

3M™ Ionic Liquid Antistat FC-4400

Introduction

3M™ Ionic Liquid Antistat FC-4400 is a high purity antistatic additive compatible with a variety of high performance polymer systems, including thermoplastic resins and thermosets. Antistat FC-4400 is optically clear and has low metal and halogen ions, which makes it ideal for electronics, display and semiconductor applications. Outstanding thermal stability, low water content and negligible volatility allow Antistat FC-4400 to be readily melt processed with high melting engineering resins.

Features and Benefits

- Optical clarity
- Low metal and halogen ions
- Stable antistatic performance over a wide humidity range
- Static dissipation in a wide variety of polymers with typical resistivities of 10^9 to 10^{12} ohms/sq
- Thermal stability – trigger temperature by TGA of 340°C
- Wide liquid range for ease of handling in production
- Hydrophobic

Advantages

Electrostatic Performance Plus Optical Clarity

Antistat FC-4400 provides excellent static dissipation performance to polymers at relatively low loadings. Typical surface resistivities in polymer formulations range from 10^9 to 10^{12} ohms/sq. Antistat FC-4400 is colorless and highly soluble in organic media making it ideal for use in a wide variety of polymer systems where optical clarity is critical.

Ease of Manufacturing and Thermal Stability

Antistat FC-4400 is a liquid above 27°C (m.p.), but it is nonflammable and has negligible vapor pressure at elevated temperatures. The thermal trigger temperature by TGA is 340°C, making Antistat FC-4400 ideal for use in high temperature polymer melt processing and injection molding applications. Its wide liquid range also simplifies material handling in production.



Material Description

Name: tri-n-butylmethylammonium bis-(trifluoromethanesulfonyl)imide

Formula: $(n\text{-C}_4\text{H}_9)_3(\text{CH}_3)\text{N}^+ \text{-N}(\text{SO}_2\text{CF}_3)_2$

Appearance: Clear colorless liquid or white crystalline solid

Specifications

Assay > 99.0%

Color, APHA < 100

Residual Water < 500 ppm

Physical Properties

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

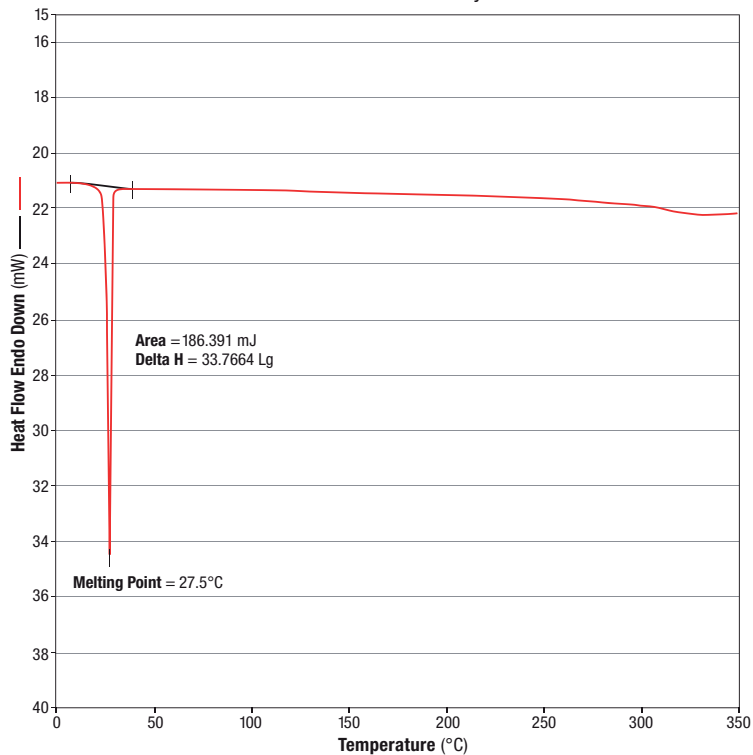
Properties	3M™ Ionic Liquid Antistat FC-4400
M.P.	27.5°C
Solubility in water @ 23°C	~765 ppm by wt
Vapor Pressure	Essentially none below the decomposition temperature
Specific Gravity (25°C)	1.26 g/mL
Volatiles (by wt)	< 0.1%
pH	~5.0 (neutral)
Viscosity @ 25°C	500 cP (supercooled)

Thermal Properties

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

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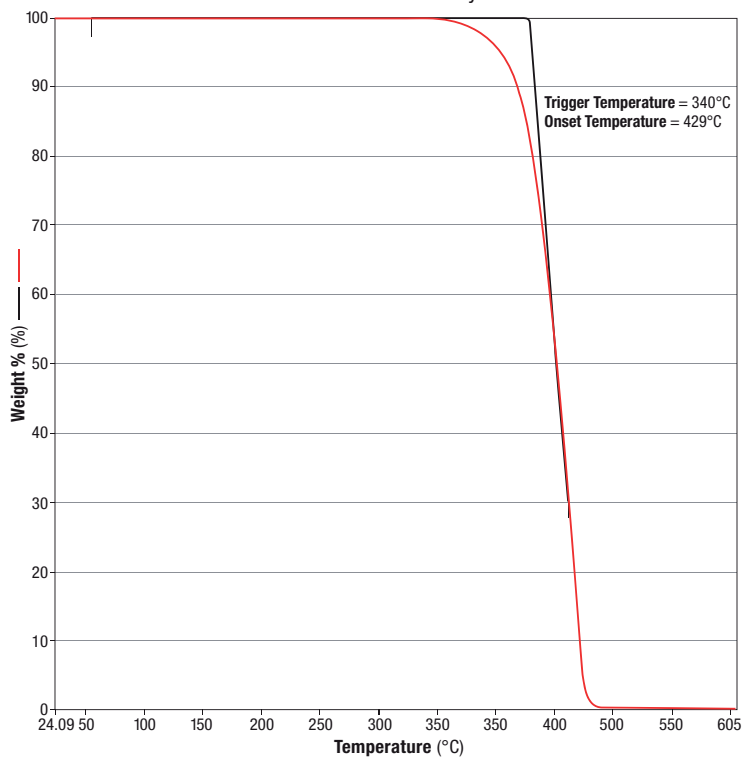
PerkinElmer Thermal Analysis



1) Hold for 1.0 min at -20°C/min 2) Heat from -20°C to 400°C at 10°C/min

TGA

PerkinElmer Thermal Analysis



Antistatic Performance

Performance of Antistat FC-4400 in Optically Clear Poly-Acrylate Based PSA¹

FC-4400 Loading (wt%)	Surface Resistivity ²	Durability (72 hr) ³
5%	$1.2 \times 10^{10} \Omega/\text{sq}$	Good
2.5%	$4.8 \times 10^{10} \Omega/\text{sq}$	Good
0%	$1 \times 10^{14} \Omega/\text{sq}$	—

¹PSA is Pressure Sensitive Adhesive

²Measured according to ASTM D257, at 23°C and 23% relative humidity.

³Durability test: A laminated sample of adhesive was placed in an oven maintained at 65°C and 90% relative humidity for up to one week. The sample was occasionally removed from the oven and visually inspected for defects. If no defects were observed, the sample was rated Good.

Performance of Antistat FC-4400 in Optically Clear, UV-Cured Poly-Acrylate Coating*

Wt% FC-4400	Log Surface Resistivity (Ω/sq)
0	11.1
1	10.5
5	9.7

*Customer data

Performance of Antistat FC-4400 in Melt Processed Polyvinylidene Fluoride (PVDF)

Wt% FC-4400	5KV Positive Static Discharge Time (sec) to 10%	5KV Negative Static Discharge Time (sec) to 10%
1	3.1	3.2
3	0.05	0.04
5	0.04	0.03

Static discharge times measured under ambient conditions.

Performance of Antistat FC-4400 in Melt Processed Polycarbonate (PC)*

Wt% FC-4400	Surface Resistivity (Ω/sq)
0	4×10^{16}
3	1.9×10^{13}
4	4.0×10^{12}
5	3.3×10^{12}

*Customer data

Applications

3M™ Ionic Liquid Antistat FC-4400 can be used as an antistatic additive in thermoset or thermoplastic resins. In thermosets, Antistat FC-4400 is typically dissolved in the monomer or oligomer mixture prior to curing with heat or light. In thermoplastics, the Antistat FC-4400 is typically melt-processed with the resin in an extruder. Due to its exceptional thermal stability, melt processing of Antistat FC-4400 is possible even with certain high temperature engineering resins. Generally, concentrations of Antistat FC-4400 between 1 – 10 wt% in the final resin are effective at dissipating static charge.

Product Handling and Shelf Life

Antistat FC-4400 has a shelf life of at least 2 years and 3M will warrant the product specifications for this period from date of manufacture for material in unopened and properly stored containers. This product is a crystalline solid at normal room temperature, but is readily melted by heating in original package above its melting point (27.5°C) at a temperature of 30 - 60°C in an oven or temperature controlled room. Once liquid, the product has a tendency to supercool and will therefore typically remain liquid for a period of days to weeks in original container at room temperature (~ 20°C). Antistat FC-4400 is available in 1 gallon bottles (10 lb, 4.5 kg), 5 gallon pails (44 lb, 20 kg) or 55 gallon drums (496 lb, 225 kg). 1.0 lb (453 g) sample sizes are also available. Please refer to the Antistat FC-4400 Safety Data Sheet (SDS) for instructions on safe and proper handling and disposal of this product.

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.

Regulatory and Product Stewardship

3M™ Ionic Liquid Antistat FC-4400 is persistent in the environment. Avoid uses of the product that result in releases to the environment during the course of normal use.

The recommended method of disposal is high temperature incineration in a facility capable of handling halogenated materials. Avoid release of waste streams containing the product to aqueous treatment systems, as conventional wastewater treatment is generally not considered to be an effective means of capture.

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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