EnDura® V91KF

Precision Polymer Engineering

Fluorosurfactant-free low temperature FKM for the oil & gas industry

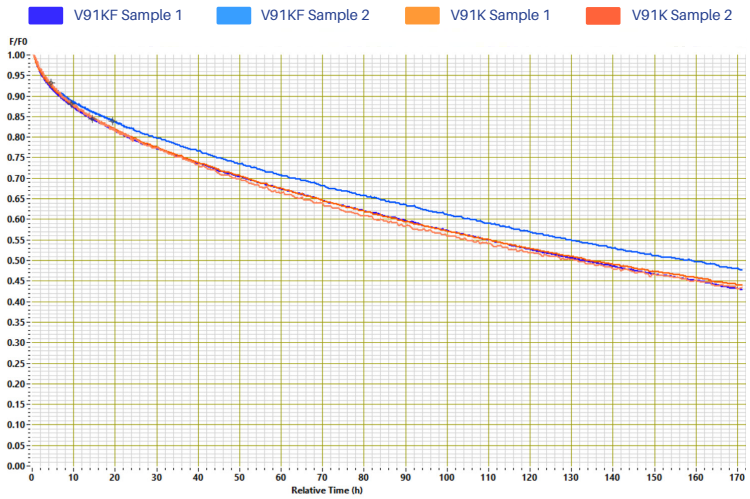
EnDura® V91KF is a fluorosurfactant-free alternative to EnDura® V91K, PPE's high mechanical strength, rapid gas decompression (RGD) resistant low temperature fluoroelastomer.

EnDura® V91KF uses a fluorosurfactant-free version of the polymer used in EnDura® V91K. The two materials are otherwise compounded and processed identically.

Extensive testing has been carried out that show, as detailed in this document, strong alignment between the original and NFS (non-fluorosurfactant) versions from a thermal, mechanical, RGD and functional sealing perspective.

Material Properties	Method	EnDura® V91K	EnDura® V91KF
Hardness (Shore A)	ASTM D412	89	90
Hardness (IRHD)	ASTM D1415	90	92
Density (g/cm^3)	ASTM D792	1.84	1.84
Tensile Strength (MPa)	ASTM D412	23	25.5
Elongation at Break (%)		143%	140%
Modulus @ 50% (MPa)		7	8
Modulus @ 100% (MPa)		16	19
Compression Set (24h @ 200°C / 392°F)	ASTM D395 Method B	11%	12%
Compression Set (24h @ 200°C / 392°F)	ISO 815 Method B	36%	36%
Compression Set (24h @ 200°C / 392°F)	ISO 815 Method C	15%	15%
Compression Set (72h @ 200°C / 392°F)	ASTM D395 Method B	20%	22%

Thermal Performance: (High Temperature)



High temperature performance has been compared using compressive stress relaxation ISO 3384-1 Method B at a constant temperature of 210°C (410°F) for 168 hours with -214 O-Rings under 25% compression.

The results show a high degree of correlation between the original and NFS materials under these conditions.

Stress relaxation is a reduction in the counter-force for maintaining the applied strain; the force is not constant but decreases with time when the material ages.

EnDura® V91KF is part of PPE's range of fluorosurfactant-free fluoroelastomer materials. It has been developed to be more environmentally sustainable.

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Thermal Performance: (Low Temperature)

Low temperature flexibility has been compared using the midpoint Glass Transition Temperature (Tg) obtained through Differential Scanning Calorimetry (DSC) ASTM D3148.

The results show a high degree of correlation between the original and NFS materials.

Material Grade	Glass Transition Temperature (°C)
EnDura® V91K	-30.5°C / -22.9°F
EnDura® V91KF	-30.9°C / -23.6°F

DSC: Comparable Glass Transition Temperature

Thermal Expansion:

The Coefficient of thermal expansion (CTE) has been compared using a thermomechanical analyser (TMA).

The results show a high degree of correlation between the original and NFS materials.

Material Grade	Coefficient of Thermal Expansion µm/(m °C)
EnDura® V91K	107 µm/(m °C)
EnDura® V91KF	112 µm/(m °C)

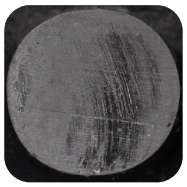
TMA: Comparable Coefficient of Thermal Expansion

RGD Performance:

Resistance to rapid gas decompression (RGD) has been compared using the 8-cycle pressure test procedure from ISO23936-2 Annex B using -325 O-Rings at 100°C (212°F) and 150bar (2175.5psi). Both materials passed the testing with 0 ratings.

Compound	EnDura® V91K	EnDura® V91KF
Specimen	O-ring	O-ring
Squeeze	16.7%	15.8%
Gland fill	86.5%	84.7%
O-ring score		
1	00000000	00000000
2	00000000	00000000
3	00000000	00000000
4	00000000	00000000
Result	Pass	Pass

EnDura® V91K O-ring cross section after testing



EnDura® V91KF O-ring cross section after testing

Sealing Performance:

Sealing performance has been compared using an arduous, proprietary fixture test using -341 O-Rings supported by profiled back-up rings. The seals are subjected to temperature cycling from ambient temperature to 177°C (350°F) and to a series of pressure reversals at a maximum pressure of 1034bar (15psi).

Unlike O-Ring extrusion testing which is typically subjective, this test is more objective, and success at each stage of the test is dependent on maintaining the pressure differential for the required duration.

The original and NFS material performed very similarly in the test conducted.