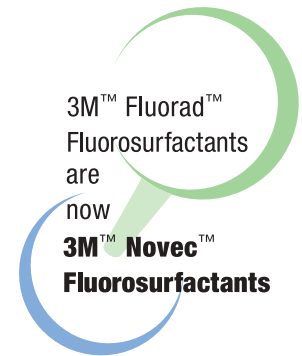




Novec™ Fluorosurfactants For Paints and Coatings

Application Information



**Goodbye
orange peel,
goodbye fish
eyes...**

Contamination, surface defects and hard-to-wet surfaces cause all manner of problems in paints and coatings. Unsightly “orange peel,” cratering, “fish eyes” and picture framing effects are just some of the problems formulators face.

**...Hello
smooooooth.**

To address these defects, surfactants are added. Surfactants decrease a coating’s surface tension to allow better leveling, wetting and spreading—especially on unclean surfaces.

The lower the surface tension, the more effectively a coating wets, levels and spreads. And no surfactant lowers surface tension more effectively than those made with fluorochemicals—like the next generation of 3M™ Novec™ Fluorosurfactants. These new fluorosurfactants...

- Dramatically lower surface tension
- Help paints and coatings overcome surface contamination
- Are effective in both aqueous- and solvent-based systems

Which means orange peel, cratering, fish eyes and picture framing can be things of the past.

What’s more, Novec fluorosurfactants help to maintain low surface tension throughout the entire drying process. This helps to create smoother, higher gloss coatings.

You can use Novec fluorosurfactants in many industrial and commercial coatings, including paints, resins, adhesives, inks, clearcoats, floor coverings and more!

In November 2003, all 3M fluorochemical surfactants, including those formerly sold under the 3M “Fluorad” brand, began to carry a new brand name, **3M™ Novec™ Fluorosurfactants**.

3M’s Novec brand is applied to chemistries promising safe, effective, sustainable solutions in a number of specialized industrial applications. Whenever you see a product carrying the Novec brand, you can be assured that it will help you meet the highest standards for performance, worker safety and environmental responsibility.



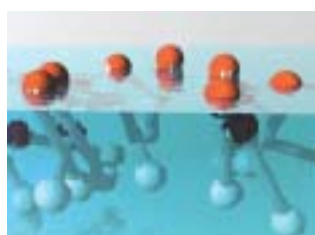
What's going on in there?

When a surfactant is added to a paint or coating formulation, it migrates to the lowest energy interface, typically the bulk liquid and air interface. That's because surfactant molecules are made up of two groups: a hydrophilic (water-loving) group and a hydrophobic group. The hydrophobic end is attracted to the air, and tends to push out of the liquid, while the hydrophilic end is attracted to the water and tends to be pulled in. These combined actions lower the surface energy of a liquid—allowing it to better wet, level and flow over a surface.

Coating Formulation



Fluorinated Surfactant



Hydrocarbon Surfactant

Fluorosurfactants vs. hydrocarbon and silicone surfactants

3M™ Novec™ Fluorosurfactants are more effective at reducing surface tension levels in aqueous and non-aqueous systems...to levels lower than those achievable with hydrocarbon and silicone surfactants. Novec fluorosurfactants can reduce surface tensions in aqueous and organic systems to about 20 dynes/cm. Hydrocarbon surfactants can reduce surface tensions to about 30 dynes/cm, whereas silicone surfactants lower surface tensions to about 25 dynes/cm.

In addition, Novec fluorosurfactants can reduce surface tensions more efficiently. That means you need less surfactant to do the same job.

Surface Tension Reduction Potential of Novec Fluorosurfactants FC-4430 and FC-4432

The following table shows the surface tension reduction potential (in dynes/cm) of 3M™ Novec™ Fluorosurfactants FC-4430 and FC-4432 in some commonly available waterborne resins in comparison to competitive hydrocarbon and silicone surfactants.

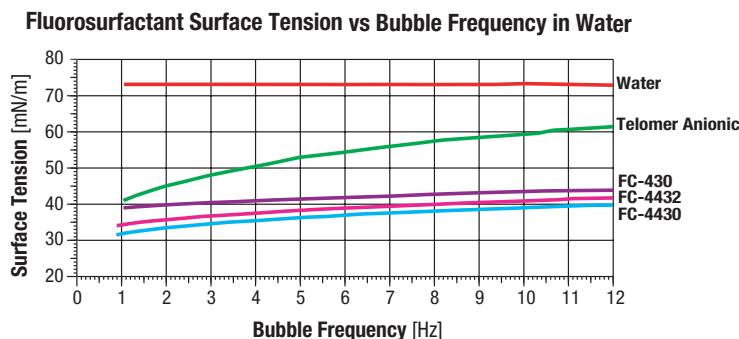
Resin	No Surfactant	HC Surfactants 1.00%	FC-4430 0.3%	FC-4432 0.3%	Competitive FC Surfactant 0.3%	Silicone Surfactant 0.5%
NeoCryl™ A-6099	39.1	29.0	24.3	20.1	26.1	27.3
NeoRez™ R-941	43.1	29.8	21.2	19.9	24.4	23.8
NeoRez™ R-9621	47.4	33.1	21.2	20.4	24.2	22.8
JONCRYL™ 537	37.4	31.8	19.7	21.0	25.6	27.6
JONCRYL™ 1532	38.4	32.9	21.2	23.4	26.9	28.9
JONCRYL™ 1925	41.0	31.2	19.7	20.2	25.4	27.1
JONCRYL™ 1972	38.9	27.6	22.4	21.9	26.3	27.6

NeoCryl and NeoRez are trademarks of NeoResins

JONCRYL is a trademark of Johnson Polymers

FC-4430 and FC-4432 Provide Low Dynamic Surface Tensions

Dynamic surface tension data describe the ability of a surfactant to move and organize in a solution. Low dynamic surface tensions or rapid surfactant migration can be important in high-speed coating processes or low viscosity systems. Novec fluorosurfactants FC-4430 and FC-4432 can reduce dynamic surface tensions to lower levels than conventional fluorosurfactants (PFOS and telomer derived) as illustrated in the following chart.



Low Interfacial Surface Tensions at Low Concentrations

The ability to obtain lower interfacial surface tension is a key requirement for the stabilization of pigments and polymer resins in an aqueous formulation. 3M™ Novec™ Fluorosurfactants FC-4430 and FC-4432 can provide low interfacial surface tensions as indicated by the following table.

Surfactant	Interfacial Tension* Light Phase: Heptane			Interfacial Tension* Light Phase: Cyclohexane		
	200ppm	0.5%	1.0%	200ppm	0.5%	1.0%
Control		43.7			51.2	
FC-4430	3.5	2.2		2.5	1.5	
FC-4432	4.2	2.6		4.2	2.1	
FC-430	3.5	2.4		4.0	2.1	
SDS ¹	15.4	6.1	5.8	12.9	5.0	4.9
SDS-10 ²	15.9	4.1	3.7	13.5	2.9	2.6
Silicone Dispersant	14.4	10.9	10.5	11.7	8.8	8.8

¹Sodium dodecyl sulfate ²Sodium dodecyl benzene sulfonate *dynes/cm

New Chemistry – Fewer Problems

Based on an entirely new fluorochemical building block, Novec Fluorosurfactants FC-4430 and FC-4432 are polymers that show the same performance benefits that have long differentiated fluorochemicals from competing surfactant technologies, such as silicones and hydrocarbons. 3M believes that this stems from the unique physical properties of the fluorochemical component of these materials. Another advantage of Novec fluorosurfactants is that very little product is necessary to afford a significant surface tension reduction of a formulation, which for customers means low use levels. Hydrocarbons, in contrast, often require an order of magnitude more product to significantly reduce surface tensions, and the surface tensions levels reached do not approach those possible with Novec fluorosurfactants FC-4430 or FC-4432.

Intercoat and second coat adhesion can often be adversely affected when using silicone or conventional fluorochemical surfactants. However, in formulations using Novec fluorosurfactants FC-4430 or FC-4432, derived from 3M's new building block, this problem has not been observed even at higher loading levels.

The end result: Beautiful

With Novec fluorosurfactants it's possible to control the surface tension of the coating during the entire coating process.

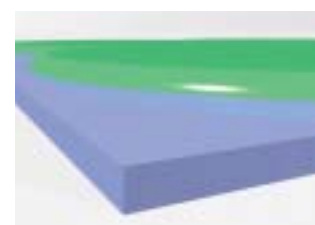
Improved wetting. For a liquid to wet a surface, its surface tension must be lower than the surface energy of the substrate and all the contaminants on the substrate. Novec fluorosurfactants aid in the wetting of a coating applied to a variety of materials, including hard-to-wet surfaces such as plastics and oily metals. They can even help overcome contamination from roller grease, condensation drip, dust, gel particles or silicones. Lowering surface tension during applications helps to prevent surface defects, including cratering, picture framing, fish eyes and de-wetting.

Better leveling. When a liquid contains components of different surface tensions and areas of different evaporation rates, there is the possibility that surface tension gradients could form defects at the liquid/air interface. These defects are in the form of a surface roughness often referred to as "orange peel." Novec fluorosurfactants improve leveling by reducing or even eliminating these gradients during the coating dry down phase—resulting in a smoother, more uniform surface.

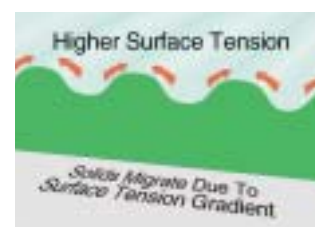
Novec fluorosurfactants control surface tension throughout the entire drying or curing phase. Maintaining low surface tension throughout this process creates smoother, higher gloss coatings. Using Novec fluorosurfactants can also reduce the occurrence of the surface defect called "orange peel."



Contaminants can cause surface tension gradients, resulting in a "cratering" or "fish eye" effect.



Novec fluorosurfactants concentrate at the liquid surface, lowering the surface tension of the liquid. This allows the liquid to wet and spread more evenly, and reduces the possibility of surface defects.



If a coating contains components of different surface tensions, the solids will tend to migrate, resulting in an "orange peel" effect.

Safety and Handling

3M™ Novec™ Fluorosurfactants FC-4430 and FC-4432 are intended for use in non-dispersive applications.

3M does not recommend these products for use in applications involving repeated exposure through skin contact, inhalation or ingestion. They are not intended for cosmetic or medical usage. Neither 3M nor the Food and Drug Administration has evaluated or reviewed these products for food, medical, pharmaceutical or cosmetic applications.

It is the buyer's responsibility to determine whether these products are durable and properly cured for the end use. Recommended disposal of this material is high temperature incineration and/or landfill.

For additional product safety and handling information, please read the product labels and Material Safety Data Sheets before using these products.

3M Resources

The next generation of Novec fluorosurfactants are now available for use in industrial and commercial paints and coating applications. For additional information, please contact your local 3M representative, or call 800-541-6752.

United States

3M Performance Materials Division
3M Center, Building 223-6S-04
St. Paul, MN 55144-1000
800 541 6752
800 810 8514 (Fax)

Europe

3M Specialty Materials
3M Belgium N. V.
Haven 1005, Canadastraat 11
B-2070 Zwijndrecht
32 3 250 7511

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3M Performance Materials Division

3M Center, Building 223-6S-04
St. Paul, MN 55144-1000

www.3m.com/paintsandcoatings

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