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TEFLON®

encapsulated

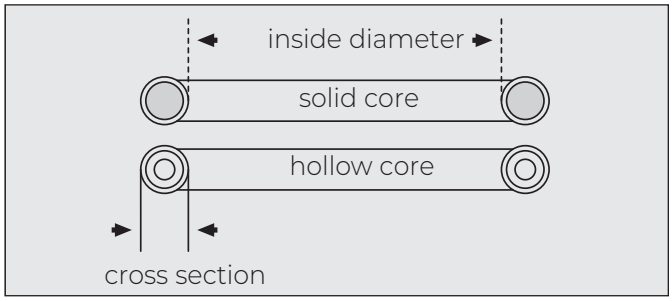
O-rings

WHAT EVER THE INDUSTRY

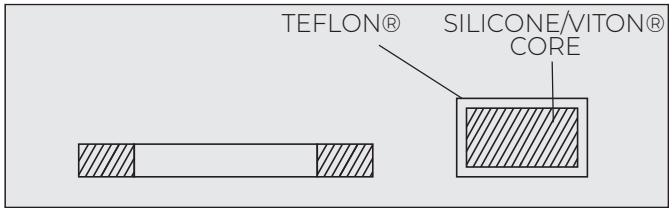
WE HAVE A PART IN IT

Encapsulating O-Rings

Consisting of a seamless and uniform TEFLON®-FEP or PFA encapsulation which completely encloses a core material of either Silicone, Viton® or EPDM elastomers. The dimensions of the O-Ring are characterised by the inside diameter and the cross section I.D. x C.S.
The seal with a solid core will provide the best resistance to compression set and also has good recovery characteristics, whilst the seal with the hollow core will provide effective sealing in cases where the amount of force is limited. The seal with a hollow core is also particularly useful in sealing delicate objects such as glass or plastics.



The encapsulated seal can also be supplied in a rectangular section. For these profiles the section diameter must not be less than 2.62mm to provide sufficient elasticity. See also Hose Coupling gaskets.



The seamless, uniform and integral TEFLON® encapsulation of the O-Ring is responsible for the sealing effect, whereas the continuous reset and the constant pressure of the encapsulation onto the sealing point is accomplished by the elastomer core. The result is an overall sealing compression, increasing with medium pressure. The encapsulated O-Ring behaves like a highly viscous fluid, any pressure exerted on the seal is transmitted practically undiminished in all directions.

Standards

Encapsulated O-Rings are manufactured to all international standards in the following cross sections:

AS/BS Sizes	Preferred Metric		
1.78 mm	1.60 mm	5.00 mm	9.50 mm
2.62 mm	1.80 mm	5.50 mm	10.00 mm
3.53 mm	2.00 mm	5.70 mm	11.00 mm
5.33 mm	2.40 mm	6.00 mm	12.00 mm
6.99 mm	2.50 mm	6.35 mm	12.70 mm
	3.00 mm	6.50 mm	14.00 mm
	3.15 mm	7.00 mm	15.00 mm
	3.50 mm	8.00 mm	16.00 mm
	4.00 mm	8.40 mm	18.00 mm
	4.50 mm	9.00 mm	20.00 mm

Other special sizes can be offered subject to minimum order quantities.

Thickness of Encapsulation

As described earlier, the O-Ring has a seamless and uniform TEFLON®-FEP or PFA encapsulation which completely encloses an elastomer core material. Due to the actual manufacturing processes, certain relations between the O-Rings internal diameter, the section diameter and the thickness of the TEFLON® encapsulation must be observed.

Cross Section	Thickness	Tolerance
2.62 mm	0.279 mm	+/- 0.076 mm
3.00 mm		
3.53 mm	0.305 mm	
4.00 mm		
5.00 mm	0.381 mm	
5.33 mm		
5.70 mm		
7.00 mm	0.508 mm	

Properties

- High chemical resistance due to the TEFLON® encapsulation.
- Operational temperature range of FEP -60°C to +204°C.
- Operational temperature range of PFA -60°C to+260°C.
- Anti-adhesive properties/non-stick surface.
- Sterilisable- FDA approved
- Low vapour permeability and minimal water absorption.
- Low compression set.
- 98% of all technical applications are within the operating temperature range.
- The elastomer core of the O-Ring ensures a continuous intensive contact with the sealing surface.
- TEFLON® resins and Silicone, Viton® or EPDM elastomers combine to make the O-Ring an inexpensive, efficient and economical solution to many critical sealing problems.

Chemical Resistance

The TEFLON® encapsulation is the essential component of the seal which is resistant to practically all chemicals. Within normal use temperatures, TEFLON® resins are attacked by so few chemicals that it is more practical to describe the exceptions rather than to tabulate the chemicals with which they are compatible. Molten alkali metals, fluorine and several complex halogen compounds (chlorine trifluoride) are incompatible with TEFLON® resins. In some instances at or near the suggested service limit temperature of TEFLON®-FEP 204°C and TEFLON®-PFA 260°C a few chemicals at high concentrations have been reported to be reactive. Attack has been produced at such high temperatures by 80% NaOh or KOH, metal hydrides such as boranes (e.g. B2 H6), aluminum chloride, ammonia (NH_3), and certain amines R-NH_2) and imines (R=NH).
Also slow oxidative attack has been observed by 70 % nitric acid under pressure at 250°C. Special testing is required when such extremes of reducing or oxidising conditions are approached. Except for the chemicals under the conditions mentioned, it can be said that the encapsulated O-Ring, in general, is chemically inert. Therefore, the seal can be in continuous contact with another substance without any chemical reaction or degradation taking place. For example, the O-Ring can be immersed in aqua regia and nothing will happen. However, we must distinguish between chemical reactions as in the aqua regia example and physical actions such as absorption and permeation .

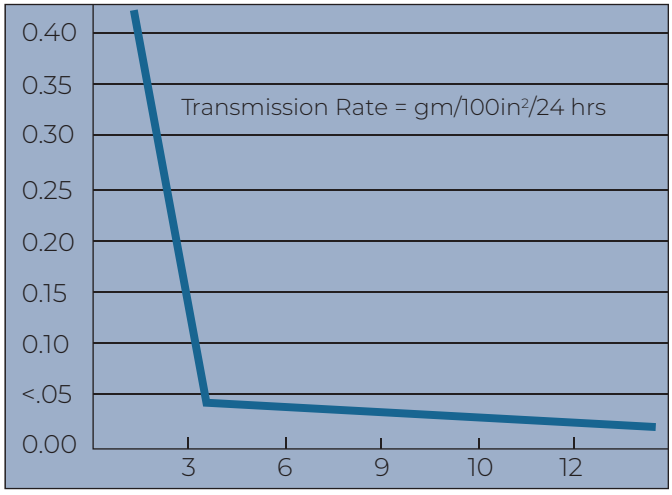
Gas Permeability

All plastics have some permeability to gases. In the case of the TEFLON® encapsulation of the O-Ring, gases and vapours will permeate at a considerably lower rate than for most other plastics. The primary permeation mechanism is intermolecular migration. This migration rate depends on the type of gas, pressure, temperature, size of contact areas and thickness of encapsulation. While highly corrosive gases do not attack the TEFLON® encapsulation of the O-Ring, they may eventually permeate through and damage the elastomer core and hence affect the mechanical properties of the seal. Thus, in addition to chemical resistance, these permeability effects must be considered in gas sealing systems.

Permeability of TEFLON®-FEP and PFA Resins

Gases[2]	23 °C	35 °C	50 °C
Carbon Dioxide/Helium			
Nitrogen	0.18		
Oxygen	0.39		
Vapours[2]			
Acetic Acid		0.42	
Acetone	0.13	0.95	3.29
Acetphenone	0.47		
Benzene	0.15	0.64	
N-Butyl Ether	0.08		0.65
Carbon Tetrachloride	0.11	0.31	
Diecane	0.72		1.03
Dipentene	0.17		0.35
Ethyl Acetate	0.06	0.77	2.90
Ethyl Alcohol	0.11	0.69	
Hexane		0.57	
Hydrochloric Acid (20%)	0.01		
Methanol			5.61
Piperidine	0.04		
Skydrol Hydraulic Fluid	0.05		
Sodium Hydroxide (50%)	4x10-5		
Sulphuric Acid	8x10-5		
Toluene	0.37		2.93
Water	0.09	0.45	0.89

Water vapour transmission rate of TEFLON® FEP and PFA Resins at 40°C.



Exposure of encapsulated O-Rings to acids, bases and solvents

Reagent	Exposure Temp °C	Exposure Time	Weight Gains %
Hydochloric Acid			
10%	25	12mths	0
	50	12mths	0
	70	12mths	0
20%	100	8hrs	0
	200	8hrs	0
Nitric Acid			
10%	25	12mths	0
	70	12mths	0.1
Sulphuric Acid			
30%	25	12mths	0
	70	12mths	0
	100	8hrs	0
	200	8hrs	0.1
Sodium Hydroxide			
10%	25	12mths	0
	70	12mths	0.1
50%	100	8hrs	0
Ammthsnium Hydroxide			
10%	25	12mths	0
	70	12mths	0.1
Solvent			
Acetone			
	25	12mths	0.30
	50	12mths	0.40
	70	2wks	0
Benzene			
	78	96hrs	0.5
	100	8hrs	0.6
	200	8hrs	1.0
Carbon Tetracholride			
	25	12mths	0.6
	50	12mths	1.6
	70	2wks	1.9
	100	8hrs	2.5
	200	8hrs	3.7
Ethyl Alcohol 95%			
	25	12mths	0
	50	12mths	0
	70	2wks	0
	100	8hrs	0.1
	200	8hrs	0.3
Ethyl Acetate			
	25	12mths	0.5
	50	12mths	0.7
	70	2wks	0.7
Toluene			
	25	12mths	0.3
	50	12mths	0.6
	70	2wks	0.6

Note: These are equilibrium test values; additional exposure times would not increase the values significantly.

Absorption

The encapsulated O-Ring absorbs practically no common acids and bases at temperatures as high as 200°C with exposures of up to one year. Even the absorption of solvents is surprisingly small; weight increases are generally less than 1% at elevated temperatures and exposure times. Due to the TEFLON® encapsulation of the O-Ring, the effects of volume swell, which is one of the principal causes of seal failure, can be virtually disregarded.

Absorption of representative liquids in TEFLON®-FEP 160 and TEFLON®-PFA 350 fluorocarbon resins.

168 HOUR EXPOSURE TO SOLVENTS AT THEIR BOILING POINTS

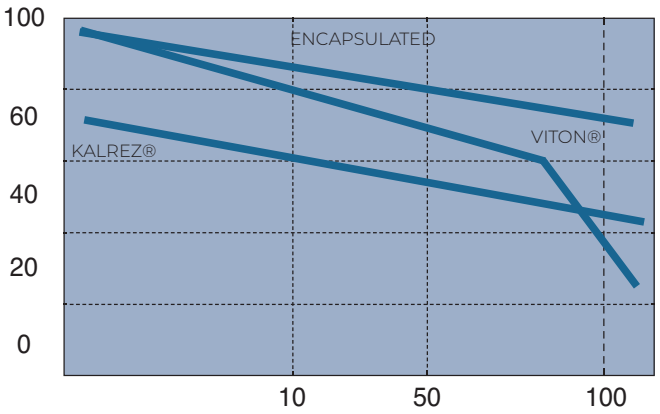
	Temperature °C	Range of Weight Gains %
Aniline	185	0.3-0.4
Acetophenone	201	0.6-0.8
Benzaldehyde	179	0.4-0.5
Benzyl Alcohol	204	0.3-0.4
N-Butile Amine	78	0.3-0.4
Carbon Tetrachloride	78	2.3-2.4
Dimethyl Sulphoxide	190	0.1-0.2
Freon 113	47	1.23
Iso octane	99	0.7-0.8
Nitrobenzene	210	0.7-0.9
Perchloroethylene	121	2.0-2.3
Sulphuryl Chloride	68	1.7-2.7
Toluene	110	0.7-0.8
Tri-butyl Phosphate	200	1.8-2.0
168 HOUR EXPOSURE TO ACIDIC REAGENT		
Bromine (anhyd)	22	0.53
Chlorine (anhyd)	120	0.5-0.6
Chlorosulphonic Acid	150	0.7-0.8
Chromic Acid 50%	120	0.00-0.01
Ferric Acid 25%	100	0.00-0.01
Hyrdochloric Acid 37%	120	0.00-0.03
Phosphoric Acid (conc)	100	0.00-0.01
Zinc Chloride 25%	100	0.00-0.03

1) No significant differences between FEP and PFA resins in these tests.
2) Equilibrium values; additional exposure times would not increase the values.
3) PFA data only.
4) Not boiling.

Compression Set

The O-Ring resists hardening and embrittlement due to the TEFLON® encapsulation. The O-Rings retain their elasticity and recovery properties at temperatures up to 204°C due to the Silicone or Viton® core materials. The results of compression set tests, which compares the retained sealing force of perfluoroelastomer Kalrez®, fluoroelastomer Viton® and the TEFLON® encapsulated O-Ring can be observed in the following diagram.

Retained sealing force%



TIME DAYS AT 204°C HOT AIR AGED
BS 1806/AS 568 A-120 O-RINGS
25% COMPRESSION

The results of these tests have shown that by combining the mechanical properties of Silicone, Viton® or EPDM elastomers and the chemical resistance of TEFLON® resins the encapsulated O-Ring possesses the ability to resist compression set and retain its mechanical properties in adverse conditions.

Groove Design Criteria

Due to the many diverse applications that the encapsulated O-Ring is utilised in, the effects of thermal expansion, extrusion and compression set are important considerations in groove design. For example, when high temperatures are involved a consideration for thermal expansion is necessary, when such conditions exist groove width should be increased in order to achieve a successful seal. The surface finish of the groove should be at least 32 microinches. It should be noted that these standard dimensions are the same as for all elastomer O-Rings and can be used as a starting point when evaluating an effective seal. In many applications these dimensions will need no modifications when machining grooves in metal. When machining grooves in TEFLON®, polypropelene and other plastics, it is recommended that the groove width be 114% of the chosen O-Ring cross section, the depth be 86% and the surface finish be 32 microinches or better.

Installation Procedure

The assembling area should be free of sharp edges, burrs, machining traces, threads, etc. A clean light lubricant may be applied to the O-Ring to minimise abrasion. It should be noted that the elasticity of the elastomer core material within the encapsulated O-Ring is impaired by the less flexible TEFLON® encapsulation. To improve flexibility for difficult installations, the O-Ring can be heated to approximately 100°C+ in boiling water, oil bath or hot air. This softens the O-Ring and allows it to be stretched. Install the O-Ring when it is still hot as it will shrink to a tight fit when cooled.

Comparison of TEFLON® Encapsulated with other O-Ring compounds

Criteria	FEP Encapsulated	PFA Encapsulated	Solid P.T.F.E.	Kalrez®	EPDM	Silicone	Viton®	Nitrile
Dilute Acids	A	A	A	A	B	B	A	C
Concentrated Acids	A	A	A	A	D	D	B	D
Dilute Alkalis	A	A	A	A	B	B	A	C
Concentrated Alkalis	A	A	A	A	D	D	B	D
Solvents	A	A	A	A	C	C	B	C
Oils & Greases	A	A	A	A	D	B	A	A
Water & Steam	A	A	A	A	A	B	B	C
Ozone	A	A	A	A	A	A	A	D
Non-Stick	A	A	A	D	D	D	D	D
Flexibility	B	B	D	B	A	A	A	A
Compression Set	A-B	A-B	B	B	A	A	A	A
Temperature Range ˚C	-60	-60	-160	-40	-55	-5	-20	-40
	+204	+260	+230	+316	+150	+230	+205	+110

General Specification

- Encapsulation material: TEFLON®-FEP 160 or PFA 350 fluorocarbon resins.
- Core material: Silicone Viton® or EPDM.
- Continuous service temperature FEP: -60°C to +204°C.
- Continuous service temperature PFA: -60°C to +260°C.
- Coefficient of friction: .1 to .2.
- Coefficient of linear thermal expansion: 1.0 x 10-4 in/in/°F.
- Elongation at break: 100 % - 156 %.
- Water absorption: <0.01.
- Average Shore A hardness 85-90 for solid Silicone core 90-95 for solid Viton® core and 75-80 shore A for hollow Silicone core.
- FDA Compliance: The clear TEFLON® encapsulation of the O-Ring complies with part 177 of Title 21 of the Food and Drug Administration regulations.

Tolerances

These are generally in accordance with BS1806 and DIN3771 but it should be noted the encapsulated O-Ring is formed from an extruded core material and an extruded outer sleeve of TEFLON® FEP or PFA, it therefore follows that some slight variance may occur as opposed to that of a moulded O-Ring.

Testing

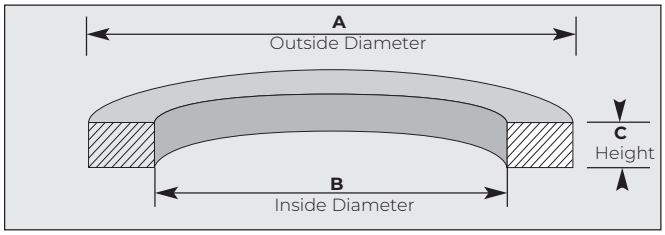
While laboratory testing of encapsulated O-Rings is a valuable screening technique, the final selection of applications must be based on functional evaluations or experience under actual end use conditions. This has become industry practice dictated by the many complex aspects of performance in severe conditions.

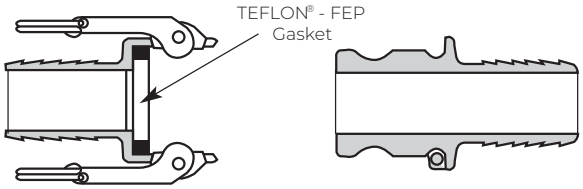
Additional Information

Should any additional information be required please telephone our technical support desk on: 01706 624422.

Quick Release Coupling - Encapsulated Gaskets

- Resistant to most chemicals due to total uniform encapsulation of TEFLON®-FEP.
- A core elastomer energiser of Silicone or Viton® provides a continuous contact with the sealing surface to give a non-stick and reusable leak free seal.
- Temperature range -60°C to +204°C.
- Sterilisable - FDA approved for use in food and pharmaceutical industries.





Coupling Size		Actual Gasket size in mm		
		A	B	C
3/4”	19.0 mm	35.0	22.2	5.54
1”	25.4 mm	39.7	27.0	6.47
1 1/4”	31.7 mm	49.2	34.5	6.47
1 1/2”	38.0 mm	55.6	41.3	6.47
2	50.8 mm	66.7	50.8	6.47
2 1/2”	63.5 mm	79.4	60.3	6.47
3”	76.2 mm	94.5	76.2	6.47
4”	101.6 mm	123.8	101.3	6.47

Bibliography

·Journal of TEFLON® resins, Du Pont publication.
·Bulletin E-2623/E-21623, Du Pont publication.
·Fluoroplastic Linings by Harvey Atkinson
·TEFLON®-KALREZ®-VITON® are registered trademarks of DuPont Performance Elastomers

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