Chapter B4

FEPM

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Individual chapters of the Kalsi Seals Handbook are periodically updated. To determine if a newer revision of this chapter exists, please visit www.kalsi.com/seal-handbook.htm.

1. Seal material profile: FEPM

ASTM designation: FEPM

Common names: Tetrafluoroethylene and Propylene Copolymer

TFE/P

Trade names: Aflas (Asahi Glass Co.)

General material description

FEPM, better known by the Asahi trade name “Aflas”, is a fluorocarbon polymer offering advantages over FKM in some situations.

Compared to FKM, FEPM has substantially less high temperature compression set resistance, slightly less oil resistance, about the same resistance to acids, and better resistance to hot water, steam, explosive decompression, brine, sour downhole environments, downhole corrosion inhibitors, bases, water based drilling fluids and high ph drilling fluids. The typically quoted temperature range of FEPM is -35 to 450°F (-37 to 232°C), with a brittle point of -45°F (-43°C).

FEPM offers useful resistance to acids, alcohol, amine corrosion inhibitors, bases, brake fluid, CO_2, CH_4, gamma radiation, H_2S, hot water, methane, oil, ozone, sour gas, steam, and many hydraulic fluids.

FEPM has poor compression set resistance

The principal drawback to FEPM in rotary sealing is its poor compression set resistance. According to some sources, FEPM exhibits better compression set resistance in larger cross-sections.

Kalsi Engineering, Inc. recommends that homogeneous FEPM Kalsi Seals be axially preloaded with a spring and washer arrangement to help offset the effect of compression set. See the Engineering section for details on spring and washer implementation.

In view of the high compression set characteristics of FEPM materials, rotary seals that employ solid cross-section FEPM seals should generally only be used in applications that isolate the rotary seal from shaft deflection and runout.

Testing of homogeneous FEPM seals

The only high temperature testing with homogeneous FEPM rotary seals by Kalsi Engineering has been with low differential pressure and axial spring loading using the -8 compound. This 80 durometer Shore A compound is relatively soft, especially at high temperature, and is therefore unsuitable for high differential pressure.

The tests with the -8 material were performed with 2.75" (69.85 mm) PN 344-25-8 Kalsi Seals, with one seal facing a drilling fluid environment. The first test was about 235 hours at 522 ft/minute (2.652 m/s) using Mobil Glygoyle 30 lubricant. The first hundred hours were at 37 psi (255.1 kPa) across one seal and 47 psi (324 kPa) across the other, and the remainder of the test was at 15 psi (103 kPa) across one seal and 25 psi (172 kPa) across the other. The drilling fluid temperature was maintained at 275°F (135°C), and the bulk oil temperature was maintained between 275 and 300°F (135 to 149°C). The torque for the pair of seals was 32 to 37 in-lb (3.62 to 4.18 N·m), and the rotary leakage for the pair was about 1.45 ml/hr. The seals were in good condition at the conclusion of the test, with some protrusion of the seal into the extrusion gap due to spring force and lubricant pressure. The spring was configured to provide an axial force that was equivalent to approximately 28 to 31 psi (193.1 to 213.7 kPa) across the seal at 70°F (21.1°C), 35 psi (241 kPa) at 220°F (104°C), and 40 to 44 psi (276 to 303 kPa) at 370°F (187.8°C).

A total of 10 spring-loaded FEPM tests were performed. In another test with similar spring force to the first test, satisfactory results were achieved at 522 ft/minute (2.652 m/s) with a 375°F (190.6°C) bulk oil temperature, although the torque was higher at about 55 to 60 in-lb (6.21 to 6.78 N·m) for the pair of rotary shaft seals. Tests with significantly higher spring force were unsatisfactory, due to spring-induced flattening of the hydrodynamic geometry.

The lab testing was with substantially concentric running conditions. The ability of spring-loaded FEPM seals to follow runout has not been tested; therefore, it is recommended that FEPM seals be mounted in seal carriers that have a closely guided bearing relationship with the shaft in order to isolate the seals from runout.

Known media limitations:

Avoid acetates, ethers, ketones (MEK, acetone), halohydrocarbons (carbon tet, trichlorethylene), and toluene.

Molding shrinkage for FEPM seals

FEPM shrinks differently than HNBR during the molding process. When HNBR tooling is used to produce FEPM seal, shaft and groove dimensions may require adjustment.

FEPM seal materials (special order)

Material dash no.	Material name	Material hardness, Shore A Durometer
-7	FEPM (TFEP)	70 ±5
-8	FEPM (TFEP)	80 ±5
-9	FEPM (TFEP)	90 ±5

Accommodating high temperature differential thermal expansion

For operation above 300°F (148.9°C), FEPM rotary seals typically require a wider groove width than similar HNBR seals. Seal width prediction at various temperatures is provided in the handbook appendices.