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**To:** General Release  
**cc:**

**From:** Engineering  
**Date:** 7-Dec-06, revised 28-Jan-08,  
17-Mar-09, 22-Jan-19

Comparison of four fluoroelastomeric seal materials as used in Hawkeye Venting Gauge Hatches: Fluorocarbon (FKM, a.k.a. Viton), expanded Fluorocarbon (eFKM, a.k.a. Viton Sponge), Tetrafluoroethylene-Propylene (FEPM, a.k.a. AFLAS) and Perfluoroelastome (FFKM, a.k.a. Kalrez)

**Description:**

Fluorocarbon / FKM (DuPont Viton™) is a synthetic rubber used as an elastomeric compound for seals and gaskets. FKM is comprised of several copolymers depending on the grade. Because of the wide array of copolymers and variances in the quality of the base components, FKM characteristics can vary significantly from manufacturer to manufacturer, even location to location.

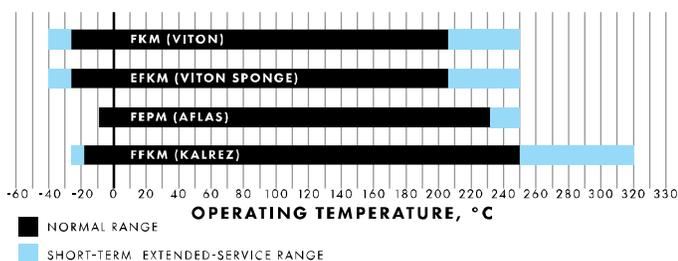
Expanded Fluorocarbon / eFKM is a closed cell sponge material made of the same DuPont Viton™ as described above. Commonly produced as a sheet with a continuous skin on each side, it is used as seals and gaskets in applications with low sealing forces.

Tetrafluoroethylene-Propylene / FEPM (Asahi Glass Co. Ltd AFLAS) like FKM, is an elastomeric compound made from copolymers. However, FEPM differs from FKM in composition as different copolymers allowing higher operating temperatures and improved chemical compatibility.

Perfluoroelastomer / FFKM (DuPont Kalrez™) is an amorphous material sharing much of the compatibility and application of a crystalline PTFE / Teflon seal, but unlike Teflon is a flexible and resilient elastomeric compound.

It should be noted that without detailed knowledge of the chemical, temperature and pressure conditions an elastomer will be exposed to, it is impossible to predict the behavior of the elastomer prior to installation in a specific application.

**Temperature Range:**



AFLAS loses flexibility at temperatures lower than -4°C. Viton remains flexible to -26°C and Viton sponge to -23°C.

AFLAS, however, has higher maximum operating temperatures, 232°C compared to 204°C for Viton. The values stated for Kalrez can vary, depending on compound, to a minimum of -26°C [-18°F] up to 300°C [572°F]

**Chemical Compatibility:**

Although FKM is incompatible with pure hydrogen sulphide, it is recommended for use with sour gas and sour crude oil by the manufacturer. Additionally, FKM is suitable for use with ethylene glycol and inorganic acids such as HCl. FKM should not be used with methanol based fluids, ammonia gas, amines, alkalis, superheated steam or organic acids like formic or acetic acid.

Since eFKM and FKM are produced from the material, with the primary difference being the final physical form, these two materials will have virtually the same chemical compatibility.

FEPM is compatible with hydrogen sulphide, and natural gas. Unlike FKM, FEPM can also be used with amines, steam, as well as bases, phosphate esters, engine oils, as well as pulp & paper liquors. FEPM is not suitable for use with aromatic fuels (i.e benzene, toluene or xylene), ketones or carbon tetrachloride.

**GENERAL FLUOROELASTOMER CHEMICAL COMPATIBILITY<sup>1</sup>**

	FKM / VITON EFKM / V. SPONGE	FEPM / AFLAS	FFKM / KALREZ	EPDM <sup>2</sup>
B T E X	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
AMINES	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
CRUDE OIL	EXCELLENT	GOOD	EXCELLENT	EXCELLENT
NATURAL GAS	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
HYDROCHLORIC ACID	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
SULPHURIC ACID	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
SOUR CRUDE OIL	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
SOUR NATURAL GAS	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT

EXCELLENT   
  GOOD   
  FAIR   
  UNSUITABLE

N.B.1 THIS CHART IS FOR REFERENCE ONLY. ALTHOUGH HAWKEYE STRIVES TO ENSURE PRESENTED INFORMATION IS ACCURATE, A QUALIFIED PERSON SHOULD ENSURE THE SUITABILITY OF A SELECTED MATERIAL IN THE SPECIFIC CHEMICAL, TEMPERATURE AND PRESSURE CONTEXT OF THEIR APPLICATION.  
2 SHOWN FOR COMPARISON PURPOSES ONLY, NOT AVAILABLE AS A SEAL MATERIAL ON HAWKEYE VENTS

FFKM is also compatible with hydrogen sulphide and natural gas, and most other compounds. Kalrez is contraindicated for fluorinated refrigerants, such as R11, R12 and so on.



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#### Hardness:

FKM, FEPM and FFKM are all solid rubber materials with lower hardness limits of approximately 55 Shore A durometer with typical values around 75 Shore A.

eFKM, being an expanded material, has a hardness of approximately 5-10 Shore A which is close to the bottom of the scale. By comparison, hard plastic seals such as PTFE (DuPont Teflon™) have a hardness of approximately 95-100 Shore A, the upper limit of the scale.

#### Sealing Performance:

The three solid rubber seal materials perform very similar in low force sealing applications as found in venting gauge hatches. The rubber seal conforms to the valve seat to form a tight seal when sealing forces are high, but as the set (opening) pressure of the valve is approached and the sealing force decreases leakage will occur. Compatible sealants can be applied to the valve to improve the sealing performance allowing the valve to remain bubble-tight up to at least 90% of the set pressure. However, set point accuracy decreases with the application of sealant and an increased opening pressure must be allowed for.

The softness of eFKM allows the seal to conform to the seat of the valve under much lower sealing forces resulting in improved dry (ungreased) sealing performance when compared to solid rubbers. The valve can maintain a bubble-tight seal up to 75-90% of the set pressure, beyond industry standards, while maintaining excellent set point accuracy. For improved seal tightness, a compatible sealant can be applied to the sealing surface, but a decrease in set point accuracy will occur. Hard plastic seals have difficulty providing a bubble-tight seal in any low force sealing application and are not recommended.

#### Cost:

The following is a relative cost comparison based solely on the pressure/vacuum seal in the Hawkeye Marsh Hawk gauge hatch.



Kalrez is significantly more expensive, on the order of 40 to 50 times, than Viton or AFLAS offerings.

#### References

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