■	●	●	■	●	■	■	■		■		▲	■	■	●	
Naphthalenic	●	▲	■	●		■	●	●	■	●	■	■			▲			■	■	●	
Natural Gas		●	■	●	●	■	●		●	●		●	●	▲	▲		♦		♦	●	●
Neatsfoot Oil		●	▲	●		▲	●	●	■	●	■	■	●	●	■		●	▲	■	●	
Nitric Acid	●	■	■	▲	■				■	●	■		■	■	■				■	●	
Nitrobenzene	●	■	▲	●	■	●		■	■	●	■	■	■	■	■		■	■	■	●	■
Nitroethane	●	■	▲	●		▲	■	■	♦	●	▲	♦		■			■	■	▲	●	
Nitrogen, Gas		●	●	●	●	●	●	●	●	●	●	●		●	●		●	●	●	●	●
Nitrogen Tetroxide		■	♦	■			■	■	■		■	■	■	■	■		■	■	■	●	
Nitromethane		■	▲	●		▲	■	■	♦	●	▲	■	■	■			■	■		●	
Nitropropane		■	▲	●		▲	■	■	■	●	■	■		■			■	■	■	●	
N-Pentane		●	■	●		■	●	♦	▲		■	●		●	●		■	■	♦		
Octyl Alcohol		▲	▲	●		▲	▲	▲	▲		▲	▲	▲		▲		■	▲	▲	●	●
Oleic Acid	●	●	■	●	●	♦	●	●	▲	●	■	♦	●	▲	●		▲	■	■	●	
Oleum (Fuming Sulfuric Acid)		■	■	●	■	■	▲	■	■	●	■	■	▲	■	■		■	■	■	●	■
Oronite 8200		▲	■	●		■	●	●	■		■	●	▲				●	■	■		
Oxalic Acid		▲	●	●	♦	●	●	●	●	●	♦	▲	▲		■		▲	▲	●		●
Oxygen, Cold		▲	●		▲	●	●	●	▲	●	▲	●	■	▲	■		●	●		●	
Oxygen, 200-400°F		■	■	●	■	■	▲					■	■	■	■		■		■	●	
Ozone		■	●	▲		●	●	●	●		■	▲	♦	▲	▲		●	●	■		●
Peanut Oil		●	♦	●	●	♦	●	●	▲	●	■			●	■		▲	●	■	●	
Petroleum Oil		●	■	●	●	■	●	●	▲		■	●		▲	■	●	▲	■	■	●	
Phenol	●		▲	●	♦	■	●	▲	■	●	■	■	■	■	■		■	■	■		■
Phenylhydrazine		■	■	●		■	●		■		●	■	■	■	■				▲	●	
Phosphoric Acid		■	▲	●		●	●	♦	▲	●	■	■		♦	■			■	▲	●	▲
Phosphorous Trichloride		■	●	●		●	●	●	■	●	■	■	■	■					■	●	
Pine Oil	●	▲	■	●		■	●	●	■		■	■		●	▲		●	■	■	●	
Potassium Nitrate	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
Potassium Sulfate		●	●	●	●	●	●	●	●	●	●	●	●	■	▲		●	●	■	■	
Producer Gas		●	■	●		■	●	▲	▲		■	▲	●	▲	■		●	▲	■	▲	
Propane		●	■	●	●	■	●	▲		●	■	♦	●		●			■	■	●	●
Propanol		●	●	●	●	●	●	●	●		●	●	●	■	●		■	●	●	■	●

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Propyl Acetate		■	▲	●	■	▲	■	■	■		■	■	■	■	▲		■	■	■	■	
Propyl Alcohol	●	●	●	●	●	●	●	●	●		●	●	●	■	●		■	●	●	●	●
Propylene		■	■	●		■	●	▲	■	●	■	■	■	■	▲		■	■	■	●	
Propylene Oxide		■	▲	●		▲	■	■	■	●	■	■	■	■			■	■	■	●	
Pydraul, 230C, 312C, 540C		■	■	▲	■	■	●	■	■		■	■	■	■	■		■	■	■	●	■
Pydraul, 30E, 50E, 65E, 90E		■	▲	▲	■	▲	●	●	■		■	■	■	■			■	●	■	●	■
Pydraul, 10E		■	▲	▲	■	▲	●	■	■		■	■	■	■			■	■	■	●	
Pyranol, Transformer Oil		●	■	●	■	■	●	●	▲		■	▲	●	●	■		▲	■	■		●
Pyrogard42,43, 53,55 (Phosphate Ester)		■	●	●		●	●	■	■		■	■	■	■	■		■	■	■	●	
Radiation		♦	■	▲		♦	■	■	♦		♦	♦	♦	♦	■			▲	♦	●	●
Rapeseed Oil		▲	●	●	●	●	●	●	■		■	▲	▲	▲	■		▲	■	■	●	
Red Oil		●	■	●	●	♦	●	●	▲		■	♦	●	▲	●		▲	■	■	●	
RJ-1 (MIL-F-25558)		●	■	●	●	■	●	●	▲	●	■	▲	●	●	●		▲	■	■		
RP-1 (MIL-R-25576)		●	■	●	●	■	●	●	♦		■	♦	●	●	●			■	■		
Sea Water		●	●	●		●	●	●	●	●	●	▲	●		■			●	●	●	●
Silicone Greases		●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	♦	●	●	●
Silicone Oils		●	●	●	●	●	●	●	●	●		●	●	●	●		●	■	●	●	●
Silver Nitrate		▲	●	●	■	●	●	●	●	●	●	●	▲	●	▲		●	●	●	●	
Skydrol 500	●	■	▲	●	■	●	■		■	●	■	■	■	■	■	▲	■	♦	■	●	■
Sodium Bicarbonate		●	●	●	●	●	●	●	●	●	●	●	●	■	♦		●	●	●	●	●
Sodium Carbonate	●	●	●	●	●	●	●	●	●	●	●	●	●	■	■		▲	●	●	●	●
Sodium Chloride	●	●	▲	●	●	●	●	●	●	●	●	●	●	●	♦		●	●	●	●	●
Sodium Hydroxide	●	●	●	●		●				●		●									
Soybean Oil		●		●	●	■	●	●		●	■	●	●	●	■		▲	●	■	●	▲
Steam to 350°F	●	■	▲			●	■	■	■	●	■		●			■	■	■		●	
Stearic Acid	●	●	▲	●	▲	▲	●	♦	♦	●		▲	▲	■	▲		●	▲	●	●	
Stoddard Solvent		●	■	●	●	■	●	●	■	●	■	♦	●	●	▲		▲	■	■	●	♦
Styrene Monomer	▲	▲	▲	●		■	▲	♦	■	●	■	■	■	■	■		♦	■	■	●	■
Sucrose Solutions		●	●	●		●	●	♦	▲	●	●	●	▲	■	■			●	●	●	
Sulfur Chloride		■	■	●		■	●	●		●	■	■	■	■	■		♦	♦	■	▲	
Sulfur Dioxide Gas, Dry		■	▲	●		●	●	▲		●	♦	■	■	■	■			▲	♦	●	▲
Sulfur Dioxide Gas, Wet	●	■	●	●		●	●	▲		●		▲	■	■	■		♦	▲		●	▲
Sulfur Dioxide, Liquefied Under Pressure		■	▲	●		●	■	▲	■		■	■	■	■	■			▲	■		
Sulfur Hexafluoride		▲	●	▲	●	●		▲	▲		■	●	▲	■	♦		▲	▲	■	●	
Sulfur Trioxide		■	▲	▲		♦	●	▲	■	●	♦	■		■	■		■	▲	■	●	

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Sulfuric Acid (Concentrated)	●	■			■					●					■					●	■
Sulfurous Acid	●	♦	●	●		●	●		●	●		▲	▲	■	■		■	■	▲	●	
Tannic Acid		●	●	●	▲	●	●	●	●	●	●	●	●	■	●		●	▲	▲	●	▲
Tartaric Acid		●	▲	●	▲	♦	●	●	●	●	●	●	●		■		●	●	▲	●	▲
Tertiary Butyl Alcohol		▲	▲	●		▲	●	▲	▲		▲	▲	▲	■	▲		■	▲	▲	●	
Tertiary Butyl Mercaptan		■	■	●		■	●		■		■	■	■	■	■		■	■	■	●	
Tetrabromoethane		■	■	●		■	●	▲	■		■	■	■	■	■		■	■	●		
Tetrabutyl Titanate		▲	▲	●		●	●	●	●		▲	▲	▲						▲	●	
Tetrachloroethane		■	■	●		■	●		▲	●	■	■	■	■	●		■	■	■	●	
Tetrachloroethylene		♦	■	●		■	●	▲	■	●	■	■		■	■		■		▲	●	
Tetraethyl Lead		▲	■	●		■	●		■	●	■	♦	▲				▲		■	●	
Tetrahydrofuran		■	▲	●		■	■	■	■	●	■	■	■	■	●		■	■	■	●	■
Tetralin		■	■	●		■	●	●	■		■	■	■	■	■		■	■	■	●	
Toluene	■	♦		●		■	●	▲	■	●	■	■	■	■			■	■	■	●	■
Transmission Fluid, Type A		●	■	●	●	■	●	●	▲		■	▲	●	●	●		●	▲	■	●	●
Triethanolamine	●	▲		▲		●	■	■	●	●	▲	■	♦	■	■		■	■	▲	●	
Turbine Oil		▲	■	●	●	■	●	▲			■	▲	●	▲	●		●	■	■	●	●
Turpentine	▲	●	■	●	●	■	●	▲	■	●	■	■	●	▲	▲		■	■	■	●	
Varnish		▲	■	●		■	●	▲	■	●	■	■	▲	■	●			■	■	●	●
Vinegar		▲	●			●	●	♦	●	●	▲	▲		■	▲			●	▲	●	▲
VV-H-910		♦		●	▲	●	●	▲	▲		▲	▲	♦		■		■		●		
Wagner 21B Brake Fluid		▲	▲	●		●	■	■	▲			▲	♦	■	■		■	♦	●	●	■
Water, Fresh	●	●	●	▲	▲	●	▲	●	●	●	●	▲	●	■	■		●	▲	▲	●	●
Whiskey		●	●	●		●	●	●	●	●	●	●	●	■	■		■	●	●	●	●
White Pine Tar		▲	■	●		■	●	●	■		■	■	▲		▲			■	■	●	
Xylene	▲	■	■	●	■	■	●		■	●	■	■	■	■	▲		■	■	■	●	■

This chemical compatibility information is for use as a general guideline only.
The customer assumes sole responsibility for the design and must test and verify the material of the seal for each specific application.

GLOSSARY OF TERMS USED IN THE RUBBER INDUSTRY

ABRASION RESISTANCE	ASTM REFERENCE	BS REFERENCE	ISO REFERENCE
Abrasion properties of rubber are difficult to define. Many different abrasion machines have been designed but they do not always give similar results. The most common abraders are AKRON, Dunlop and DuPont. Results are recorded as volume loss per standard test piece, or as the difference in volume loss when compared with a standard material of known abrasion value. Indices of relative abrasion are also used.	D394	BS 903 Part A9	
ACCELERATED AGEING			
Heat ageing is widely used as a method of evaluating long term ageing properties. Hardness and dumbbell type tensile test pieces are placed in an air circulating oven for a specific period of time at a given temperature (e.g. 7 days at 70°C 0. The properties of the rubber are then tested and compared with the properties before ageing. The percentage retained for each property is recorded (change in hardness is recorded in degrees).	D573	BS 903 Part A19	/// ISO 188
CHEMICAL RESISTANCE - Link to DuPont Chemical Resistance Guide			
This is usually expressed as the change in properties (such as hardness, strength and elongation at break) caused by the presence of chemicals under defined conditions (including concentration, time and temperature).			
COEFFICIENT OF FRICTION			
Ratio of the force needed to move an elastomer over a given surface to the total forces pressing on the elastomer and surface.			
COMPRESSION SET			
A cylindrical button of rubber of known thickness is compressed to a fixed height (typically 70% or 75% of its original height) at a defined temperature for a specific period of time. The button is then released, allowed to recover (typically for 30 mins) and the thickness is measured. Compression Set is the height that is not recovered expressed as a percentage of the amount by which it was compressed. $\%\ \text{Comp. Set} = \frac{\text{original height} - \text{recovered height}}{\text{original height} - \text{compressed height}} \times 100$	D395	BS 903 Part A6	// ISO 815
DIELECTRIC STRENGTH / ELECTRICAL PROPERTIES			
The resistance of an elastomer to the conducting of an electrical current. Anti-static and conductive properties of rubbers are defined by measuring their electrical resistance. Typical measurements are obtained through the thickness of a sample by using 25mm sq. electrodes under a pressure of 45N and applying a voltage of 500V DC @ approx. 6mA. (Energy dissipated into the test piece is limited to 3W max.) The surfaces should be cleaned before measuring. Patterned surfaces should be wetted with a conductive solution or paint. Results should be recorded in Ω, defining the conditions of testing.	D991 & D257	BS 2050	

FLAME RESISTANCE	ASTM REFERENCE	BS REFERENCE	ISO REFERENCE
Flame resistance testing requires a standard burner and fuel which gives a flame of known characteristics. Rubber samples are then placed at a certain position in the flame and removed after an ignition period. The time taken for the rubber to self-extinguish is recorded with notes regarding afterflow and any hot particles emitted by the sample at any stage		BS 2011	
FLUID RESISTANCE / VOLUME SWELL			
Fluid resistance is commonly measured by the effect of the fluid on the volume of the rubber exposed as a volume change (e.g. +100% indicates that the volume of the rubber has doubled as a result of exposure to the fluid, -10% indicates that the volume of rubber has decreased as a result of exposure to the fluid). Volume change is measured by determining the weight of a sample in air and water before and after exposure to the fluid under defined conditions. The sample is normally totally immersed in the fluid. Volume Change % $\frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$ Fluid resistance may also be defined in the same way as chemical resistance (above) i.e. by change in properties of the rubber. W_1 Wt in air (initial) W_2 Wt in water (initial) W_3 Wt in air (swollen) W_4 Wt in water (swollen)	D471	BS 903 Part A16	/// ISO 1817
ELONGATION AT BREAK			
Elongation is defined as the length at breaking point expressed as a percentage of its original length (i.e. length at rest) e.g. if a rubber reaches twice its length before breaking its elongation is 100%.	D412	BS 903 Part A2	// ISO 37
HARDNESS			

Measured in degrees and based on the penetration into the rubber of a defined indentor under a set load. Three scales are commonly used: IRHD (International Rubber Hardness Degrees), Shore A and Shore D for hard materials over 90° Shore A. IRHD is preferred for most specifications but Shore A is also in widespread use.	D2240
	D1415
		BS 903 Part A26	// ISO 48
			// ISO 1400
			// ISO 1818

HYSTERESIS			
The build up of heat in an elastomer sample caused by rapid deformation			
MODULUS			
Modulus is measured as the force per unit area required to extend a rubber to a stated percentage of its original length e.g. to 100%, 200% or 300%. It is often written as M100 = 3.0 MPa (i.e. modulus at 100% = 3.0 Mpa).	D412	BS 903 Part A2	// ISO 37
OZONE RESISTANCE			
Ozone causes cracking in rubber. Test pieces are usually placed under a small degree of tension e.g. by bending round a mandrel or stretching by 5%. The sample is exposed under static conditions to a controlled atmosphere containing ozone (typically 50 pphm). The cracks are graded by standard photographs, by measurement or by description, e.g. 'visible under 10 x magnification' 'visible to the unaided eye' etc. Results may be recorded as the time taken to reach a particular grade of cracking, or by the grade of cracking apparent after a fixed period of time.	D1149	BS 903 Part A43	/// ISO 1431/1

TEAR STRENGTH	ASTM REFERENCE	BS REFERENCE	ISO REFERENCE
Tear Strength is measured as the force required to tear a standard piece. The standard test pieces are designed to produce weak points where a tear is initiated	D624	BS 903 Part A3	/// ISO 34
REBOUND RESILIANCE			
The measure of the rebound (bounce) of a metal ball dropped at a given height onto an elastomer sample. Resilience is measured on standard test equipment (of which there are several types – e.g. Dunlop, Tripsometer, Lupke, Rebound). Standard test pieces are struck by the 'hammer' and the 'bounce back' of the hammer measured. This is expressed as a percentage of the flight path of the hammer	D1054 D2632	BS 903 Part A8	// ISO/R 1767
TENSILE STRENGTH			
This is measured in various units and is expressed as a force per unit area. A standard dumbbell type test piece of known cross sectional area is used which is stretched until it breaks. The force required to do so is then recorded and expressed as force per unit area.	D412	BS 903 Part A2	// ISO 37
SPECIFIC GRAVITY / DENSITY			
Density is defined as the mass per unit volume and is measured by weighing the rubber sample in air and water. S.G. $\frac{\text{Weight in Air}}{\text{Weight in air – weight in water}}$		BS 903 Part A1	/// ISO 2781
WEATHER RESISTANCE			
Weather resistance is a fairly subjective test and it is necessary to state clearly the conditions under which the exposure took place i.e. dates, geographic location, angle and direction of exposure relative to the sun etc. The properties of test pieces are measured before and after exposure and expressed as percentage changes (with exception of hardness changes which are usually recorded in degrees). The change in any property may be measured but the most common are hardness, tensile strength, elongation at break and modulus at 100% and 300%.	D1171	BS 903 Part A53 BS 903 Part A54 BS 903 Part A55	
THERMAL CONDUCTIVITY			
The ability of an elastomer to conduct heat.			

This guide is intended to assist understand the most frequently used terms from the rubber industry.
The information contained should be used in conjunction with the national & international standards and legislation relating to properties and safe application of rubber. Ultimately it is the direct responsibility of the customer to make the final decision as to the suitability of a rubber material for a particular application.

MAKE AN ENQUIRY

Do you have an enquiry?

If you have a question about us, our products and service levels, or something more specific about industrial rubber and its uses, why not ask? We'll try to help, and even if we can't, we can probably point you in the right direction.

Don't forget to check out our information section of our website – you may find the answer to your question there!

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Your Question?

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Your Telephone No.

Company Name

Company Address

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Product required and quantity

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