

# PTFE

## Micro powders Handbook

**C&F**

# Introduction

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## What is Everflon™' Fluoropolymer lubricant

Everflon™ is the trade name for C&F Group. polytetrafluoroethylene (PTFE) and fluorinated ethylene propylene (FEP) lubricant powders developed for use as additives for a wide variety of media such as thermoplastics, elastomers, oils, greases, inks and coating systems.

These finely divided, clean, inert, white powders impart the high performance properties of PTFE to the host material, resulting in improved surface lubricity and reduced wear over a wide temperature range.

All Everflon™ lubricant powders are manufactured from virgin rather than reprocessed PTFE or FEP feedstock sources to ensure consistent high performance and quality.

Everflon™ lubricant powders are virtually immune from chemical attack, do not absorb water, have a wide working temperature range (-190°C to +260°C for PTFE and -100°C to +200°C for FEP) and have excellent weathering and ageing characteristics. They also possess very low coefficients of friction, typically 0.01 for PTFE lubricant powders (0.3 for FEP), allowing for excellent non-stick and sliding properties.

## HOW Everflon™ LUBRICANT POWDERS WORK

Everflon™ lubricant powders are low molecular weight, soft materials which smear to form dry lubricating films under light contact pressure. When this contact pressure continues between two mating surfaces, either of which contains a Everflon™ powder, a transfer of the fluoropolymer lubricant to the opposing surface takes place. This results in the build up of a microscopically thin lubricating film allowing for excellent antifrictional properties.

# Commercially Available Everflon™ PTFE Micropowders

## Everflon™ PTFE Micropowder Grade

### MV1

Everflon™ MV1 is a finely divided PTFE lubricant powder with good flow properties but a much finer particle size distribution compared to MV3.

The mean particle size is 3 to 6 microns, depending on the test methods used. It disperses easily in liquids in both high and low-shear mixers. The resulting dispersions have relatively low viscosity compared with those produced from other PTFE lubricant powders. They are particularly suitable for use with low viscosity lubricating oils and industrial finishes.

### MV3

Everflon™ MV3 is a friable PTFE powder which can be broken down to sub-micron particles by high-shear mixing in liquid media. The extent of the reduction in particle size depends largely on the degree of shear.

For example, mixing Everflon™ MV3 with a medium viscosity lubricating oil and subsequently passing the mixture twice through a triple-roll mill gives a submicronic particle size range with many particles measuring 0.3 micron. Everflon™ MV-3 is particularly suitable for addition to inks for can coatings as well as oils, greases and elastomers.

### MV9

Everflon™ MV9 is a finely divided PTFE powder with a mean particle size typically in the region of 9-12 micron (depending on the test method used). It has the lowest surface area and porosity of all the Everflon™ range of lubricant powders and is particularly suitable for use in printing inks and industrial finishes.

### MVP

Everflon™ MVP is a finely divided PTFE powder which has a slightly coarser mean particle size to typically 17 microns. It also has a less compact and more porous structure than MV9. The absence of processing additives makes it particularly suitable for incorporation into thermoplastics.

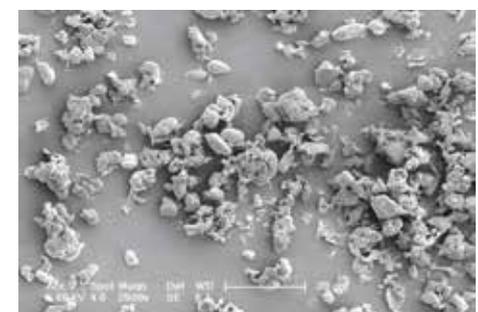
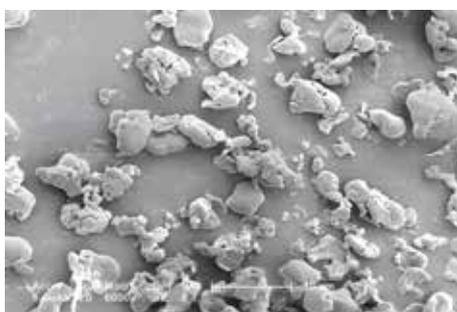
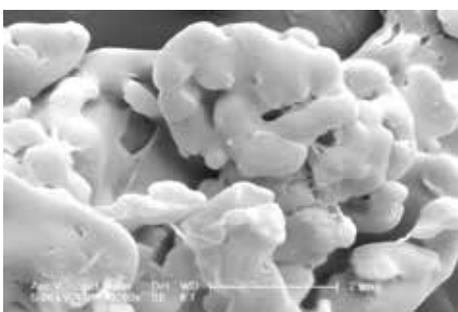
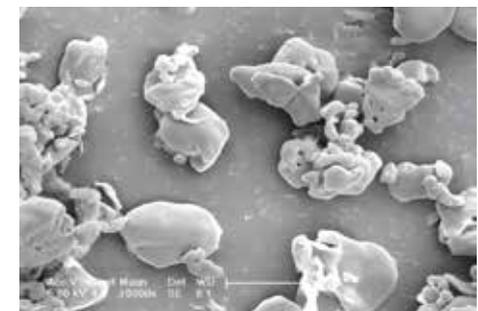
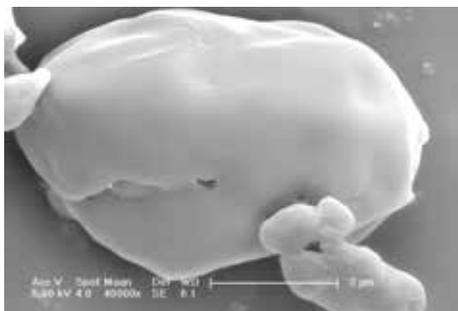
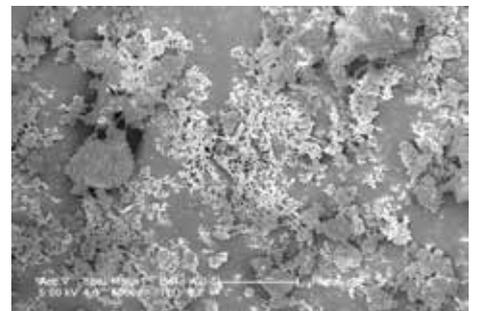
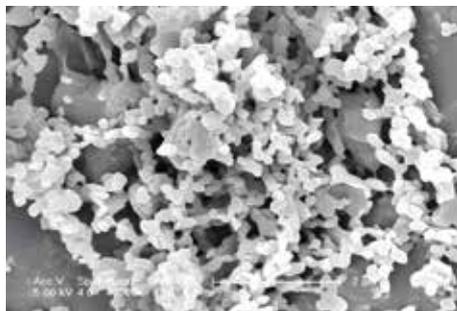
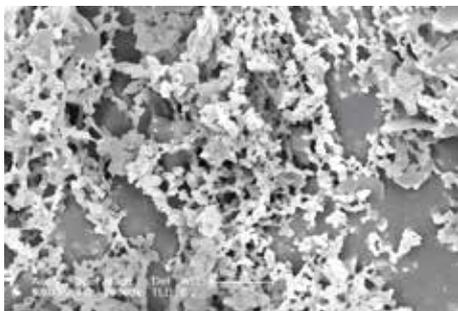
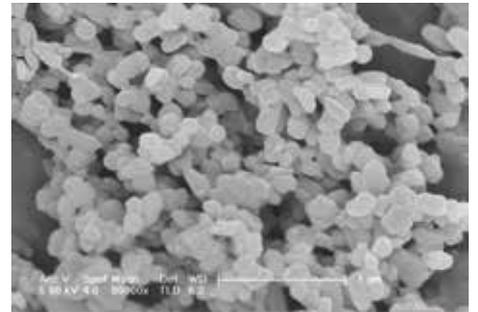
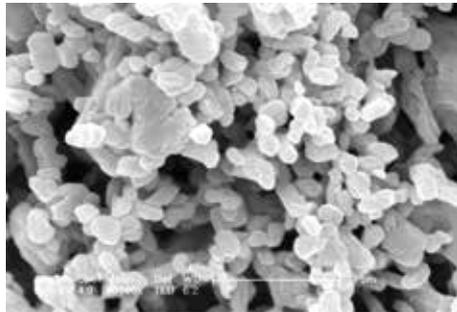
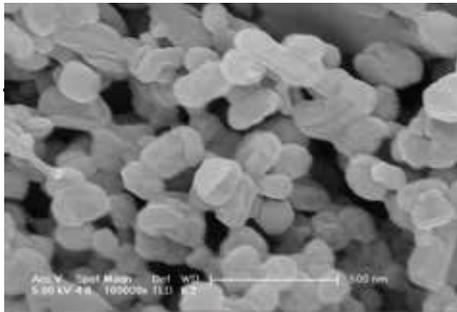
### MVS

Everflon™ MVS is a finely divided PTFE lubricant powder manufactured from a special feedstock to ensure maximum product consistency and fitness for more demanding surface coating applications. It has a mean particle size of 3 to 6 microns, (depending on the test method used) which is similar to MV3, but possesses a narrower particle size distribution.

## Everflon™ LUBRICANT POWDER PROPERTY DATA

PROPERTY	UNITS	MV1	MV3	MV9	MVS	MVP
BULK DENSITY	g/l	450	480	530	560	400
RELATIVE DENSITY	-	2.2	2.2	2.2	2.2	2.2
PARTICLE SIZE (MALVERN LASER DIFFRACTION)	Microns : AVE	1~2	3~5	9~12	3	17
SURFACE AREA (KRYPTON ABSORPTION)	m <sup>2</sup> /g	0.8	1.5~3	5~10	1.5~3	2.3
MELTING PEAK TEMPERATURE (D.S.C.)	°C	328	335	335	335	335
SERVICE TEMPERATURE RANGE	°C	- 190 + 260				
FDA COMPLIANCE	-	Yes	Yes	Yes	Yes	Yes

### High Resolution Scanning Electron micrographs



In most applications the performance of compositions containing Everflon™ PTFE lubricants will be limited by the properties of the base material. The chemical inertness of PTFE prevents any reaction between the Everflon™ PTFE lubricant powder and the other constituent, and ensures that it will outlast the base material in corrosive environments. Its wide service temperature range ensures that it will survive temperatures encountered by most materials in which it may be incorporated.

The following, are a number of applications for Everflon™ PTFE lubricant powders with the recommended grades and processing data for each end use.



## PRINTING INKS

### Advantages of Using Everflon™ Lubricant

Everflon™ PTFE micropowder have the following advantages compared with conventional anti-scuff agents in the preparation of offset, heat-set, gravure and flexographit printing inks:

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Improved rub and scuff resistance preserve the attractive finish of printed stock through to its final destination.

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Reduced blocking and set off can eliminate costly waste thereby improving efficiency and lowering reject rates, especially with reeled stock on high speed printing machines.

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Easy dispersion at room temperature can make processing cheaper and more efficient.

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Reduce friction allows printed stock to slide and stack easily.

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Chemical inertness enables these powders to be used in any formulation without danger of chemical reaction or solvent attack.

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Simplified stock control (because one Everflon™ PTFE micropowder may replace a wide range of natural and synthetic waxes).

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Excellent temperature resistance enable the powders to be used at temperatures up to 260°C. When used in heat-set inks they remain dispersed in the ink during exposure in the drying oven, allowing fast solvent release and giving excellent print gloss. Everflon™ PTFE micropowder thus enable faster printing speeds to be achieved.



In gravure ink applications there is a need for a small particle sized Everflon™ PTFE lubricant powder since the PTFE may have a tendency to settle in the cell of the gravure plate, displacing the ink and resulting in a visual flaw in the printed image.

Most gravure ink printing cells are typically 5 to 35 microns deep by 100 to 150 microns wide; the PTFE particle should be small and hence the light enough to enter and leave the cell without causing blocking.

A small particle size Everflon™ PTFE lubricant powder is also required for offset printing, where an aluminium plate is coated with a thin film of photographic emulsion.

Typical particle size of the inks are 5 to 7 microns. The ideal size of the Everflon™ PTFE lubricant should be less than 5 microns to avoid abrading the emulsion coating on the plate.

Everflon™ PTFE lubricant powders can be used in both "paste" inks for metal decoration and high quality paper printing applications and also "liquid" inks for less demanding areas such as cardboard packaging and newspapers. Paste inks tend to be solvent based whereas liquid inks are more commonly water based.

Everflon™ PTFE lubricant powders may also be used in combination with polyethylene or polypropylene waxes.

Everflon™ MV3I has a very fine particle size and is a very robust, versatile lubricant powder.

It has been developed to disperse easily in inks using high or low shear mixers, without a change in either the particle size of the powders and with minimum viscosity modification of the ink. The addition of Everflon™ MV3I to an ink ensures the maximum retention of gloss and the maximum reduction in coefficient of friction. Dispersion is readily achieved in a paddle mixer. Triple roll milling with a tight nip is not advised as this may deform the particles, but de-aeration of the ink on a triple roll mill is satisfactory, provided that the rolls are set fairly loose. The proportion of Everflon™ MV3I required is 1 to 3% by weight of the non-volatile constituents of the ink.





## METAL DECORATION COATINGS

### Advantages of Using Everflon™ PTFE

Everflon™ PTFE powders are ideal additives for use with metal decoration coatings, often referred to as "can coatings". The cans themselves may be produced in a number of different ways ie:-

Everflon™ PTFE powders are principally used on the external coating of the can to give improved frictional and rub resistance properties to the coating to facilitate easy sliding and movement of the cans on the production line. The Everflon™ PTFE also acts as a processing aid during the drawing and neck forming operations of the can production.

Everflon™ PTFE powders are preferred for can coatings rather than other materials (such as polyethylene blends) since they can withstand the relatively high stoving (drying) temperatures of up to 250°C without "burn-out" problems.

The base resins used for coatings are typically epoxy/phenolics containing between 0.5 to 2% Everflon™ PTFE powder. Typical masterbatch compositions may be mixed together using high shear blending equipment such as triple roll mills or stirred media mills (eg. bead mills, sand mills and Attritor mills). Coating thicknesses are typically 6 to 10 microns so the need for a Everflon™ PTFE lubricant powder which can be broken down to a fine particle size is paramount.

Everflon™ PTFE have low surface energies which makes them difficult to wet-out in anything but certain solvent or surfactant systems. However, this feature can be used to an advantage in can coatings since solvent removal during the drying of the coating allows the Everflon™ powder to become non-wetted and thus migrates to the surface resulting in a lubricant rich coating.



Everflon™ MV3C is a friable PTFE powder which can be broken down to a very fine particle size by the application of high shear during mixing in liquid media. The extent of particle size reduction depends largely upon the degree of shear but sub-micron (0.3  $\mu\text{M}$ ) particle dispersions are possible. The ability to achieve this fine particle size reduces PTFE sedimentation in the formulation and minimises the build up of material on the transfer blanket used in applying external can coatings. Everflon™ PTFE powders are typically added at between 0.5 to 2%, by weight, of the non-volatile content of the coating.





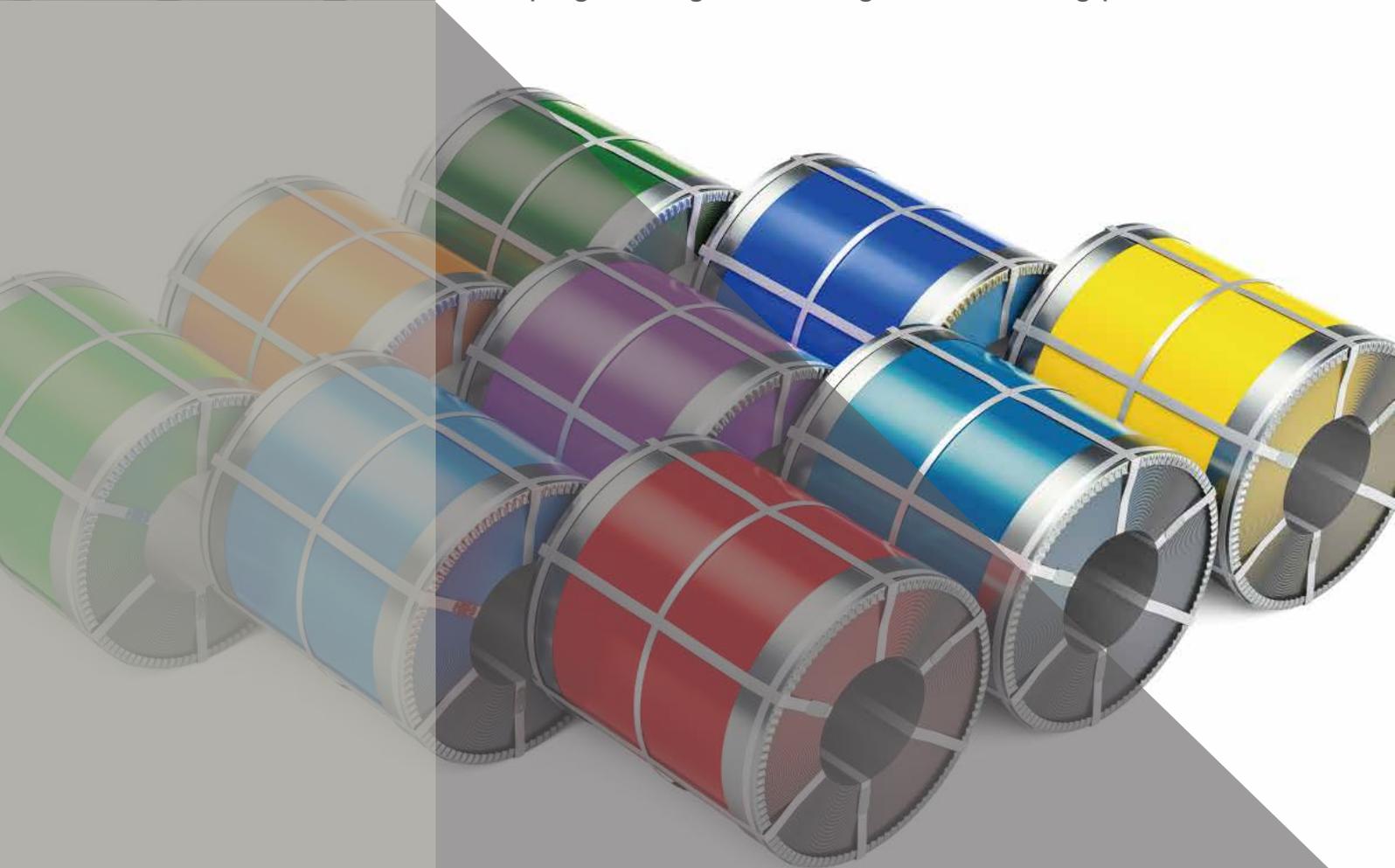
## COATINGS AND INDUSTRIAL FINISHES

### Advantages of Using Everflon™ PTFE

Everflon™ PTFE powders can be added to many industrial finishes to improve surface lubrication, reduce blocking and promote scuff resistance. They may be used to provide excellent non-stick surfaces in hollow-ware products such as bakeware and cookware for improved abrasion resistance, anti-friction properties and good corrosion resistance.

Most hollow-ware products are made from coated strips of steel or aluminium which have been treated with a Everflon™ PTFE lubricant coating prior to fabrication into the finished product.

Not only does the inclusion of a Everflon™ PTFE powders improve non-stick properties in the fabricated component but it also acts as a processing aid during the actual drawing, stamping, folding and cutting manufacturing processes.



Everflon™ PTFE MV3C may be readily dispersed using high or low shear mixers with minimal change in the particle size of the powder or the viscosity of the formulation. This is particularly important if the formulated coating resin is to be applied by automatic spray equipment.

For aerosol sprays, MV3C is the preferred choice due to its ease of dispersion and minimal effect on modifying the viscosity of the resulting formulation.

Some spray formulations can use both solvents and air drying acrylic lacquers can produce a dry, hard film coating. This film forming "binding" agent helps to retain the fine Everflon™ particles on the substrate. If a film forming agent were to be used, this would be added at approximately 1% by weight and the solvent phase reduced to 24%.

For industrial coatings requiring excellent surface finish, Everflon™ MV3C would be the recommended grade.

Liquid resin coatings benefit most from the addition of Everflon™ MV3C which ensures good gloss and surface hardness whilst, at the same time, giving the maximum reduction in coefficient of friction.





## PAINTS

### Advantages of Using Everflon™ PTFE



Everflon™ PTFE powders may be added to a number of decorative, masonry, aircraft and marine paint formulations to improve hardness, toughness, scuff, wear and abrasion resistance, water repellancy, ease of cleaning, and anti-fouling properties. Everflon™ PTFE powders can also reduce flammability and help prevent dripping in fire hazard situations and aids spreading properties in industrial paints.

As more paint manufacturers develop water based rather than solvent based formulations, the use of Everflon™ PTFE powders increases the paints ability to withstand higher abrasion and wear resistance as measured via a combined ball indentation and scratch resistance test.

Matt based paints, which are traditionally more difficult to clean, also benefit from the addition of Everflon™ PTFE powders. Gloss coatings also gain from the addition of Everflon™ PTFE powders but a small particle size is important to ensure that no imperfections in the smooth surface finish result.

Everflon™ PTFE powders used in marine coatings provide excellent anti-fouling, marine growth and lubricating properties due to the "non-stick" nature of the PTFE. This results in improved surface finish on boat hulls allowing for higher surface speeds and fuel efficiency. Due to the inertness and low toxicity of lubricants, these advantages are achieved with minimal ecological and environmental effects.

Everflon™ PTFE lubricant powders can be used in aircraft paint formulations where an abrasion resistant finish applied to the lower fuselage and underside of the wings provides protection from gravel and stones on unpaved runways. Additionally, Everflon™ PTFE powders are used in paints used to treat the inside of aircraft holds to prevent corrosion from condensation or hydraulic fluid, and on sliding surfaces such as wing slats where good wear resistance is required.

Everflon™ PTFE powders have also been used in industrial paint applications where the PTFE provides a thin coating for hopper, silo and general vessel lining in order to provide a nonstick surface, avoiding product "caking" and build-up. The typical Everflon™ PTFE powder lubricant content is 20% by weight.

Everflon™ PTFE MV3C may be added at up to 15% by weight to aircraft and marine paint formulations. Suitable dispersion of the PTFE can be achieved using low shear paddle mixers.





## THERMOPLASTICS

### Advantages of Using Everflon™ PTFE

Everflon™ PTFE micropowders predispersed into a thermoplastic base resin greatly improve the surface wear characteristics of the compound. The molecular weight and particle size of the Everflon™ PTFE lubricant used may be custom-tailored to yield optimum improvements, for the selected resin system in wear, friction and PV (pressure-velocity) rating.

During the initial "break-in" or "running in" period of the plastic component, the Everflon™ PTFE particles embedded in the thermoplastic matrix shear to form a high lubricity film over the mating surface. The Everflon™ PTFE serves to cushion asperities from shock and subsequent fatigue failure.

For each family of bearing materials there is an optimum ratio of polymer to Everflon™ PTFE content. Wear rate can be improved by modifying the level (w/w) of PTFE in a compound typically up to 15 to 20%.

The addition of Everflon™ PTFE beyond the optimum point, will result in increased wear but the coefficient of friction will continue to show improvement. This critical loading is based on the ability to uniformly disperse the Everflon™ PTFE throughout the resin matrix.

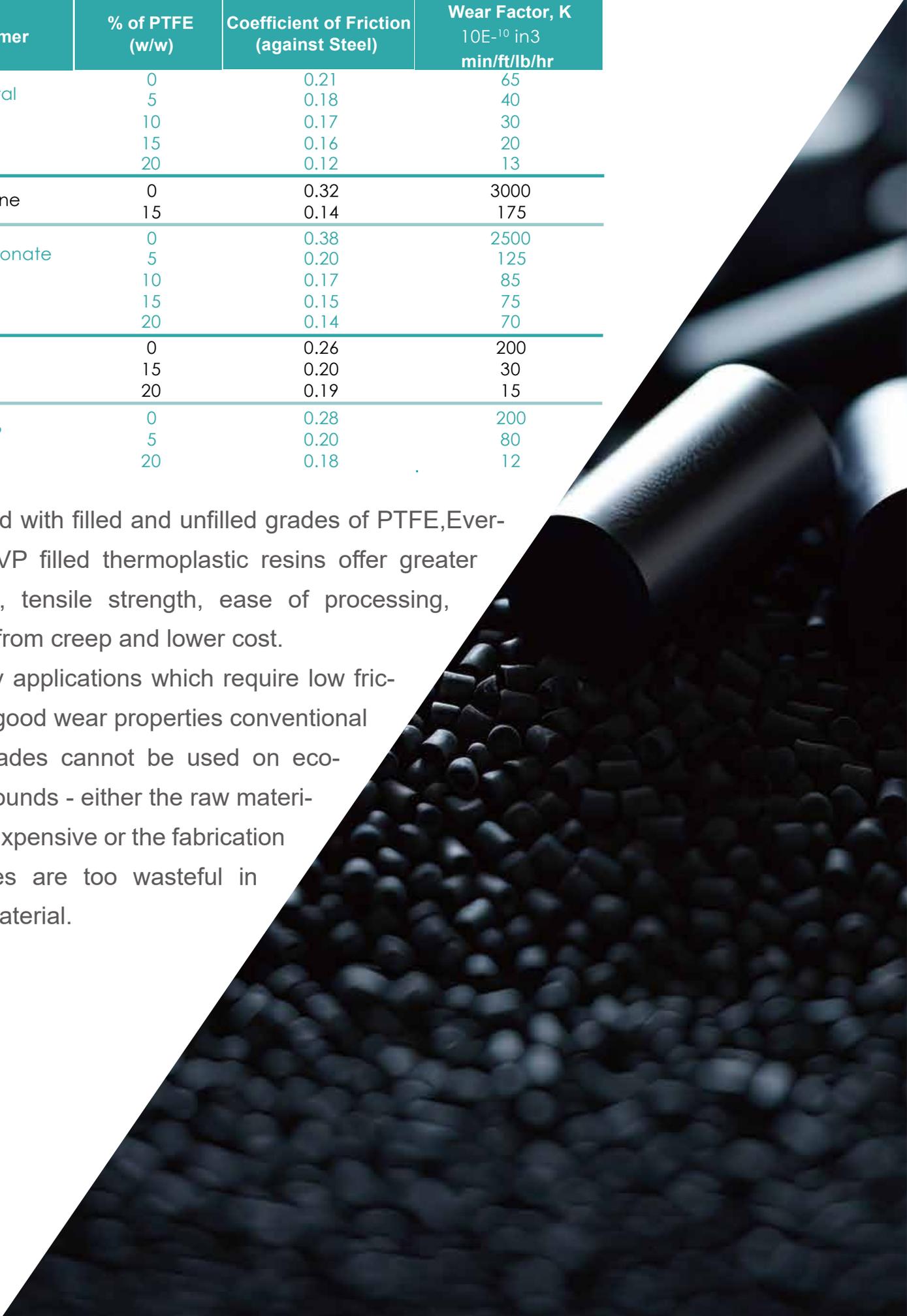
While the optimum loading will vary slightly with each resin system, it approaches 20 wt% for crystalline polymers and 15 wt% for amorphous and elastomeric resins. The optimisation is clearly seen by observing the wear and frictional values for the various resin families shown in Table.



Polymer	% of PTFE (w/w)	Coefficient of Friction (against Steel)	Wear Factor, K 10E <sup>-10</sup> in <sup>3</sup> min/ft/lb/hr
Polyacetal	0	0.21	65
	5	0.18	40
	10	0.17	30
	15	0.16	20
	20	0.12	13
Polystyrene	0	0.32	3000
	15	0.14	175
Polycarbonate	0	0.38	2500
	5	0.20	125
	10	0.17	85
	15	0.15	75
	20	0.14	70
Nylon 6	0	0.26	200
	15	0.20	30
	20	0.19	15
Nylon 6/6	0	0.28	200
	5	0.20	80
	20	0.18	12

Compared with filled and unfilled grades of PTFE, Everflon™ MVP filled thermoplastic resins offer greater hardness, tensile strength, ease of processing, freedom from creep and lower cost.

For many applications which require low friction and good wear properties conventional PTFE grades cannot be used on economic grounds - either the raw material is too expensive or the fabrication techniques are too wasteful in time of material.





Everflon™ MVP filled plastics can be processed by orthodox fabrication techniques and the cost can be controlled by monitoring the proportion of Everflon™ MVP to give the optimum combination of cost and performance.

In addition to improving the friction and wear properties of thermoplastics, Everflon™ MVP can also have useful effects on polymer melts. It has been observed that it improves the flow of polycarbonates and glass-filled nylon thus allowing intricate cavities to be filled more easily.

It also increases the swell ratio (as measured on polyethylene grades), indicating that it increases the elasticity of the melt.

This conclusion is supported by the occurrence of fewer voids and sink marks in thicksection mouldings and extrusions and by the fact that mould shrinkage is reduced.

Significant reductions in friction can be achieved with as little as 2% Everflon™ MVP (w/w) allowing its use purely as a processing agent in applications such as masterbatch preparations.

Used at these low levels, Everflon™ MVP powders provide improved mould release, internal lubrication, increased processing rates, and shorter moulding cycles.

They also reduce the adiabatic heat which causes unintentional and uncontrolled curing in thermoset compounds and allow greater extrusion rates in thermoplastics.

However, for optimum PV values and resistance to wear, 10% to 20% (w/w) of MVP should be used in the finished product. PTFE filled thermoplastics are recommended for applications requiring low friction losses, freedom from "stick-slip" and maximum wear resistance.

In general Everflon™ MVP should be mixed by the same techniques as those used for mixing pigments or masterbatches.

Everflon™ MVP can be tumble mixed with thermoplastics in powder form to give dry blends which can then be extruded or moulded. To ensure an acceptable dispersion of the PTFE the particle size of thermoplastic powder should not exceed 150 microns.

It is also possible to obtain a good dispersion by mixing Everflon™ MVP with thermoplastics in granule form, using high shear mixers. These mixers may also be used to prepare a masterbatch containing about 40% Everflon™ MVP which can then be blended with the bulk of the thermoplastic, still in granular form, to produce a composition of the required PTFE content.

The processing conditions for Everflon™ MVP-filled thermoplastics are identical to those of the host material.





## THERMOSET RESINS

### Advantages of Using Everflon™ PTFE

Everflon™ PTFE micro powders can be dry mixed with thermosetting moulding powders using similar processing techniques as for thermoplastics. Ideally Everflon™ MVP should be incorporated during the manufacture of the resin but dry mixing before moulding also gives good results. In the case of thermosetting laminating resins (eg, for the production of phenolic/cotton laminates), the lubricant powder should be mixed with the liquid resin by gentle stirring.

Good dispersion should be achieved without the need for vigorous mixing. Any tendency for the Everflon™ MVP to settle to the bottom during the course of a long production run can be overcome by using a stirred tank. Everflon™ MVP PTFE micro powders may be added at typical levels of between 10 to 15% by weight.

Everflon™ MVP filled thermosets are recommended for applications which require low friction losses, freedom from 'stick-slip' and maximum wear resistance, such as slides, gears, cams, bushes, components for instruments and low-power motors, and liners for control cables. They are particularly suitable for sliding contact applications in domestic appliances and automobiles.

Propolymer Additive

**PTFE**

MVP

14~17um

Everflon  
polymers



## ELASTOMERS

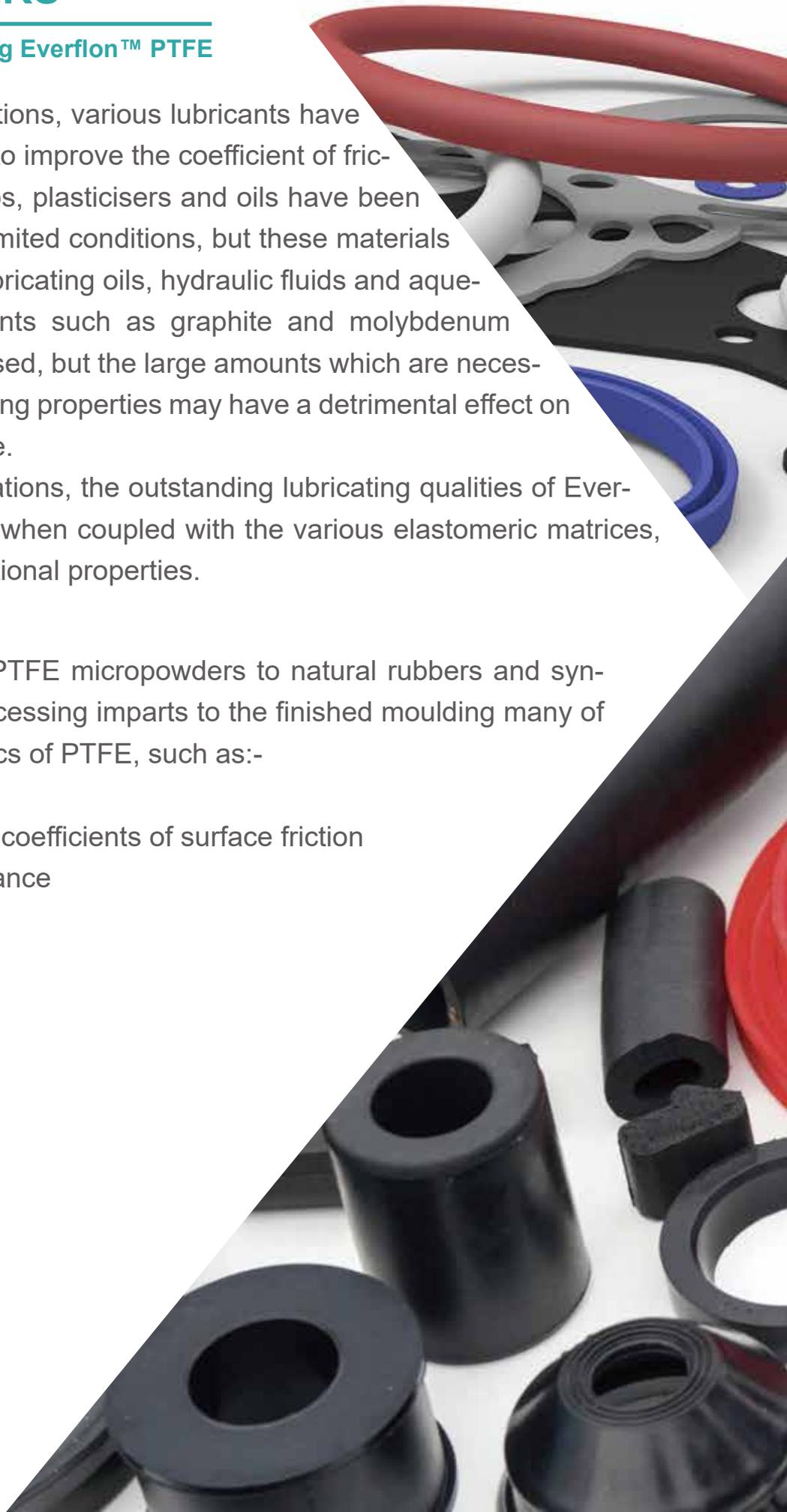
### Advantages of Using Everflon™ PTFE

In many elastomeric applications, various lubricants have been added to formulations to improve the coefficient of friction. Waxes, stearates, soaps, plasticisers and oils have been found useful under certain limited conditions, but these materials are normally extracted by lubricating oils, hydraulic fluids and aqueous solutions. Solid lubricants such as graphite and molybdenum disulphide have also been used, but the large amounts which are necessary to provide good lubricating properties may have a detrimental effect on strength and wear resistance.

For most mechanical applications, the outstanding lubricating qualities of Everflon™ PTFE micropowders, when coupled with the various elastomeric matrices, offer improved wear and frictional properties.

The addition of Everflon™ PTFE micropowders to natural rubbers and synthetic elastomers during processing imparts to the finished moulding many of the surface slip characteristics of PTFE, such as:-

1. Improved mould release
2. Lower static and dynamic coefficients of surface friction
3. Increased abrasion resistance
4. Elimination of stick slip
5. Improved tear strength



Everflon™ PTFE micrcpowder in rubbers are used where improved release or reduced wear are required. In general the improvement in surface properties is more marked with hard rubbers, i.e. those with Shore A hardness greater than 60. In the automotive and consumer durable industries the use of Everflon™ filled nitrile rubber for dynamic seals has eliminated stick-slip, improved wear resistance and reduced noise.

Everflon™ PTFE micro powder filled nitrile rubber cab also be used to replace silicone rubber on laminating rollers used with adhesives because of improved releases and better tear strength at lower cost. Similar improvements in properties have been experienced with styrene butadiene rubber, silicone and nitrile rubbers, polyurethane and fluoroelastomers blended with Everflon™ PTFE micropowders.

Everflon™ PTFE micropowders may be used in such typical elastomeric applications such as "O"- rings, hoses, fan belts and gaskets. Everflon™ PTFE micropowders may also be added in smaller amounts (typically 2 to 5%) to rubbers to provide a low friction surface for window and door seals in the automotive industry.



Everflon™ PTFE micropowders can be blended into rubber compositions by dry mixing with the fillers and subsequently compounding in the normal manner. When this compound is moulded the finished component can be easily removed from the mould due to the improved release properties. This can lead to a reduction in rejection rates, particularly on intricate mouldings.

During processing, a thin skin of rubber can form over the Everflon™ powder on the surface of the moulding and it may be necessary to lightly abrade or machine the surface before the optimum improvement in 'slip' characteristics can be achieved.

Everflon™ PTFE micropowders are inert to all chemicals used during processing and will neither interact with nor absorb any of the formulation ingredients.

Everflon™ MV3E can be added at a 15-25% concentration by weight of the elastomer to reduce surface friction and wear rate, and to eliminate 'stick-slip'. The lower percentage addition will provide most of the advantages listed, but the higher percentages are required to give improved release properties.

Everflon™ PTFE micropowders should be mixed thoroughly with the fillers before blending with the elastomer. The resulting rubber composition can then be processed under normal conditions. At these levels of addition, there is some reduction in the mechanical properties of the moulded rubber as PTFE acts as an inert filler and has no reinforcing properties.

For this reason MV3E, with its smaller median particle size, and its capability of being reduced in particle size to as little as 0.3 micron by high-shear mixing, is the preferred grade.

Satisfactory results have been obtained with, for example, butadiene-acrylonitrile, styrene-butadiene, polyurethane, polychloroprene rubbers and fluoroelastomers.



## OILS, GREASES AND SEALING PASTES

### Advantages of Using Everflon™ PTFE

There are number of applications where extremes of pressure and temperature and environment are experienced where Everflon™ lubricant powders may be used for improved lubrication.

Everflon™ MV1 excellent lubricant additives for specialised oils and greases designed for conditions where conventional additives such as graphite and molybdenum disulphide are unsuitable. The lubricating performance of these additives under various conditions is summarised in Table.

Everflon™ PTFE lubricant powders offer cleanliness, an important factor in greases intended for machinery in the food, confectionery, pharmaceutical and dairy industries. Also important for many engineering applications is the freedom from 'stick-slip' movement from which it is obtained as a result of the equal coefficients of static and dynamic friction of PTFE.

Greases incorporating Everflon™ PTFE lubricant powders are particularly well suited for applications which require low starting torques and where regular smooth sliding action is essential, for example miniaturised equipment and other mechanisms actuated by low power motors.



### SUMMARY OF LUBRICATING PERFORMANCE OF GRAPHITE, MOLYBDENUM DISULPHIDE AND PTFE UNDER VARIOUS CONDITION

Condition	Graphite	MoS <sub>2</sub>	PTFE
Dry oxygen	Poor	Moderate	Good
Dry nitrogen	Very Poor	Good	Good
Damp Air	Good	Poor	Good
Cryogenic temperatures	Poor	Poor	Good
High temperatures > 300°C	Good	Good	Poor
Vacuum	Poor	Poor	Good
Radiation	Poor	Good	Poor
Very high load, high speed	Good	Good	Poor
Low load, high speed	Good	Good	Moderate
Low load, low speed	Good	Good	Good
High load, low speed	Moderate	Moderate	Good
Corrosive environment	Good	Poor	Good

Additionally, extreme environmental demands on greases, such as those experienced in the aerospace industry where wide temperature ranges, high vacuum conditions at high speeds and heavy loads, can be accommodated by the inclusion of Everflon™ PTFE micro powders.

The low surface energy of Everflon™ PTFE micro powders means that little shear energy is required to form a soft, continuous film of lubricant.

Anti-stick properties are another advantage; the critical surface tension of fluoropolymers are below the surface tension of most liquids. An unusual consequence of this is that most lubricating greases in which Everflon™ PTFE micro powders are incorporated exclude water from interface boundaries and thus reduce hydrolytic corrosion.



Using perfluoroalkyl ether and trifluoropropylmethyl polysiloxane oils thickened by PTFE and FEP has shown that the most stable greases are those produced from Everflon™ PTFE micro powders having the smallest particle size, highest surface areas, high oil adsorption and the highest critical surface tension in relation to the surface tension of the oil.

Everflon™ PTFE micro powders may also be suitable for applications involving exposure to gaseous, or in some cases, liquid oxygen where potential fire hazards need to be eliminated. Products containing greases incorporating Everflon™ PTFE micro powders in greases include lubrication at low temperatures in corrosive conditions, where cleanliness is demanded, and where judder-free movement is required.

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Specific examples are: -

- Valves for chemical plant.
- Impregnated packing for safety valves which may be seldom used but which must not stick.
- Stop-cocks for laboratory ware and high vacuum equipment.
- General running-in of engineering equipment.

One of the more recent applications for Everflon™ PTFE lubricant powders has been the inclusion in internal combustion engine lubricating oils.

Once the lubricant is in place, the oil base provides a barrier film which bonds the PTFE to the surface giving a very low boundary friction coefficient which reduced the total running friction of the engine. Further developments are awaited in this expanding automotive applications area.

Alternative applications for oils and greases enriched with Everflon™ PTFE micropowders are conveyor chain lubricants which do not decompose at modern paint stoving temperatures, machine tool lubricants for tapping operating and reduced die wear in die stamping operations and general lubricants for moving machine parts, bearings, compressors, pumps and some hydraulic systems.

Everflon™ PTFE MV1 disperses easily with high-shear mixing. The MV1 particle is friable and when sheared in a liquid medium breaks down to submicron size; for instance after triple roll milling in a medium viscosity oil the particle size can be reduced to 0.3 micron. Ideally a masterbatch of 30-50% by weight of Everflon™ MV1 should be prepared, triple roll milled and subsequently diluted by the bulk of the medium to the required percentage addition.

This makes Everflon™ PTFE MV1 particularly suitable for addition to low viscosity media such as oils where larger particles may sediment. Additional tabilization may be achieved using suitable surfactants and other additives.

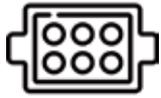
The proportion of Everflon™ PTFE MV1 added should be up to 10% by weight although lower proportions (2 to 5%) may be acceptable for certain less demanding applications.

Suitable mills which may be used to achieve mixing of Everflon™ PTFE powders into oils and grease(as well as paint and ink formulations), are shown below :-

- Triple roll mills
- Stirred media mills - Attritor mills
  - Bead mills
  - Sand mills
- Ball mills
- Paddle mixers
- Edge runner mills (eg. motorised mortar and pestle type)

Stirred media mills may be batch or continuous and are capable of producing fine dispersions of most materials.





## GELCOATS FOR BUILT-IN MOULD RELEASE

### Advantages of Using Everflon™ PTFE

Everflon™ PTFE micropowders may be used in the production of polyester and epoxy mold gelcoats for the production of ' self-releasing ' molds which offer more efficient use of capital, space and labor in the glass-reinforced (GRP) and general plastics industry.

The addition of Everflon™ PTFE micropowders should be undertaken during the manufacture of the gelcoat to ensure a workable viscosity and the required release properties.

Mold gelcoats containing Everflon™ MV1 MV3 offer the following advantages:

1. Built-in release properties - no mold release agent is required during the life of the mold.
2. Quicker production cycles - no time is wasted in cleaning the mold and applying mold release agent.
3. Reduced mold costs - less physical force is required to release moldings, so molds can last up to three times as long. A potential cause of mold damage, ie. incomplete coverage by conventional mold release agents, is eliminated.
4. Space saving - fewer molds occupy less space.
5. Labor saving - the labor-intensive operation of mold preparation is eliminated.
6. Appearance - the absence of release agents ensures an attractive, consistent finish.



Everflon™ MV3 should be added in the proportion of 25% to 30% by weight during the manufacture of the gelcoat. Thorough wetting of the Everflon™ powder is essential and this is best done by pre-mixing it with one of the solvents used in the gelcoat formulation before adding to the remainder of the ingredients. Everflon™ MV3 is a soft material and care should be taken to ensure that the particles are not damaged by mixing at too high a shear rate.

A triple roll mill can be used for mixing but the setting should be such that it mixes rather than grinds. This form of mixing is particularly good because it also ensure that no air is introduced to the resin.



## DRY LUBRICANT

### Advantages of Using Everflon™ PTFE

There are available a number of powders which are used, by themselves, as lubricants in intricate or inaccessible mechanisms, or where conventional lubricants are unacceptable. Of these powders only Everflon™ PTFE offers cleanliness combined with the capability of working under the widest range of conditions.

Everflon™ PTFE has replaced graphite for the lubrication of lace machinery. The cleanliness of PTFE has ensured the production of clean lace and eliminated the lengthy scouring process previously necessary to remove residual graphite from the lace.



## MISCELLANEOUS APPLICATIONS

[www.everflon.com](http://www.everflon.com)