

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 does not contain metal or halogen ions, which makes it ideal for electronics, display and semiconductor applications. Because of its outstanding thermal stability, low water content and negligible volatility it can be readily melt processed with high melting engineering resins at temperatures that would cause conventional chemical antistatic additives either to decompose or outgas.

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. Because it is colorless and highly soluble in organic media, antistat FC-4400 can be used in a wide variety of polymer systems where optical clarity is critical. Because it is a hydrophobic ionic liquid, the solubility of antistat FC-4400 in water is very low, providing excellent antistatic durability as well.

Ease of Manufacturing and Thermal Stability

Antistat FC-4400 is a liquid above 27°C (m.p.), but is nonflammable and has negligible vapor pressure at elevated temperatures. It is also thermally stable up to at least 340°C (644°F), making FC-4400 ideal for use in high temperature polymer melt processing and injection molding applications where other available chemical antistats would decompose and discolor. Its wide liquid range also simplifies material handling in production.

Material Description

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

Formula: $(n-C_4H_9)_3(CH_3)N^+ - N(SO_2CF_3)_2$

Appearance: Clear colorless liquid or white crystalline solid

Specifications

Assay > 99.0%

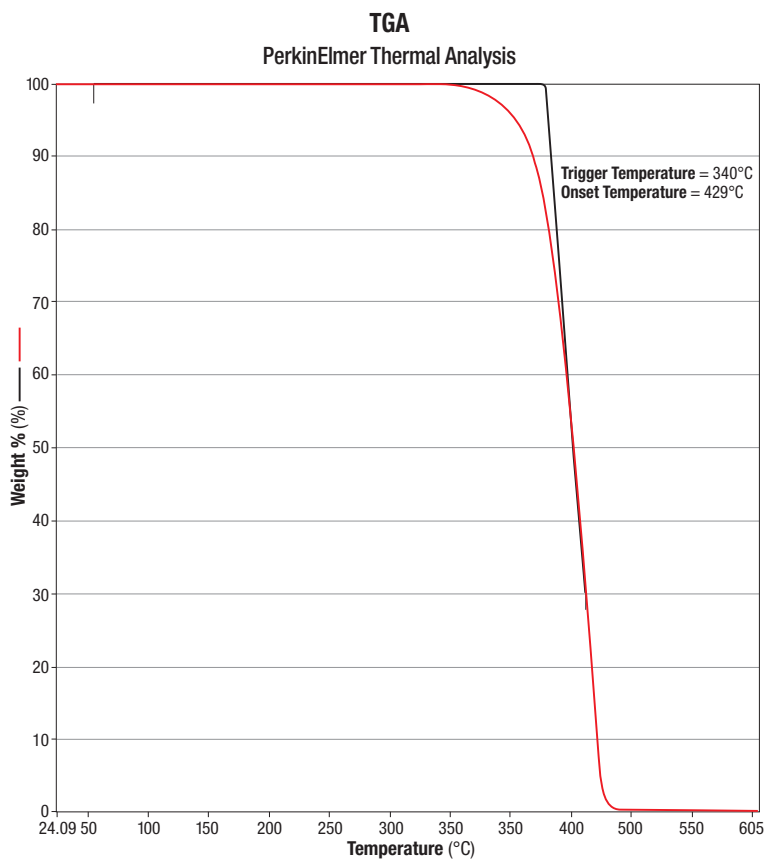
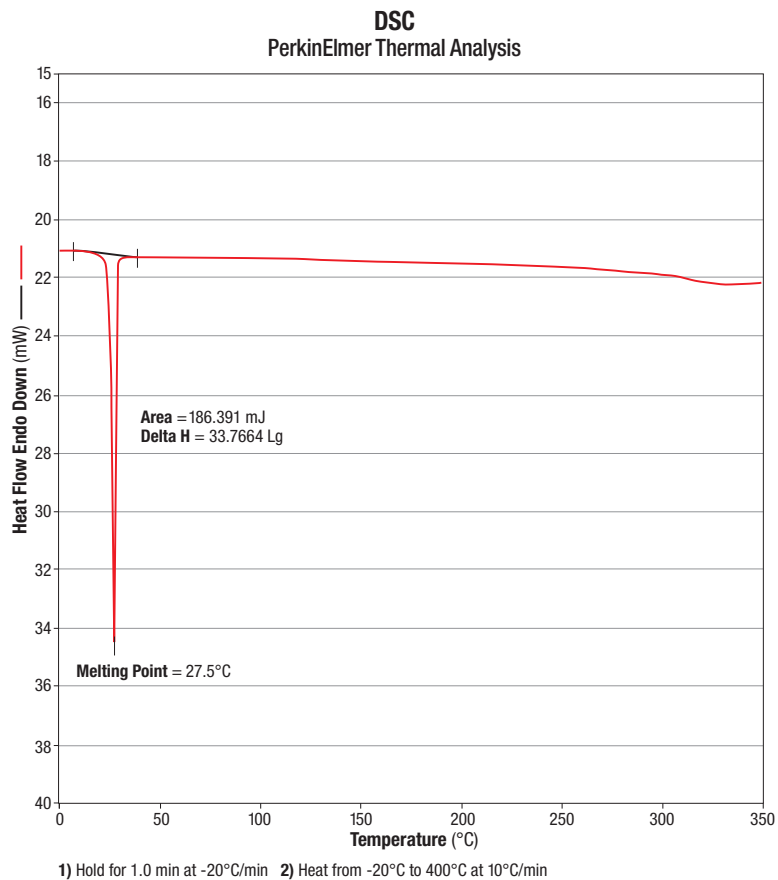
Color, APHA < 100

Residual Water < 500 ppm

Physical Properties

Properties	3M™ Ionic Liquid Antistat
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	531 cP (supercooled)

Thermal Properties



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%	$1 \times 10^{14} \Omega/\text{sq}$	–

¹ PSA is Pressure Sensitive Adhesive

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

³ Durability 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 fully melted, 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 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 Material Safety Data Sheet (MSDS) for instructions on safe and proper handling and disposal of this product.

Chemical Registry Information

US – Fully registered (TSCA inventory) with no restrictions.

Korea – Fully registered.

Japan – Exempt (no restrictions on commercial sale).

3M does not support Antistat FC-4400 for use in direct or indirect food contact applications.

The use of Antistat FC-4400 in applications that involve repeat human skin contact must be reviewed by 3M Corporate Stewardship, and may require supportive testing prior to approval.

Related Products

Other antistatic additive products available from 3M include HQ-115, HQ-115A, HQ-115IL and FC-156.

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