As a leading manufacturer of various fluorochemical products, AGC keep asking ourselves this question: What could we do to contribute to creating a more fulfilling society and making people’s lives more comfortable while protecting the global environment? One of the answers that AGC has come up with is AFLAS®.

It is high-performance fluoroelastomer that is superior to conventional rubber products in terms of thermal resistance, chemical resistance, strength, etc. and is commonly used to make sealing, hose, and covering materials. Its wide-ranging applications include underground resource mining without environmental pollution, highly reliable production equipment and facilities, enhancement of the energy-saving performance of vehicles, enabling our track record to continuously increase.

One’s choice to use AFLAS® signifies their prioritization of a sense of security, safety, and quality as well as being future-minded. With AFLAS®, more can be accomplished.
Fluoroelastomer is a general term that refers to any synthetic rubber that contains fluorine in its molecular structure. Compared to silicone and other synthetic rubber, it shows superior characteristics in terms of thermal resistance, chemical resistance, electric insulation, steam resistance, etc., and therefore has been used in a growing number of industries where the parts and products are subjected to harsh operating conditions.

FKM, FEP, and FKM* are common fluoroelastomers that have unique characteristics respectively. AGC’s AFLAS® includes especially high-functioning FEP and FFKM in its product range.

FKM was the fluoroelastomer that was developed first, which offers a good balance between performance and cost. As for FFKM, it offers superb performance but is proportionately more costly, so it’s targeted for special applications. Meanwhile, the AFLAS® FEP product series, which AGC first introduced to the market in the 1970s, has been able to successfully expand the possibilities of what fluoroelastomers can do, with its cost competitiveness and excellent thermal resistance, chemical resistance, electric insulation, etc. that nearly match those of FFKM.

In 2017, AGC debuted the AFLAS® FFKM series that was created based on the technical know-how that AGC gained from FEP, which allows AGC to meet the ever more advanced needs of various industries.

* FKM: Vinylidene fluoride-based elastomers, FEP: Tetrafluoroethylene-propylene-based elastomers, FFKM: Tetrafluoroethylene-perfluorovinyl ether-based elastomers

**Types of fluoroelastomer and the position of AFLAS®**

<table>
<thead>
<tr>
<th>Fluoroelastomer</th>
<th>AFLAS® FFKM</th>
<th>AFLAS® PM-1100</th>
<th>AFLAS® PM-5000</th>
<th>AFLAS® CP-4000</th>
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<tr>
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<td>AFLAS®-150</td>
<td>AFLAS®-400</td>
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<td>AFLAS®-100</td>
<td>AFLAS®-1100</td>
<td>AFLAS®-1500</td>
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<td></td>
<td>Binary</td>
<td>(CH₂CHCH₃)₃</td>
<td>(CH₂CHCH₃)₃</td>
<td>(CH₂CHCH₃)₃</td>
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</table>

The photo is a sample image.
FEPM SERIES

AFLAS® FEPM is a fluoroelastomer product series that is mainly composed of alternating copolymers of tetrafluoroethylene and propylene. The thermal and chemical stability of the polymers are achieved by the structure where almost all propylene units are positioned between the adjacent tetrafluoroethylene units on both sides. The product series has a track record of being successfully used in various fields for over 40 years, and also is known for its stable quality and reliability.

The AFLAS® series is a fluoroelastomer product series that is mainly composed of alternating copolymers of tetrafluoroethylene and propylene. The thermal and chemical stability of the polymers are achieved by the structure where almost all propylene units are positioned between the adjacent tetrafluoroethylene units on both sides. The product series has a track record of being successfully used in various fields for over 40 years, and also is known for its stable quality and reliability.

Characteristics of FEPM

- **Flame retardance:** It burns when put into a flame but stops burning when removed from the flame.
- **Chemical resistance:** It has high electric insulation of $3 \times 10^9 \, \Omega \cdot \text{cm}$ in terms of volume resistivity.
- **Thermal resistance:** It is resistant to heat-shrink tubing.
- **Durability:** It can withstand being exposed to 250°C steam.
- **Odor-adhesiveness:** It is resistant to high-temperature strong acid or base.
- **Oil resistance / amine resistance:** It exhibits excellent oil resistance to engine oil, gear oil, etc. that contain large amounts of amine additives.
- **Dust / dirt resistance:** It is resistant to dust and dirt.
- **Heat-shrink tubing:** It is resistant to heat-shrink tubing.

**Main applications:** AFLAS® SEPM is used in the oil exploration and production industry due to its high strength and elongation as well as resistance to H2S gas and other chemicals. It also is used to make various parts of the tubular module, including high-temperature valves, flanges, etc.

**Grade:** AFLAS® 100S/100H

- **Main applications:** Sealing material, oil seal, tube, wire and cable insulation
- **Material adjustment:** White compounds are also possible.
- **Extrusion molding:** Continuous extrusion is possible with the improved crosslinking rate, while maintaining the excellent characteristics that are equivalent to those of conventional products.
- **Compression set and mold release properties:** Excellent vulcanization speed can be achieved.
- **Durability / strength:** Excellent extrudability can be achieved.
- **Oil resistance / amine resistance:** Good compatibility with oils and amine additives.
- **Thermal resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.
- **Chemical resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.

**Main applications:** AFLAS® 150S/150P

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**Main applications:** AFLAS® 600X

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**Main applications:** AFLAS® 400E

- **Main applications:** Sealing material, oil seal, tube, wire and cable insulation
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- **Durability / strength:** Excellent extrudability can be achieved.
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- **Chemical resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.

**Main applications:** AFLAS® 150C/150S

- **Main applications:** Sealing material, oil seal, tube, wire and cable insulation
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- **Compression set and mold release properties:** Excellent vulcanization speed can be achieved.
- **Durability / strength:** Excellent extrudability can be achieved.
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- **Thermal resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.
- **Chemical resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.

**Main applications:** AFLAS® 150E/150P

- **Main applications:** Sealing material, oil seal, tube, wire and cable insulation
- **Material adjustment:** White compounds are also possible.
- **Extrusion molding:** Continuous extrusion is possible with the improved crosslinking rate, while maintaining the excellent characteristics that are equivalent to those of conventional products.
- **Compression set and mold release properties:** Excellent vulcanization speed can be achieved.
- **Durability / strength:** Excellent extrudability can be achieved.
- **Oil resistance / amine resistance:** Good compatibility with oils and amine additives.
- **Thermal resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.
- **Chemical resistance:** Excellent crosslinking rate, while maintaining the resistance to heat-shrink tubing.

**Main applications:** AFLAS® 150S/150P

- **Main applications:** Sealing material, oil seal, tube, wire and cable insulation
- **Material adjustment:** White compounds are also possible.
- **Extrusion molding:** Continuous extrusion is possible with the improved crosslinking rate, while maintaining the excellent characteristics that are equivalent to those of conventional products.
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It ensures safety and protects the natural environment while functioning properly under the harshest conditions at production sites.

The frontier of resource development is now widened into the unknown realms of the deep sea, the high-temperature and high-pressure layers of earth, etc. With such trends emerging, the technical requirements of digging equipment, etc. are becoming increasingly demanding. For example, the tip of an oil-well drilling machine must be made of material that has high thermal and pressure resistance, as it is constantly exposed to hydrogen sulfide and other corrosive gas and steam that are emitted in the ground as well as to the drilling oil that is supplied from above ground.

The AFLAS® FEPM series is capable of meeting all these stringent requirements and has been widely used to make sealing and protective covering materials. It makes a significant contribution to oilfield development around the world.

*The illustration is a sample image.
*ESP = Electric Submersible Pump
*The photo is a sample image.
Examples of use of AFLAS® in automotive applications

Vehicles and heavy machinery of today are quite safe and friendly to both the environment and humans alike. Although such high-level performance is a common requirement, it can only be achieved by meeting strict technical requirements, one by one. Engine lubricant and fuel products are intrinsic parts of this technological progress.

A wide variety of chemicals and additives are often incorporated to enhance product performance. However, they could also deteriorate or otherwise negatively affect the seals and hoses that are made of elastomers.

This sort of issue is however resolved in the case of the AFLAS® FEPM series, as it offers superior chemical resistance and increases the longevity of vehicles and heavy machinery, although it’s not necessarily evident upon the surface.

It contributes to natural resource conservation and environmental protection by generating the potential of vehicles and heavy machinery.

Transport machinery / heavy machinery

**Cylinder-head gasket**

As AFLAS® is resistant to both engine oil and coolant, it is suitable for metal gaskets that consist of metal sheets with a rubber coating applied on top.

Recommended grades: AFLAS® 150E, 400E

**Oil cooler hose / turbocharger hose**

Due to today’s more stringent regulations on exhaust gas emissions, it has become necessary for diesel engines to return the fuel gas and oil mist that leaks from the cylinder blocks back into the intake passage system. This is where AFLAS® comes into play, as it’s highly resistant to unexpected pressure that runs between the turbocharger and the intercooler. AFLAS® is the optimal choice of material to make such hoses as it’s also high resistance to the additives that are contained in the oil.

Recommended grades: AFLAS® 100S

**Oil seal / pinion shaft seal**

The lubricants that are used in automotive oil systems, such as engine oil, transmission oil, and brake fluid, contain traces and antioxidants. AFLAS® is resistant to such adverse conditions in addition to being highly resistant to the temperature changes that occur during the lubricant’s application process. Because such features deliver customer value, AFLAS® has been used in many automotive oil products* that are suitable for use in construction machinery, trucks, etc., the operating conditions of which are far more demanding compared to regular cars.

Recommended grade: AFLAS® 100S

*The photo is a sample image.

Application

AFLAS® FKM

The illustration is a sample image.

Due to today’s more stringent regulations on exhaust gas emissions, it has become necessary for diesel engines to return the fuel gas and oil mist that leaks from the cylinder blocks back into the intake passage system. This is where AFLAS® comes into play, as it’s highly resistant to unexpected pressure that runs between the turbocharger and the intercooler. AFLAS® is the optimal choice of material to make such hoses as it’s also high resistance to the additives that are contained in the oil.

Recommended grades: AFLAS® 100S
Green vehicles (HVs, PHVs, EVs, etc.) and railroad vehicles are thought to be friendly to the global environment due to their low CO₂ emissions. However, the electric wires and power cables that sustain their operation are used under more demanding conditions, partly due to those vehicles becoming lighter in weight.

The AFLAS® FEPM series offers high resistance to both external and internal heat along with flexibility that provides improved installation of wiring, in addition to superb electric insulation that is a mandatory feature of electric wire coating material. Its track record of use in various applications is ever-improving, ranging from vehicles and large machinery to home appliances.

It protects electric wires that are vital to the operation of various electric equipment, from large-scale facilities to home appliances.

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Electric wire coverings

Although fluoroplastics are excellent in electric insulation, they lack flexibility. As a result, they often lead to wiring routing issues. Meanwhile, AFLAS® offers flexibility, it has been used as thin wire material in a wide variety of applications, from automobiles to home electronics and gas appliances, etc. It is also used as thick wire material around blast furnaces, etc.

Recommended grades: AFLAS® 150E, 400E (steam crosslinking), 150CS (electron beam crosslinking).
Proven operating conditions: Temperature range of -60 to 200˚C, UL VW-1-certified

Power cable coverings

In order to reduce the weight of an electric wire, the diameter of its electric conductor has to be reduced. However, if the electric conductors are made thinner, the amount of electrical resistance will increase, which in turn requires higher thermal resistance to cope with more internally generated heat. As AFLAS® is valued as insulating material that satisfies all these tough requirements, it has been used to make power cable coverings in bullet trains and electric cars.

Recommended grades: AFLAS® 150E, 400E (steam crosslinking), 150CS (electron beam crosslinking).
Proven operating conditions: Temperature range of -60 to 200˚C, UL VW-1-certified

High-voltage power distribution system for EVs, HVs, and PHVs

Power cables are crucial for supplying power to batteries and motors in a reliable manner.

In the latest models of EVs, HVs, and PHVs, lightness is a standard requirement for energy- and space-saving, in addition to durability and electric insulation. Given its high thermal resistance, superb electric insulation, and low-specific gravity, AFLAS® is an optimal material for making electric wire coverings for these applications.
As the AFLAS® FEPM series offers superb thermal resistance and durability among other excellent features, it has been used in an ever-increasing number of applications including various infrastructures, factories, etc. For example, due to its low odor-adsorption characteristics, it is used to make packings, and other similar components in food manufacturing. As it is also highly resistant to both chemicals and steam, its use has become widespread as sealing material that is incorporated into chemical plants, replacing FKM.

It has also been adopted in a growing number of fields where only highly reliable products are accepted, such as in space stations and satellites, because of its superb radiation and ozone resistance. Its excellent characteristics are highly valued in various manufacturing operations and extreme environments.

Electronics, chemical, pharmaceutical, food, and space industries

- Alkali resistance
- Steam resistance
- Acid resistance
- Radiation resistance
- Ozone resistance
- TMAH resistance
- NMP resistance

Because of its high flame retardance, AFLAS® is widely used to make packings that are inserted between hook-up pipes that connect ducts at semiconductor fabrication plants.

Packing for hook-up pipes

Recommended grades: AFLAS® 100S/600X

Sealing for food applications

AFLAS® does not absorb odors and has high resistance to various chemicals, steam, ultraviolet radiation, etc., that are used for sterilization and antiseptic purposes. Therefore, it is suitable for making packings, etc. used in food and beverage production lines where any transfer of odors should be avoided.

Recommended grade: AFLAS® 600X

Sealing for semiconductor applications

FKM is suitable for sealing to be used in semiconductor production lines. However, it can be replaced by AFLAS® which will lead to cost reduction, depending on the types of gas and chemicals to be used.

Recommended grades: AFLAS® 100S/600X

Odor index equivalent values are numerical data indicating odor intensity after correcting for human olfactory sensitivity (i.e., threshold correction). For example, an odor index of 10 (mean 100) means the odor becomes undetectable if it is diluted tenfold.

*The photo is a sample image.

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It has sufficient thermal resistance as long as the continuous-use temperature does not exceed 230°C, and the short-term use temperature does not exceed 250°C. It offers improved thermal resistance while maintaining the same levels of excellent strength and chemical resistance.

Fluoroelastomer that overcomes higher-temperature conditions and seeks new possibilities

AFLAS® FFKM product range by their heat-resisting temperatures

**Chemical resistance:** It has significantly high resistance to high-temperature and highly active acids, alkalis, hydrogen sulfide, etc.

**Thermal resistance:** It has sufficient thermal resistance as long as the continuous-use temperature is kept between 200 and 280°C, and the short-term use temperature is maintained between 280 and 300°C.

**Oil resistance / solvent resistance:** It has significantly high resistance to oil and solvents.

**Durability / strength:** It has a superb compression set and also an excellent mechanical strength of over 20 MPa.

**Ozone resistance:** Its physical properties do not change even after being exposed to 50 ppm ozone at 40°C for a month.
AGC’s AFLAS® manufacturing system ensures steady supply

Its plants in Japan utilize cutting-edge fluorochemical technology and deliver high-quality products.

With roughly 100 years of experience in chemical production and around 50 years of experience with fluorochemical products, AGC has been a leading developer and manufacturer of high-performance fluoroelastomers from an early stage, while leveraging its technical competency and delivering superb results. In 1975, AGC started marketing AFLAS® FEPM, catering to the wide-ranging needs of various industries. In 2017, AGC introduced AFLAS® FFKM to the market and has constantly been taking on different challenges to cultivate new possibilities for fluoroelastomers. It is also noteworthy that all products that belong to the AFLAS® series are made in Japan. Being integrally produced at AGC’s dedicated plants in Japan under meticulous quality control, AFLAS® products can be securely supplied to every corner of the world.
Notice

1) The statements and data given in this publication are believed to be accurate. They are presented without any guarantee or warranty, express or implied. Statements or suggestions regarding the use of these products are made without representation or warranty that any such use is free of patent infringement and are not recommendations to infringe any patent. The user should not assume that all safety measures are indicated.

2) Please refer to the SDS (Safety Data Sheet) for safety and details.

3) This product is not designed for use in the implantation of the human body or for medical applications that come in contact with body fluid or body tissues, AGC Inc. carries out no test as to the fitness of the product for any medical applications.

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