



INTRODUCTION

This document aims to provide a comprehensive overview of the current gasket material offerings on Hawkeye Industries venting products (PVRV, Marsh Hawk, EPRV, LDH, and TVTH). Information includes temperature ratings (referenced and internally tested), chemical compatibility, hardness, and current product offerings.

1 MATERIAL DESCRIPTION

Fluorocarbon / FKM (Chemours 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. Hawkeye offers several options of solid FKM, including **standard black**, extra soft **55 Shore A durometer black** (55D FKM), and special grade **Blue Viton® A** (FKMB). Blue Viton® A is an FDA approved variant of FKM and has strict requirements on chemical stability and purity.

Expanded Fluorocarbon / eFKM is a closed cell sponge made of the same Chemours Viton® base material 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 a high-performance fluoroelastomer. However, FEPM differs from FKM in composition with copolymers that allow for higher operating temperatures and unique chemical compatibility.

Expanded polytetrafluoroethylene / ePTFE is a Teflon® polymer which is processed to have a highly porous microstructure. The expansion of the Teflon material increases elastic characteristics to improve low pressure sealing while maintaining its inert nature and diverse chemical compatibility.

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

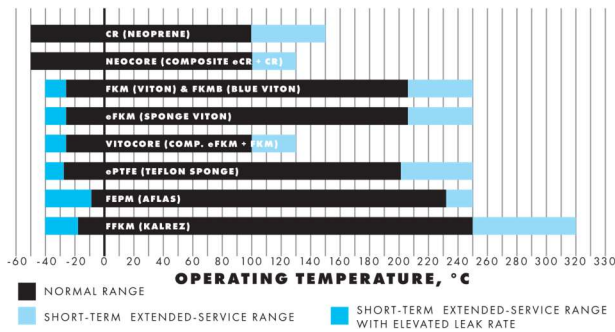
Polychloroprene / CR (neoprene) is a synthetic rubber elastomer which is characterized by its elasticity and flexibility. Its relatively low cost allows for reduced pricing, but incompatibility with many aromatic compounds limits its use.

Expanded Polychloroprene / eCR (expanded neoprene) is a closed cell sponge material made of the same CR (neoprene) compound as described above. It is used as seals and gaskets in applications with low sealing forces where eFKM (expanded Viton®) is not applicable.

2 TEMPERATURE RATING

The operating temperature range of a gasket is defined by its cold flexibility (minimum temperature) and heat resistance (maximum temperature). Cold exposure leads to a reduction in flexibility of the gasket, and thus a loss in sealing performance. Elevated temperatures may cause permanent deformation, chemical instability, and ultimately decomposition of the gasket.

Although sealing performance will decline below the listed normal temperature minimum, laboratory testing has shown no loss of structural integrity or general functionality of Hawkeye valves when observed at temperatures down to -40 °C. Thus, short term cold weather service is acceptable so long as an elevated leak rate can be tolerated. See the following image for a relative comparison of the different material options, noting that all variants of FKM (Standard, Blue Viton® and 55D Viton®) will perform similarly.



3 CHEMICAL COMPATIBILITY

The following provides a description and chemical compatibility guide to gasket materials found on Hawkeye products. A full chemical compatibility chart can be found within the references section of the Hawkeye Industries website. This resource provides a list of materials used in Hawkeye products and their compatibility with chemicals commonly found in service.

Although FKM (Viton®) is incompatible with pure hydrogen sulfide, it is recommended for use with sour gas and sour crude oil by the manufacturer. This recommendation is validated by decades of experience and thousands of vents successfully operating in sour conditions. Additionally, FKM (Viton®) is suitable for use with ethylene glycol and inorganic acids such as HCl. FKM (Viton®) should not be used with methanol-based fluids, ammonia gas, amines, alkalis, superheated steam or organic acids like formic or acetic acid.

While there may be some small differences in chemical resistance between the variants of FKM (Viton®), 55D FKM (55D Viton®) and FKMB (Blue Viton®) exhibit largely the same characteristics as standard black FKM (Viton®), because they are all made from the same underlying polymers. Similarly, since eFKM (expanded Viton®) and FKM (Viton®) are produced from the material, with the primary difference being the final physical form, these two materials will have virtually identical chemical compatibility.

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

Similar to FEPM (Aflas®), CR (neoprene) is not recommended for use with aromatic fuels, ketones or carbon tetrachloride. Although compatible for use with

hydrogen sulfide, sour applications (sour crude oil, sour natural gas) are not suitable. CR (Neoprene) should not be used with hydrochloric acid.

eCR (expanded neoprene) has virtually identical chemical compatibility to CR (neoprene) as a result of the same compounds being used in manufacture.

ePTFE (expanded Teflon®) is a largely inert material, with the exception of fluorine and alkali metals in their fluid states, that has excellent compatibility with a wide variety of solvents including fuels, aromatics, acids, ketones, and alcohols.

Similar to ePTFE (expanded Teflon®), FFKM (Kalrez®) demonstrates excellent chemical resistance over a broad range. Some solutes containing amine, aldehyde, and fluorocarbon groups show slight to moderate reactivity with FFKM (Kalrez®). FFKM (Kalrez®) is not compatible with Fluorinated refrigerants (R11,12,13 etc.) and perfluorinated lubricants (PFPE).

GENERAL ELASTOMER CHEMICAL COMPATIBILITY¹

	FKM (VITON) eFKM (SPNG VITON) VITOCORE	ePTFE (SPNG TEFLON)	FEPM (AFLAS)	CR (NEOPRENE) eCR (SPNG NEOPRENE) NEOCORE	FFKM (KALREZ)
BTEX	Green	Green	Red	Red	Green
AMINES	Red	Green	Green	Yellow	Yellow
CRUDE OIL	Green	Green	Yellow	Yellow	Green
NATURAL GAS	Green	Green	Green	Green	Green
HYDROCHLORIC ACID	Green	Green	Green	Red	Green
SULPHURIC ACID	Orange	Green	Green	Green	Green
SOUR CRUDE OIL	Green	Green	Green	Red	Green
SOUR NATURAL GAS	Green	Green	Green	Green	Green

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.

4 ANTIFREEZE CHEMICAL COMPATIBILITY

When using antifreeze chemicals that contact a vent seal directly, such as a Marsh Hawk with an integrated de-icing system, specific care must be taken to ensure seal material compatibility. This is because typical antifreeze chemicals like methanol, ethylene glycol, and propylene glycol can have undesirable interactions with certain elastomer types.

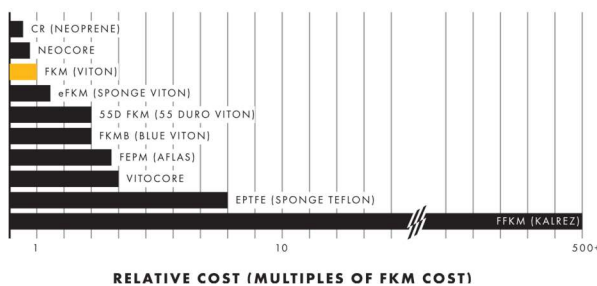
In particular, users should avoid using FKM (Viton®) – similarly eFKM (expanded Viton®) and other FKM variants – with methanol. While FKM (Viton®) exhibits fair resistance to propylene glycol, it is most suitable for use with ethylene glycol, where it shows excellent resistance.

On the other hand, CR (neoprene), FEPM (Aflas®), and FFKM (Kalrez®) exhibit excellent resistance to all three of

the above-mentioned antifreeze chemicals. Therefore, if contact with an antifreeze chemical is expected, either of these three materials should be strongly considered. In all cases, users should refer to Hawkeye’s chemical compatibility chart for specific information on these, and other commonly used chemicals.

5 COST

The following is a relative cost comparison based on gaskets used across the Hawkeye venting lineup. FFKM (Kalrez®) is significantly more expensive, on the order of 500+ times more than FKM (Viton®) or FEPM (Aflas®) offerings.



Additionally, the specialty of 55D FKM (55D Viton®) and Blue Viton® raise the relative cost for a seal to closer to FEPM (Aflas®) as a middle-premium choice.

6 HARDNESS

Typically, harder elastomers last longer and resist high sealing pressures better, whereas softer elastomers conform to sealing surfaces for a tighter seal at lower set pressures, at the cost of durability. FKM, FKMB, FEPM, CR, and FFKM are all solid rubber materials with typical values around 75 Shore A durometer.

eFKM (expanded Viton®) and eCR (expanded neoprene), being expanded materials, have hardnesses of approximately 5-10 Shore A, which is close to the bottom of the scale. ePTFE (expanded Teflon®), although an expanded material, has a similar hardness to Hawkeye solid rubber gaskets at approximately 50 to 70 Shore A. For applications where softer elastomer is desired, but eFKM (expanded Viton®) is unsuitable, 55D FKM (55D Viton®) – hardness 55 Shore A - is also available.

7 COMPOSITES

When it comes to sealing performance, factors like hardness, chemical compatibility, and temperature effects must be balanced to achieve the best results. One way to

gain a performance advantage is to combine the properties of materials through bonding into a laminated composite.

For example, eFKM (expanded Viton®) has superior sealing properties because its low hardness allows it to conform around sealing faces, but has a shorter service life compared to solid FKM (Viton®). To achieve the best sealing performance, and long-term reliability, Hawkeye combines eFKM (expanded Viton®) and FKM (Viton®) into composite Vitocore™, which outperforms either of its constituent parts.

Similarly, Neocore™ is an offering that combines eCR (expanded neoprene) and CR (neoprene) into a composite material with a lower cost than Vitocore™.

8 HAWKEYE PRODUCT OFFERINGS

Current venting solutions at Hawkeye include the Marsh Hawk, PVRV, LDH, EPRV, and TVTH. These products use flexible face gaskets to meet sealing requirements. Each product is offered with a variety of gasket materials to meet various temperature and chemical-based requirements.

* Options are only available on the STD valve, not the UBR valve PVRV.

	MODEL 3000 TVTH	MODEL 400 TVTH	MODEL 450 LOCKDOWN	SERIE 4000 MARSH HAWK	SERIES 5000 EPRV (8" TO 12")	SERIE 5000 EPRV (16" TO 24")	SERIES 6000 PVRV (12" TO 6")	SERIES 6000 PVRV (8" TO 12")	BLAST GASKETS
CR (NEOPRENE)									
NEOCORE	✓								
FKM (VITON)	✓	✓	✓	✓	✓	✓			✓
55D FKM (55 DURO VITON)	✓	✓	✓						
FKMB (BLUE VITON)				✓					✓
eFKM (SPONGE VITON)	✓	✓	✓	✓	1	2	✓		✓
VITOCORE	✓	✓	✓	✓	✓	✓			
FEPM (AFLAS)	✓	✓	✓	✓	✓	✓	✓		✓
ePTFE (SPNG TEFLON)	✓	✓	✓	✓ ³	✓ ³	✓ ³	✓ ³	✓ ³	✓
FFKM (KALREZ)				✓					

1 eFKM (Sponge Viton) available only for sizes 8" through 12" Series 5000 EPRV.
2 eFKM (Sponge Viton) available only for sizes 8" through 12" Series 6000 PVRV.
3 Values equipped with ePTFE seals may not meet API 2000 leak rate requirements and are not available with Series 6000 UBR configurations.

8.1 MARSH HAWK

The Series 4000 Marsh Hawk combines the pressure and vacuum valve in an innovative design that requires only one shared gasket.

To improve valve sealing performance, gaskets are factory coated with a pliable oil-based sealant suitable for sour service. Sealant is available as a service kit for maintenance and reapplication.

Hawkeye offers several material options for the pressure / vacuum seal, beyond the standard FKM (Viton®) seal.

- For applications where sealing is the first priority, Vitocore™ is available with a soft eFKM (expanded Viton®)

surface and durable FKM (Viton®) backing. Pure eFKM (expanded Viton®) gaskets are also available, but are not recommended for set pressures greater than 8 ozsi due to longevity concerns.

- For higher temperatures, minimally freezing conditions and acid service, FEPM (Aflas®) is available.
- For extreme applications FFKM (Kalrez®) is available.

Hawkeye does not generally recommend using solid fluoropolymer (e.g. PTFE, PFA, FEP, etc.), nor expanded ePTFE (expanded Teflon®) as a seal material in Marsh Hawks as the harder crystalline polymer structure of these materials reduces sealing performance due to the low seal-seat interfacial pressures found in the Marsh Hawk.

8.2 EPRV

The Series 5000 EPRV uses a single gasket design for direct-acting emergency pressure relief with automatic resetting.

Hawkeye offers two material options for the pressure seal, beyond the standard Vitocore™ (composite expanded Viton®/Viton®) seal.

- For temperatures not exceeding 100 °C, Neocore™ (composite expanded neoprene/neoprene) is a cost-effective alternative.
- For extreme applications ePTFE (Expanded Teflon®) is available.

Note that vents equipped with solid elastomer or expanded polymer seals (ePTFE) may not meet API 2000 leak rate requirements.

8.3 PVRV

The Series 6000 PVRV offers direct-acting pressure and vacuum relief. Using separate gaskets for pressure and vacuum relief allows pressure only, vacuum only, and pipe away configurations in addition to the standard pressure + vacuum combination to best serve customer needs.

Hawkeye offers three material options for the pressure / vacuum seal, beyond the standard Vitocore™ (composite expanded Viton®/Viton®) seal.

- For temperatures not exceeding 100 °C, Neocore™ (composite expanded neoprene/neoprene) is a cost-effective alternative.
- For extreme applications ePTFE (Expanded Teflon®) is available.

Note that vents equipped with solid elastomer or expanded polymer seals (ePTFE) may not meet API 2000 leak rate requirements and are not available with UBR valve configurations.

8.4 LDH

The Model 500 LDH provides a simple locking design with easy tank access. Sweet and sour service options provide a wide range of chemical compatibility.

- Sweet Service: CR (neoprene) is a cost-effective gasket material that handles temperatures below 100 °C.
- Sour Service: If increased temperature and chemical compatibility are needed, an FKM (Viton®) seal is an excellent choice.

8.5 TVTH

The Model 300, and 400 TVTH offer economical gauge hatch systems with integral pressure and vacuum relief.

The Model 300 comes in two standard configurations – sweet service with Neocore™ seals, and sour service with eFKM (expanded Viton®) seals.

If more extreme service resistance is needed, the Model 400 TVTH (acid service) is equipped with an eFKM (expanded Viton®) seal and epoxy coated internals to prioritize leak prevention. For additional compatibility, several other materials are offered.

- FKM (Viton®) provides a chemically equivalent substitution with greater hardness.
- For higher temperatures, minimally freezing conditions and acid service, FEPM (Aflas®) is available.
- For premium sour service performance, Vitocore™ seals are available.

9 REFERENCES

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