

# 3M™ Ionic Liquid Antistat FC-5000

## Product Description

3M™ Ionic Liquid Antistat FC-5000 is a high purity antistatic additive compatible with a variety of high performance polymer systems, including urethanes, acrylates (e.g. adhesives, UV cured coatings) and other thermoplastic or thermoset resins.

## Features and Benefits

- Low color – Optical clarity
- Ability to graft into selected polymer networks (e.g. urethanes, epoxies)
  - Better durability and stability
  - Minimal leaching concerns
- Low metal and halogen ion levels and low water content
  - Suitable for electronic, display, and semiconductor applications
  - Expected to be non-corrosive to metals and glass
- Independent to humidity
  - Stable antistatic performance over wide humidity range
- Excellent thermal stability
  - Stable to melt processing with most thermoplastics
- Negligible vapor pressure
  - Compatible with high temperature processing (e.g., melt processing)
  - No outgassing, flammability, or VOC concerns
- Hydrophobic, lipophilic salt
- Resistance to water washing in selected polymer networks (e.g. urethanes, PVC, PVDF)
- ~ 100% Active Ionic Liquid (liquid down to at least -50°C)
  - No solids handling, no melting required
- Excellent polymer compatibility - Optical clarity

## Material Description / Specifications

3M™ Ionic Liquid Antistat FC-5000	
<b>Appearance</b>	Clear colorless to light yellow liquid
<b>General Name</b>	Quaternary alkyl ammonium sulfonimide
<b>Formula</b>	$R_4N^+ N(SO_2CF_3)_2$
<b>Active Material</b>	99.7% minimum
<b>APHA Color</b>	100 maximum
<b>Water</b>	500 ppm maximum

## Applications

3M™ Ionic Liquid Antistat FC-5000 can be used as an antistatic additive in thermoset or thermoplastic resins. In thermosets, 3M antistat FC-5000 is typically dissolved in the monomer or oligomer mixture prior to curing with heat or light. In thermoplastics, the 3M antistat FC-5000 is typically melt-processed with the resin in an extruder. Due to its exceptional thermal stability, melt processing of 3M antistat FC-5000 is possible even with certain high temperature engineering resins. 3M antistat FC-5000 has excellent solubility in polar organic solvents can therefore be used in solvent cast polymer coatings as well. Generally, concentrations of 3M antistat FC-5000 between 1 to 10 weight percent in the final resin are effective at dissipating static charge.

Application	Main Benefit
<b>Adhesive</b> - Polarizer - LCD panel assembling	<ul style="list-style-type: none"> <li>• Optical clarity and compatibility</li> <li>• Independent to humidity (Stable antistatic performance over wide humidity range)</li> <li>• Thermal and hydrolytic stability</li> </ul>
<b>Protection film</b> - Polarizer - LCD display panel - Touch panel ITO film/glass - Other optical films	<ul style="list-style-type: none"> <li>• Helps reduce dust attraction</li> <li>• Helps prevent static discharge failures in electronics</li> <li>• Easier positioning of stack of films – helps improve assembly process</li> </ul>
<b>UV cured coating</b> - LCD backlight unit optical film: Diffuser, Prism Sheet - Display surface - Automotive glass	<ul style="list-style-type: none"> <li>• Helps reduce dust attraction for cleaner surfaces</li> <li>• Easier positioning of film stack – helps improve assembly process</li> <li>• Independent to humidity (Stable antistatic performance over wide humidity range)</li> </ul>
<b>Roller</b> - Urethane - Silicon	<ul style="list-style-type: none"> <li>• Helps reduce / virtually eliminates static build-up for safer working environment</li> <li>• Thermal stability, good solubility in organic polymer</li> <li>• Helps improve control of toner transfer in printer</li> <li>• Long urethane pot life</li> </ul>
<b>Packaging</b>	<ul style="list-style-type: none"> <li>• Optical clarity</li> <li>• Helps reduce dust and static discharge during packaging</li> <li>• Thermal stability</li> </ul>
<b>Clean room attire, floor, mat, etc.</b>	<ul style="list-style-type: none"> <li>• Helps reduce pickup of dust / infective / contaminated particles for cleaner surfaces</li> <li>• No outgassing, no particle shedding</li> </ul>
<b>Electronic Trays</b>	<ul style="list-style-type: none"> <li>• Helps reduce / virtually eliminates static build-up</li> <li>• No outgassing</li> <li>• Optical clarity</li> <li>• Graft into some polymer networks – minimal leaching</li> </ul>

\*Antistatic performance is dependent upon the type of polymer, additive loading level, and processing conditions.

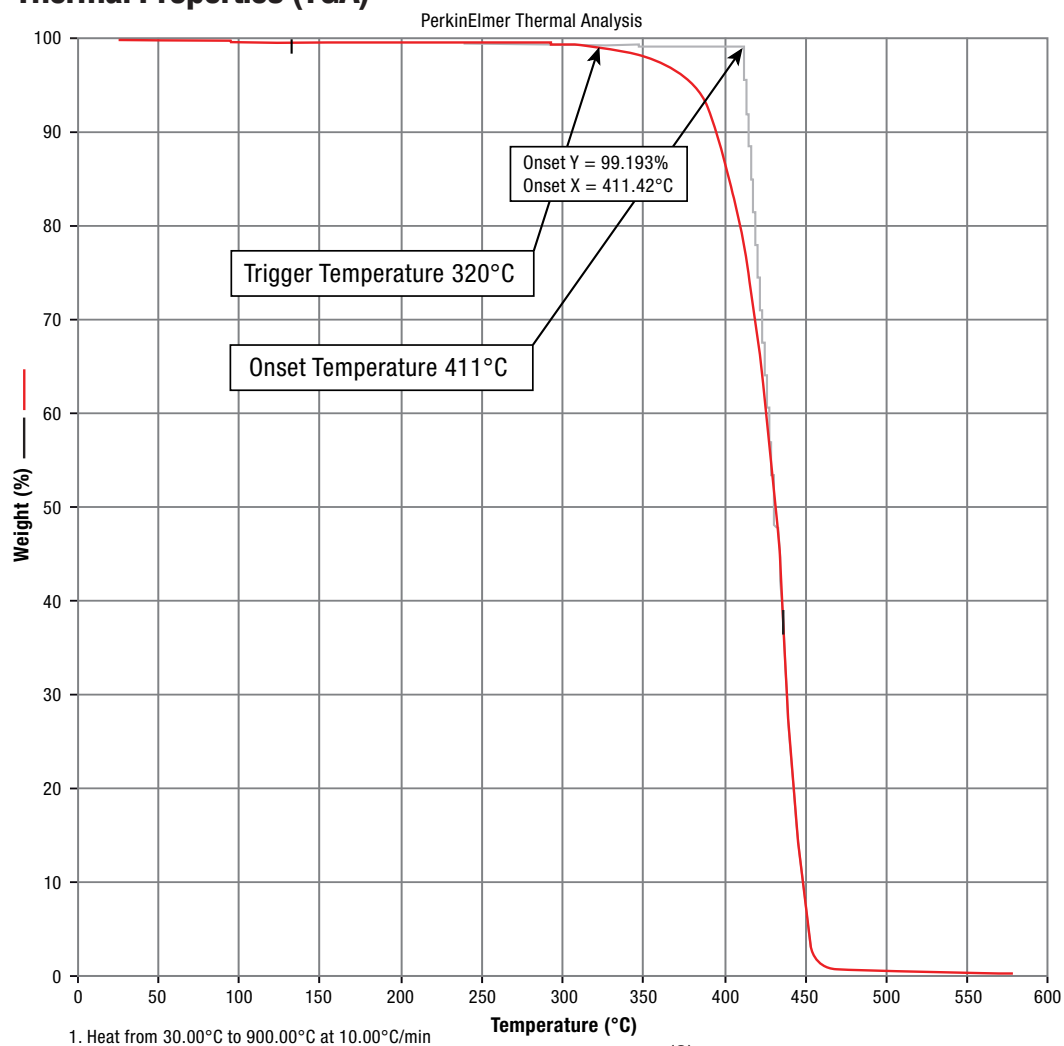
## Typical Physical Properties and Performance Characteristics

**Note:** The following technical information and data should be considered representative or typical only, and should not be used for specification purposes.

3M™ Ionic Liquid Antistat FC-5000*	
Property	Value
Melting Point	< -50°C
Solubility in Water	0.19% by weight
Vapor Pressure	Negligible below decomposition temperature
Specific Gravity	1.30 g/mL
Volatiles (by weight)	< 0.1%
pH	5 (neutral)
Viscosity	251 cP

\*Note: At 25°C unless otherwise noted.

## Thermal Properties (TGA)



**Antistatic Performance*****Thermoplastic Polyurethane***

Performance of 3M Antistat FC-5000 in Thermoplastic Polyurethane*			
FC-5000 Loading (wgt %)	Surface Resistivity ( $\Omega/\text{sq}$ )	Volume Resistivity ( $\Omega\cdot\text{cm}$ )	Static Decay Time (seconds)
0%	$1 \cdot 10^{13}$	$8 \cdot 10^{11}$	2.91
1%	$5 \cdot 10^{11}$	$4 \cdot 10^9$	0.05
3%	$7 \cdot 10^{10}$	$2 \cdot 10^9$	0.02
5%	$2 \cdot 10^{10}$	$8 \cdot 10^8$	0.01

\*Measured on Lubrizol Estane 58237

***Solvent Cast Polyurethane***

Performance of 3M Antistat FC-5000 in Solvent Cast Polyurethane			
FC-5000 Loading (wgt %)	Surface Resistivity ( $\Omega/\text{sq}$ )	Volume Resistivity ( $\Omega\cdot\text{cm}$ )	Appearance
0%	$3 \cdot 10^{14}$	$5 \cdot 10^{11}$	Optically clear
0.14%	$2 \cdot 10^{11}$	$4 \cdot 10^9$	Optically clear
0.25%	$2 \cdot 10^{11}$	$2 \cdot 10^9$	Optically clear
0.5%	$2 \cdot 10^{11}$	$1 \cdot 10^9$	Optically clear
1%	$4 \cdot 10^{10}$	$8 \cdot 10^8$	Optically clear
2%	$8 \cdot 10^9$	$3 \cdot 10^8$	Optically clear

***Acrylate Adhesives***

Performance of 3M Antistat FC-5000 in Solvent Cast Acrylate Adhesive			
FC-5000 Loading (wgt %)	Surface Resistivity ( $\Omega/\text{sq}$ )	Static Decay Time (seconds)	Appearance
0%	$5 \cdot 10^{14}$	> 30	Optically clear
1%	$3 \cdot 10^{12}$	4.78	Optically clear
2%	$1 \cdot 10^{12}$	1.49	Optically clear
3%	$4 \cdot 10^{11}$	0.59	Optically clear

***Engineered Polymers******PET***

Performance of 3M Antistat FC-5000 in PET*			
FC-5000 Loading (wgt %)	Surface Resistivity ( $\Omega/\text{sq}$ )	Volume Resistivity ( $\Omega\cdot\text{cm}$ )	Static Decay Time (seconds)
0%	$7 \cdot 10^{15}$	$3 \cdot 10^{16}$	> 30
2%	$4 \cdot 10^{11}$	$2 \cdot 10^{14}$	0.29
4%	$1 \cdot 10^{10}$	$1 \cdot 10^{13}$	0.10

\*Measured on Eastman Chemical Tritan FX100

**Engineered Polymers (continued)**

**coPEN**

Performance of 3M Antistat FC-5000 in coPEN*		
FC-5000 Loading (wgt %)	Surface Resistivity (Ω/sq)	Static Decay Time (seconds)
0%	$2 \cdot 10^{15}$	WNC**
2%	$4 \cdot 10^{11}$	0.45
4%	$3 \cdot 10^{10}$	0.08

\*Measured on 90/10 PEN/PET

\*\*WNC – Would not charge

**PVC**

Performance of 3M Antistat FC-5000 in PVC*			
FC-5000 Loading (wgt %)	Surface Resistivity (Ω/sq)	Volume Resistivity (Ω*cm)	Static Decay Time (seconds)
0%	$2 \cdot 10^{14}$	$2 \cdot 10^{13}$	> 30
1%	$1 \cdot 10^{13}$	$9 \cdot 10^{10}$	0.42
3%	$1 \cdot 10^{12}$	$1 \cdot 10^{10}$	0.09
5%	$1 \cdot 10^{12}$	$3 \cdot 10^9$	0.03

\*Measured on Alpha Gary PVC

**PVDF**

Performance of 3M Antistat FC-5000 in PVDF*			
FC-5000 Loading (wgt %)	Surface Resistivity (Ω/sq)	Volume Resistivity (Ω*cm)	Static Decay Time (seconds)
0%	$6 \cdot 10^{14}$	$1 \cdot 10^{14}$	> 30
0.5%	$4 \cdot 10^{13}$	$1 \cdot 10^{12}$	5.04
1%	$3 \cdot 10^{12}$	$1 \cdot 10^{11}$	0.91
3%	$4 \cdot 10^{11}$	$2 \cdot 10^{10}$	0.13
5%	$8 \cdot 10^{11}$	$5 \cdot 10^9$	0.03

\*Measured on Rowland Technologies Kynar PVDF

**Resistance to Water Washing**

Polymer	3M Antistat FC-5000 (Ungrafted) Resistance to Water Washing		
	FC-5000 Loading (wgt %)	Surface Resistivity (Ω/sq)	
		Initial	After Water Wash*
Solvent Cast Polyurethane	0%	$3 \cdot 10^{13}$	$3 \cdot 10^{13}$
	0.25%	$1 \cdot 10^{11}$	$4 \cdot 10^{10}$
PVDF	0%	$1 \cdot 10^{15}$	$8 \cdot 10^{14}$
	1%	$3 \cdot 10^{12}$	$7 \cdot 10^{12}$

\*Immersion in DI water for 5 minutes

All surface and volume resistivity measurements were made on a Keithley 6517A / 8009 Resistivity test fixture. All static decay time measurements were made on an Electro-tech Static Decay Meter Model 406C. Static decay time results are the average of the time to decay to 10% of the initial charge for a +5 kV and -5 kV charge. All performance testing was run at ambient conditions.

### **Product Handling and Shelf Life**

3M™ Ionic Liquid Antistat FC-5000 has a shelf life of at least 1.5 years and 3M will warrant the product specifications for this period from date of manufacture for material in unopened and properly stored containers. 3M antistat FC-5000 is available in 1 gallon bottles (10 lb, 4.5 kg) or 5 gallon pails (44 lb, 20 kg). 1.0 lb (454 g) sample sizes are also available. Please refer to the 3M antistat FC-5000 Material Safety Data Sheet (MSDS) for instructions on safe and proper handling and disposal of this product.

3M does not support the use of 3M antistat FC-5000 for use in direct or indirect food contact applications.

The use of 3M antistat FC-5000 in applications that involve repeat human skin contact must be reviewed by 3M Corporate Stewardship, and may require supportive testing prior to approval. Avoid uses of the product that result in releases to water.

### **Related Products**

3M has a family of ionic liquids and salts for antistatic applications. For more information, contact your 3M representative or visit [www.3M.com/electronics](http://www.3M.com/electronics).

## Regulatory

For regulatory information about this product, contact your 3M representative.

## Technical Information

The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

## Product Use

Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

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