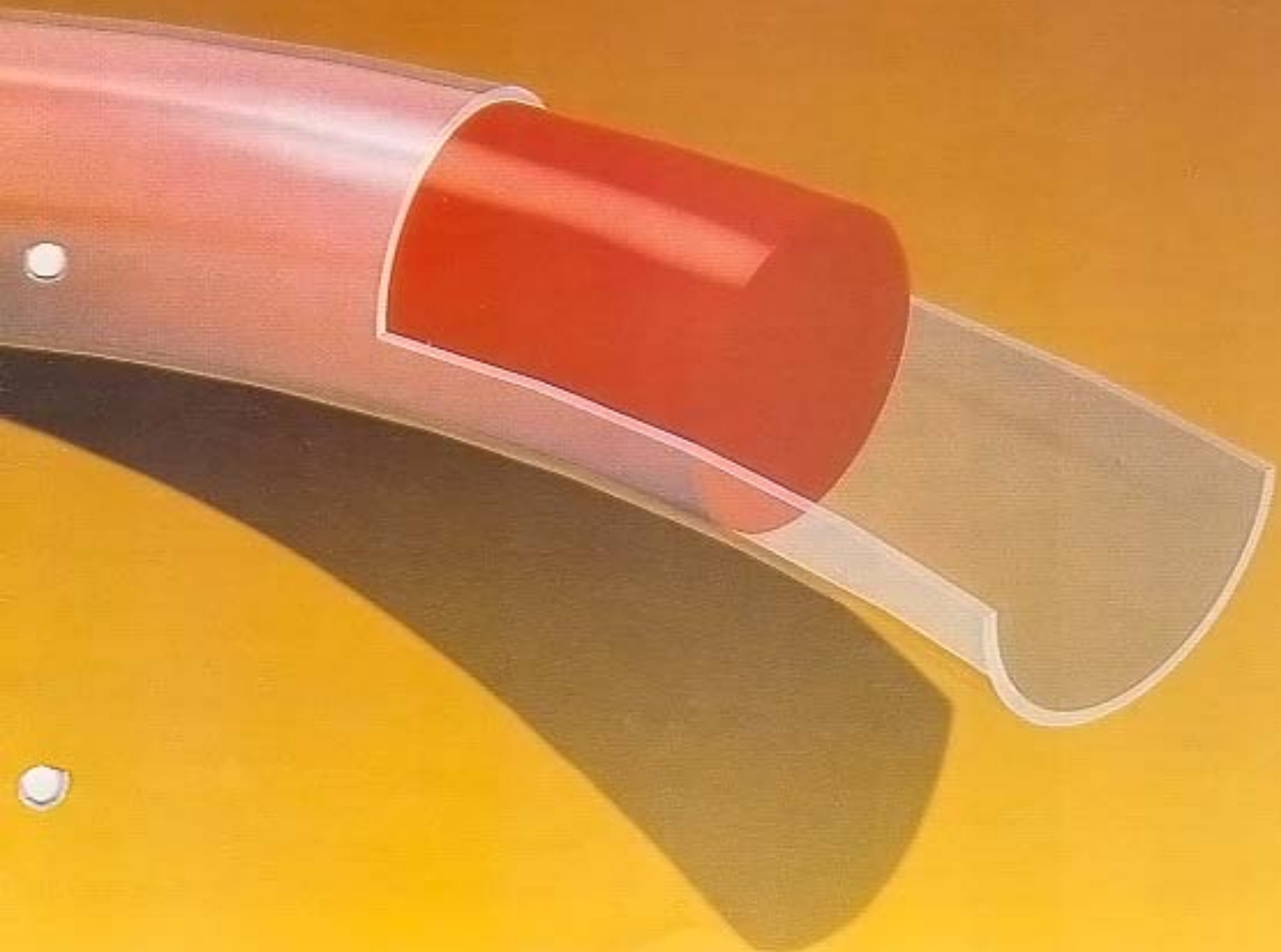
ERIKS

seals

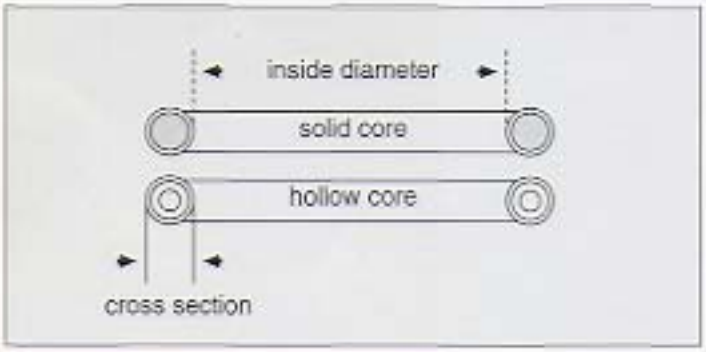
TEFLON® encapsulated O-rings



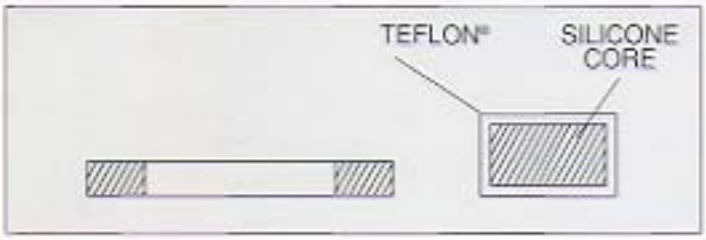
ERIKS-Encapsulated O-Rings

Consisting of a seamless and uniform TEFLON®-FEP encapsulation which completely encloses a core material of either Silicone ZZR-765B or Viton® E- 60C 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 ERIKS 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 on page 4.



The seamless, uniform and integral TEFLON®-FEP 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 ERIKS encapsulated O-Ring behaves like a highly viscous fluid, any pressure exerted on the seal is transmitted practically undiminished in all directions.

Standards

O-Rings are manufactured to conform to the following international standards.- *Special sizes can also be produced.*

BS1806/AS568A	Preferred metric	
1.78 mm	2.00 mm	4.50 mm
2.62 mm	2.40 mm	5.00 mm
3.53 mm	2.50 mm	5.70 mm
5.34 mm	3.00 mm	6.00 mm
7.00 mm	3.50 mm	8.00 mm
	4.00 mm	8.40 mm
		10.00 mm

Properties

1) High chemical resistance due to the TEFLON®-FEP encapsulation .
2) Operational temperature range of -60°C to +204°C.
3) Anti-adhesive properties/non-stick surface.
4) Sterilisable- FDA approved
5) Low vapour permeability and minimal water absorption.
6) Low compression set.
7) 98% of all technical applications are within the operating temperature range.
8) The elastomer core of the O-Ring ensures a continuous intensive contact with the sealing surface.
9) TEFLON®-FEP resins and Silicone or Viton® elastomers combine to make the O-Ring an inexpensive, efficient and economical solution to many critical sealing problems.

Chemical Resistance

The TEFLON®-FEP 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 (NH3), and certain amines R-NH2) 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 ERIKS encapsulated O-Ring, in general, is chemically inert. Therefore, the seal can be in continuous contact with another substance without a chemical reaction or degradation taking place. For example, the ERIKS 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 .

Thickness of Encapsulation

As described earlier, the ERIKS O-Ring has a seamless and uniform TEFLON®-FEP 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®-FEP encapsulation must be observed.

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

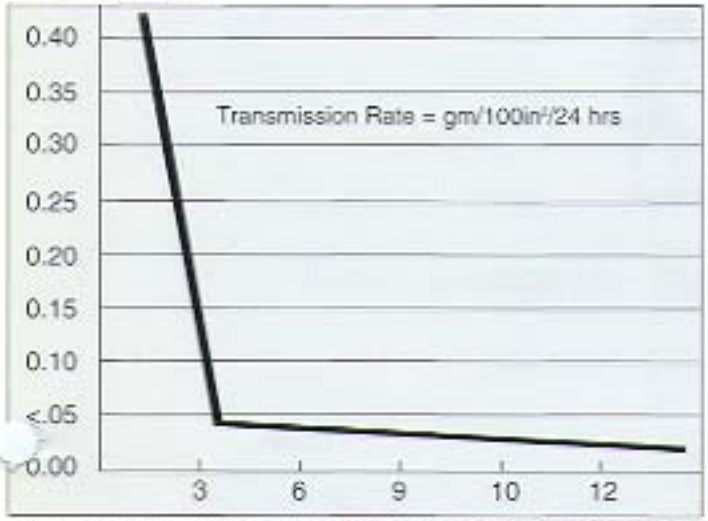
Gas Permeability

All plastics have some permeability to gases. In the case of the TEFLON®-FEP encapsulation of the ERIKS 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®-FEP 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 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	
Decane	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 Resins at 40°C.



The vapour transmission rate will significantly decrease when the thickness of encapsulation is increased.

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

REAGENT	Exposure Temp °C	Exposure Time	Weight Gains %
Hydrochloric 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 Tetrachloride			
	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®- FEP 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

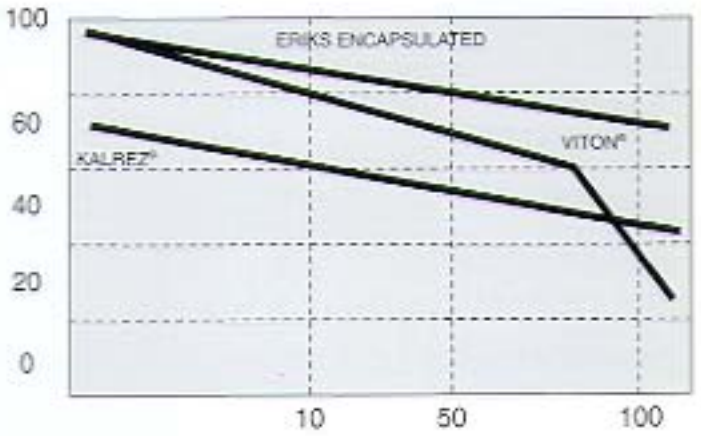
	Temperature °C	Range of Weight Gains %
Aniline	185	0.3-0.4
Acetophenone	201	0.6-0.8
Benzaldehyde	179	0.4-0.5
Benzyl Alcohol	204	0.3-0.4
N-Butile Amine	78	0.3-0.4
Carbon Tetrachloride	78	2.3-2.4
Dimethyl Sulphoxide	190	0.1-0.2
Freon 113	47	1.23
iso-octane	99	0.7-0.8
Nitrobenzene	210	0.7-0.9
Perchloroethylene	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
Chlosulphonic Acid	150	0.7-0.8
Chromic Acid 50%	120	0.00-0.01
Ferric Chloride 25%	100	0.00-0.01
Hydrochloric 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 ERIKS O-Ring resists hardening and embrittlement due to the TEFLON®-FEP 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 ERIKS TEFLON®-FEP 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-1200-RINGS
25% COMPRESSION

The results of these tests has shown that by combining the mechanical properties of Silicone or Viton® elastomers and the chemical resistance of TEFLON®-FEP resins the ERIKS-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 ERIKS 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 3... 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 FEP 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 ERIKS-TEFLON® Encapsulated with other O-Ring compounds

Criteria	Eriks Encapsulated FEP Seamless	FEP Encapsulated with Seam	Solid PTFE	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 and Greases	A	A	A	A	D	B	A	A
Water and Steam	A	A	A	A	A	B	B	C
Ozone	A	A	A	A	A	A	A	D
Temperature Range °C	+204	+200	+230	+316	+150	+230	+205	+110
	-60	-15	-160	-40	-55	-55	-20	-40
Anti-Stock	A	A	A	D	D	D	D	D
Flexibility	B	C	D	B	A	A	A	A
Compression Set	A-B	D	B	B	A	A	A	A

General Specification

1) Encapsulation material: TEFLON®-FEP 160 fluorocarbon resins.
2) Core material: Silicone ZR 765B or Viton® E-60C elastomers.
3) Continuous service temperature: -60°C to +204°C.
4) Coefficient of friction: .1 to .2.
5) Coefficient of linear thermal expansion: 1.0 x 10^{-4} in/in/°F.
6) Elongation at break: 100 % - 156 %.
7) Water absorption: <0.01.
8) Average Shore A hardness 80-85 for solid Silicone core 85-90 for solid Viton® core and 75-80 shore A for hollow Silicone core.
9) FDA Compliance: The clear TEFLON®-FEP encapsulation of the ERIKS O-Ring complies with part 177 of Title 21 of the Food and Drug Administration regulations.

Industry Applications

The encapsulated O-Ring can be utilised in a wide range of industries: For example - Aircraft & Aerospace • Chemical Process • Pharmaceutical Production • Polymer Production • Paint & Coating Operations • Food and Drink • Petrochemical • Chemical Transport • Semi-Conductor Manufacturing • Refrigeration Engineering • Photochemical • Medical Equipment. *Also used in* - Hose Couplings • Pumps • Valves • Mechanical Seals • Filtration Systems • Pipelines • Heat Exchangers • Road and Rail Tankers • Access Covers and Autoclaves etc.

Testing

While laboratory testing of ERIKS 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: 0161 832 6784 Ext. 209.

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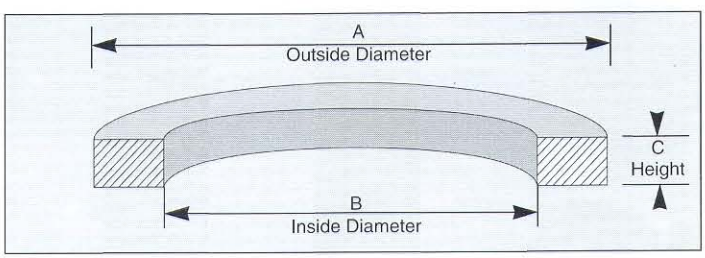
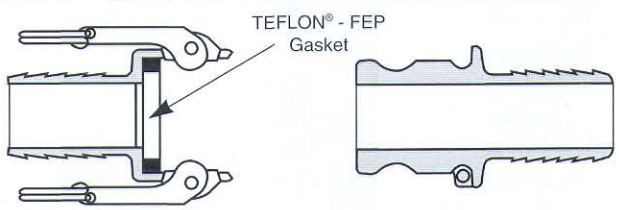
Quick Release Coupling - ERIKS - Encapsulated Gaskets

1) Resistant to most chemicals due to total uniform encapsulation of TEFLON®-FEP.
2) A core elastomer energiser of Silicone provides a continuous contact with the sealing surface to give a non-stick and reusable leak free seal.
3) Temperature range -60°C to +204°C.
4) 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 trade marks of Du Pont