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 Polymer-Alloy Type Permanent Antistatic Agent for Styrene Resins
 

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# PELESTAT NC6321

## Preface

PELESTAT NC6321 is a polymer-alloy type permanent antistatic agent for styrene resins which was developed by using an original Sanyo Chemical compatibilization technique. This product imparts a permanent antistatic property to styrene resins such as ABS resins and styrene-acrylic resins (MS resins) while causing practically no lowering of the physical properties and moldability of the resins themselves.

## Typical Properties

| Property                        | Value                          | Remarks                                       |
|---------------------------------|--------------------------------|---|
| Appearance                      | Pale yellow pellet             | -   |
| Melting point                   | Approx. 203°C (397°F)          | DSC, ASTM D 3418                              |
| Reduced viscosity               | Approx. 1.7                    | 0.5 wt % formic acid solution at 25 °C (77°F) |
| Melt flow rate                  | Approx. 20 g                   | 10 min, ASTM D 1238 [215 °C (419°F), 21.18 N] |
| Refractive index                | Approx. 1.51                   | 23°C (73°F), ASTM D 542                       |
| Surface resistivity             | Approx. $1 \times 10^9 \Omega$ | ASTM D 257                                    |
| Thermal degradation temperature | Approx. 285°C (545°F)          | *   |

\* The lowest temperature at which PELESTAT NC6321 begins to thermally decompose.  
(Measured using a thermal gravimeter in air)

## Features

PELESTAT NC6321 has the following features:

- Imparts an excellent antistatic property to plastics such as ABS resins and MS resins when the amount added is between 10 and 15 wt %.
- Exhibits a permanent antistatic property immediately after molding. The antistatic property in the resulting plastic minimally changes even after washing with water because it is a high-molecular-weight antistatic agent. In addition, it works even in low humidity due to its low dependency on humidity.
- Minimally affects the mechanical and surface properties of the resins themselves.
- Does not impair the heat resistance of resins because this product is thermally stable.
- Applicable to IC-related products due to its low-content of halogenated compounds.

## Application Methods

### 1. General Procedure

As shown in Figure 1, PELESTAT NC6321 and a styrene resin are dry-blended using a blender, and are kneaded and pelletized using a twin-screw extruder.

Dispersants, fillers and pigments can be added during the dry-blending or the kneading process if necessary.

This blend is then molded into the final product using an appropriate molder (e.g. injection molding machine).

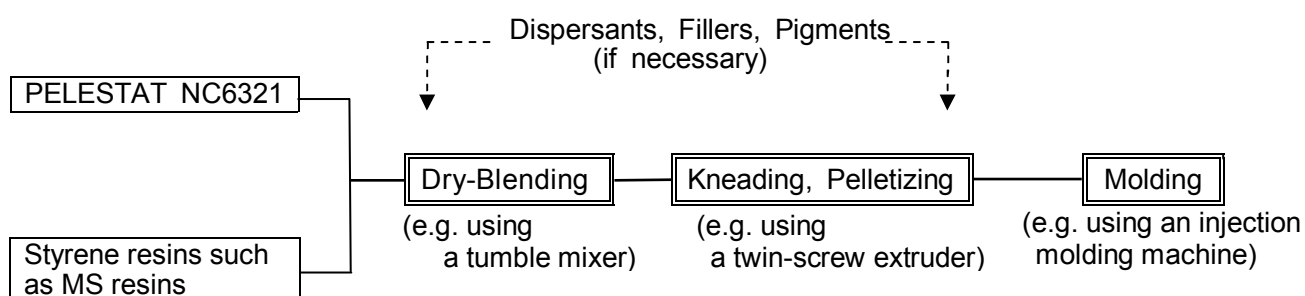


Figure 1. General Procedure for Application of PELESTAT NC6321

### 2. Amount to be Used

The standard amount of PELESTAT NC6321 is between 10 and 15 wt %.

Determine the optimal amount by referring to the results of its performance tests.

### 3. Kneading Conditions

Use a high share rate kneader (e.g. twin-screw extruder) when this product is kneaded.

The standard kneading temperature is between 210°C and 250°C (410°F – 482°F).

Determine the kneading temperature according to the resin applied.

#### 4. Drying of PELESTAT NC6321

- This product can be immediately used after the factory sealed package is opened because this product is packed under moisture-proof conditions.
- Drying is necessary when the factory sealed package is kept unsealed for several hours because this product has some hygroscopic properties.  
The following are examples of the conditions for drying.

##### Drying under reduced pressure

Vacuum : Below 1300 Pa (0.2 psi)  
Temperature : 70°C – 80°C (158°F – 176°F)  
Duration : 2 – 4 hours

##### Hot-air drying

Temperature : 85°C – 95°C (185°F – 203°F)  
Duration : 4 – 6 hours

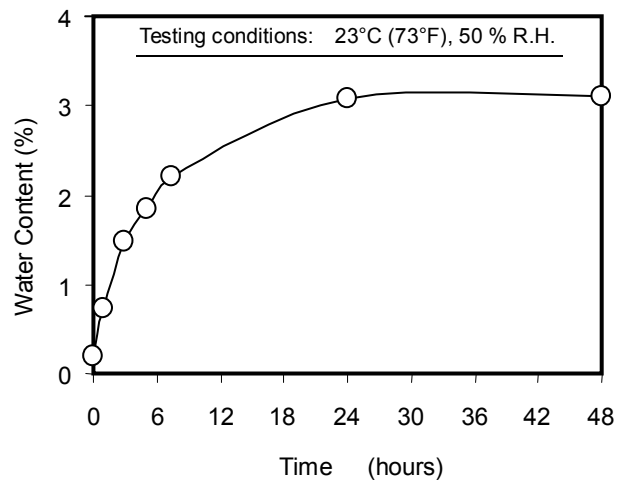


Figure 2. Hygroscopic Properties of PELESTAT NC6321

#### Precaution Against Mishandling

- In the case of using resins at molding temperatures below 200°C (392°F), PELESTAT NC6321 may not fuse, possibly resulting in poor effectiveness. Furthermore, in case of using resins at molding temperatures above 300°C (572°F), this product may thermally decompose, possibly resulting in poor effectiveness. The recommended molding temperature is between 210°C and 250°C (410°F – 482°F).
- Depending on the kind of resin, this product may have an influence on the resin's physical properties including mechanical properties. Test their influence on each other's physical properties beforehand to ensure that there are no problems.

## Performance Tests

The examples on pages 4 to 8 are the results of performance tests using ABS resins and MS resins mixed with PELESTAT NC6321.

This product imparts a permanent antistatic property to these thermoplastic resins that cannot be attained by any other conventional blend-type, low-molecular-weight antistatic agents. Furthermore, this product minimally affects the physical properties of these thermoplastic resins because this product is highly compatible with them.

### 1. Application to ABS Resins

#### A. Relationship Between Amount of PELESTAT NC6321 and Resulting Surface Resistivity

ABS resin containing PELESTAT NC6321 is highly antistatic when the amount of this product added is between 10 and 15 wt %. Refer to Figure 3 and determine the optimal amount according to the desired surface resistivity.

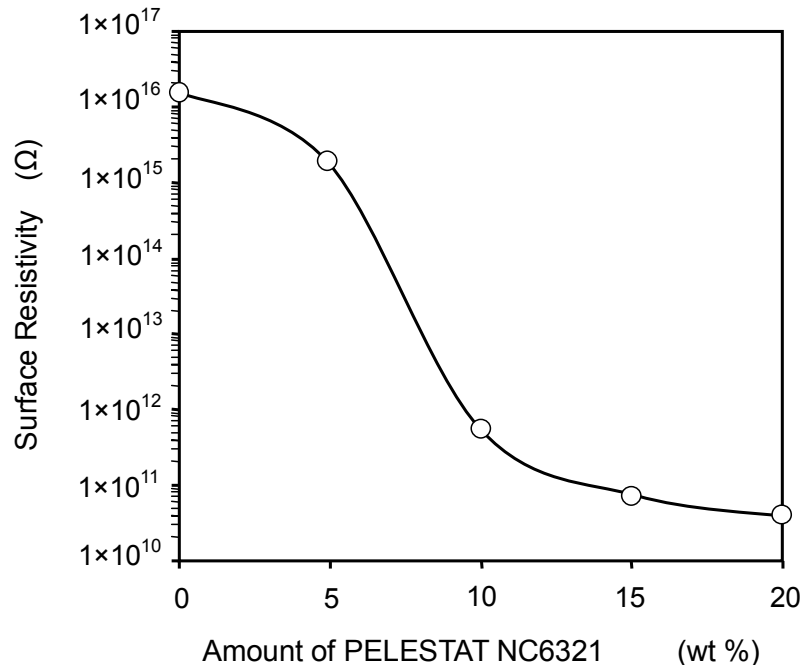


Figure 3. Relationship Between Amount of PELESTAT NC6321 and Surface Resistivity

#### Materials and Methods:

##### Materials:

A predetermined amount of PELESTAT NC6321 was dry-blended with the ABS resin and the mixture was kneaded using a twin-screw extruder at approx. 230°C (446°F). The kneaded compound was then molded using an injection molding machine [nozzle temperature: approx. 230°C (446°F), mold temperature: approx. 50°C (122°F)] into samples 2 mm (approx. 0.08 inches) in thickness.

##### Method:

Each sample was kept at 23°C (73°F), 50 % R.H. for 24 hours. Then, the surface resistivity of each was measured using a megohmmeter according to ASTM D 257.

## B. Effect on Surface Resistivity When Washed with Water (Evaluation of Durability of Antistatic Effect)

The surface resistivity of the ABS resin blended with PELESTAT NC6321 minimally changes, remaining antistatic even when washed with water. This product imparts a permanent antistatic property that cannot be attained by any other conventional blend-type, low-molecular-weight antistatic agent, which loses its antistatic property after being washed with water approximately three times.

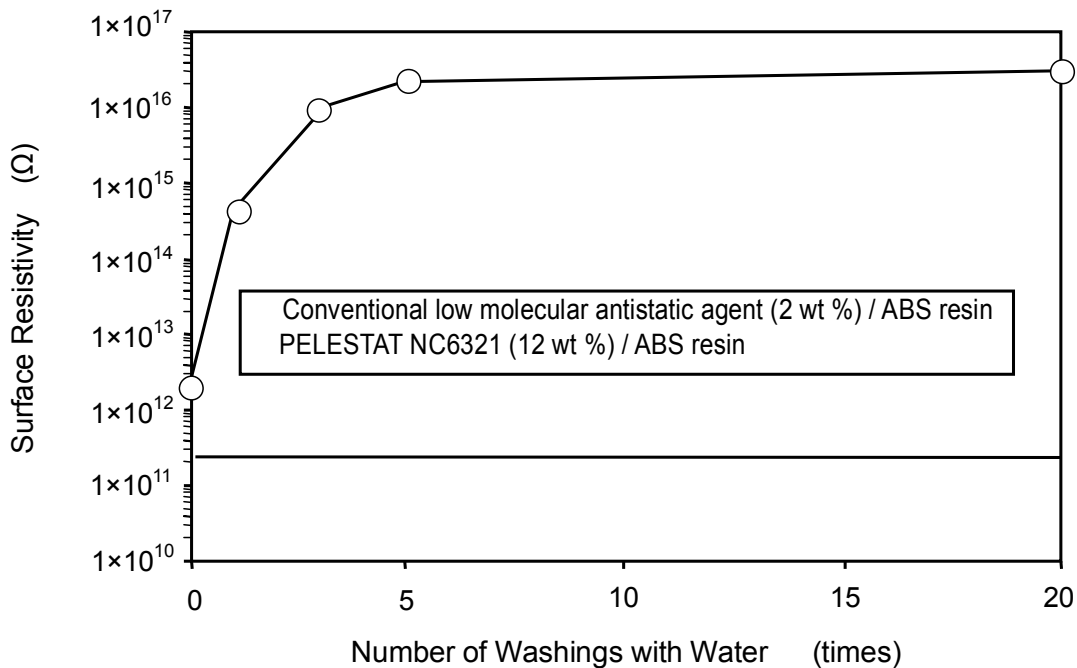


Figure 4. Effect on Surface Resistivity When Washed with Water

### Materials and Methods:

#### Materials:

##### PELESTAT NC6321 (12 wt %) / ABS resin

PELESTAT NC6321 (12 wt %) was dry-blended with the ABS resin and the mixture was kneaded using a twin-screw extruder at approx. 230°C (446°F). The kneaded compound was then molded using an injection molding machine [nozzle temperature: approx. 230°C (446°F); mold temperature: approx. 50°C (122°F)] into samples 2 mm (approx. 0.08 inches) in thickness.

##### Conventional low-molecular-weight anionic antistatic agent (2 wt %) / ABS resin

A conventional blend-type, low-molecular-weight antistatic agent, a Sanyo Chemical product, was applied. These samples were prepared by using the method described above.

#### Method:

Each sample was submerged in water and their surfaces were rubbed with cotton cloth. The samples were dried under reduced pressure [133 Pa (0.02 psi)] at 70°C (158°F) for 2 hours and were kept at 23°C (73°F), 50 % R.H. for 24 hours. The surface resistivity was measured using a megohmmeter according to ASTM D 257. This process was repeated according to the number of washings with water as described in Figure 4.

## C. Effect of Humidity on Surface Resistivity

The surface resistivity of the ABS resin blended with PELESTAT NC6321 minimally changes even in low humidity due to this product's low dependency on humidity. Conversely, an ABS resin blended with any other conventional low-molecular-weight antistatic agent loses its antistatic property in low humidity.

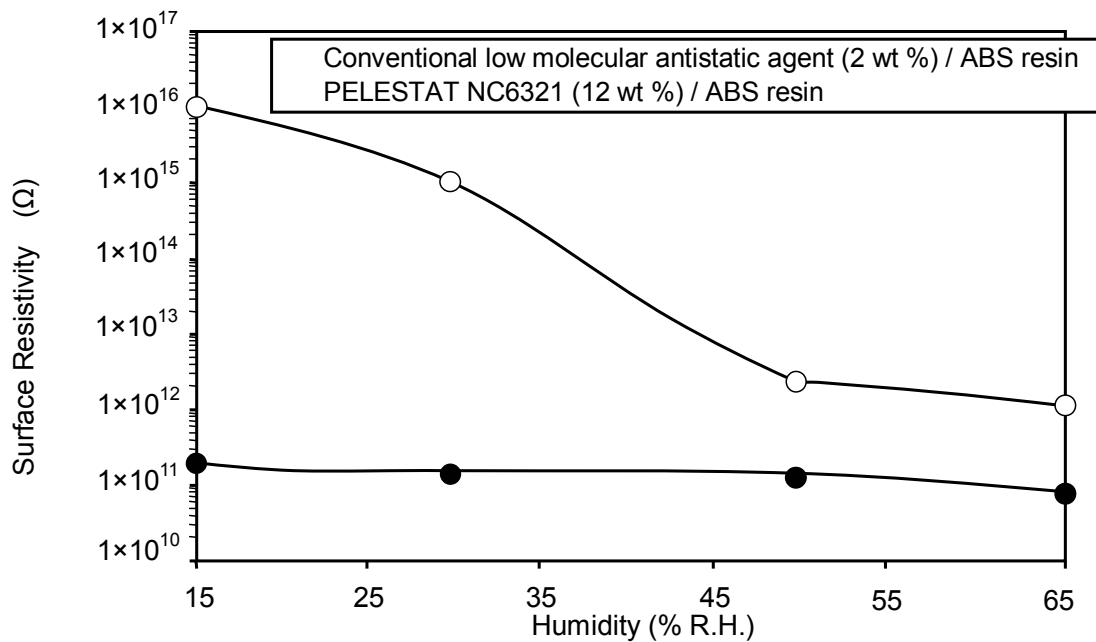


Figure 5. Effect of Humidity on Surface Resistivity

Materials and Methods:

Materials:

See Figure 4.

Method:

Each sample was kept at 23°C (73°F) at a predetermined humidity for 24 hours. Then, the surface resistivity of each was measured using a megohmmeter according to ASTM D 257.

#### D. Effect on Resin Physical Properties

As shown in Table 1, PELESTAT NC6321 minimally affects the ABS resins' physical properties.

Table 1. Effect on ABS Resins' Physical Properties

| Property                                       | Method (ASTM No.) | PELESTAT NC6321 (12 wt %) / ABS | ABS Resin       |
|--|-------------------|---------------------------------|-----------------|
| Surface resistivity Ω                          | D 257             | $2 \times 10^{11}$              | $> 10^{16}$     |
| Melt flow rate (10 min, 220°C, 98.07 N)        | D 1238            | 30                              | 27              |
| Tensile strength MPa (psi)                     | D 638             | 41 (5,900)                      | 42 (6,100)      |
| Flexural modulus MPa (psi)                     | D 790             | 2,200 (319,000)                 | 2,300 (334,000) |
| Izod impact strength (notched) J/m (ft·lbf/in) | D 256             | 140 (2.6)                       | 150 (2.8)       |
| Deflection temp. under load (1.82 MPa) °C (°F) | D 648             | 89 (192)                        | 90 (194)        |

Materials and Methods:

Materials:

Surface resistivity

PELESTAT NC6321 (12 wt %) was dry-blended with an ABS resin and the mixture was molded using an injection molding machine under the same conditions as described in Figure 4 into samples 2 mm (approx. 0.08 inches) in thickness. ABS resin was also molded under the same conditions.

Melt flow rate

The above materials were molded, cut into pellets and used as samples.

Other mechanical properties

Samples were prepared under the same conditions described in Figure 4 except that the predetermined size described in ASTM was applied.

Methods:

See the ASTM No. described in Table 1.

(The testing method for surface resistivity is described in Figure 3.)

## E. Dispersibility of PELESTAT NC6321 in ABS Resins

As shown in Figure 6, PELESTAT NC6321 is finely dispersed in the ABS resin.

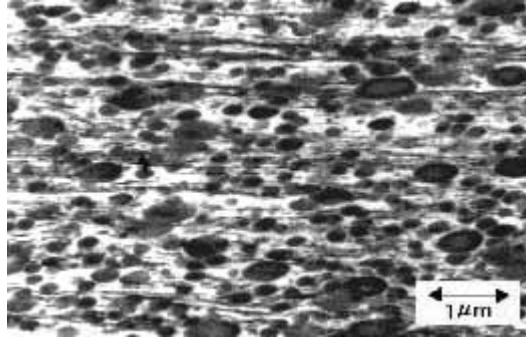


Figure 6. Transmission Electron Micrograph of Molding (TEM photo)  
Composed of PELESTAT NC6321 (12 wt %) and ABS Resin

[Explanation of Photograph]

Black stripes: PELESTAT NC6321

Black particles: Butadiene component of ABS resin

Figure 6 is a magnification (approx. 10,000 times) of a section of the PELESTAT NC6321 (12 wt %) / ABS resin mixture described in Figure 4. This product (black stripes) is dispersed in ABS Resin (white portion) and works as a conductive network.

## 2. Application to MS Resin

### A. Effect on MS Resin's Physical Properties

As shown in Table 2, PELESTAT NC6321 imparts a permanent antistatic property to the MS resin. The compatibility of this product with this resin is excellent, and the resin's physical properties show minimal change.

Table 2. Effect on MS Resin's Physical Properties

| Property                                  |                                | Method<br>ASTM No. | PELESTAT NC6321<br>(10 wt %) / MS Resin | MS Resin <sup>*1</sup> |
|---|--------------------------------|--------------------|---|------------------------|
| Surface<br>resistivity                    | Before washing <sup>*2</sup> Ω | D 257              | $1 \times 10^{12}$                      | $> 10^{16}$            |
|   | After washing <sup>*3</sup> Ω  |                    | $1 \times 10^{12}$                      | $> 10^{16}$            |
| Total light transmittance                 | %                              | D1003              | 90.0                                    | 91.0                   |
| Haze                                      | %                              | D1003              | 2.5                                     | 1.0                    |
| Tensile strength                          | MPa (psi)                      | D638               | 88 (12,800)                             | 91 (13,200)            |
| Flexural modulus                          | MPa (psi)                      | D790               | 2,600 (377,000)                         | 2,900 (421,000)        |
| Izod impact strength<br>(notched)         | J/m (ft·lbf/in)                | D256               | 20 (0.37)                               | 20 (0.37)              |
| Deflection temp. under load<br>(1.82 MPa) | °C (°F)                        | D648               | 92 (198)                                | 93 (199)               |

\*1 Refractive index of the resin: approx. 1.51 [23°C (73°F)]

\*2 Using samples which were not washed.

\*3 Samples were submerged in water and the surfaces were rubbed with a cotton cloth after being immersed, and then dried under vacuum [133 Pa (0.02 psi)] at 70°C (158°F) for 2 hours.

Materials and Methods:

Materials:

PELESTAT NC6321(10 wt %) / MS resin

PELESTAT NC6321 (10 wt %) was dry-blended with the MS resin (refractive index: approx. 1.51) and the mixture was kneaded using a twin-screw extruder at approx. 220°C (428°F). The kneaded compound was then molded using an injection molding machine [nozzle temperature: approx. 220°C (428°F); mold temperature: approx. 60°C (140°F)] into a predetermined sample.

MS resin

The MS resin was molded under the conditions described above.

Methods:

See the ASTM No. described in Table 2.

Surface resistivity

The samples 2 mm (approx. 0.08 inches) in thickness before and after washing with water were kept at 23°C (73°F) and 50 % R.H. for 24 hours. The surface resistivity of each was measured using a megohmmeter according to ASTM D 257.

Total light transmittance and haze

The samples were kept at 23°C (73°F) and 50 % R.H. for 48 hours. Total light transmittance and haze were measured using a hazemeter according to ASTM D 1003.

B. Relationship Between Amount of PELESTAT NC6321 and Resin Optical Property

PELESTAT NC6321 has an a refractive index of approx. 1.51. When this product is added to MS resins (refractive index: 1.51 – 1.57), a MS resin with a refractive index of approx. 1.51 should be used so that this product minimally affects the transparency.

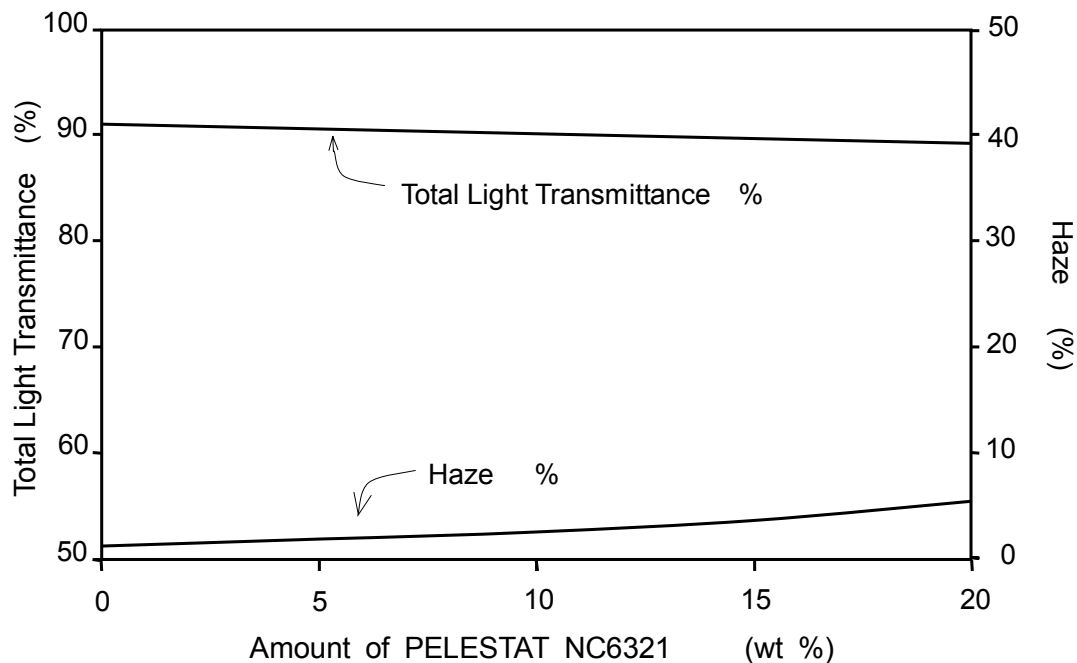


Figure 7. Relationship Between Amount of PELESTAT NC6321 and Resin Optical Property



Materials and Methods:

Materials:

A predetermined amount of PELESTAT NC6321 was dry-blended with the MS resin (refractive index: approx. 1.51) and the mixture was kneaded using a twin-screw extruder at approx. 220°C (428°F). The kneaded compound was then molded using an injection molding machine [nozzle temperature: approx. 220°C (428°F); mold temperature: approx. 60°C (140°F)] into samples 2 mm (approx. 0.08 inches) in thickness.

Method:

See Table 2 (ASTM D 1003).

### Examples of Applications

PELESTAT NC6321 has been used as a permanent antistatic agent in styrene resins such as ABS resins, HIPS resins, MS resins (including transparent ABS resins and MBS resins), polyester resins such as PBT, nylon resins and PC / ABS alloys in the following applications:

- Household electrical goods, office equipment, etc.
- Housings and storage cases of video game hardware, magnetic tapes, etc.
- Lighting fixture covers, meter panels, etc.
- IC trays, containers, etc.

### Patent Registered

USP 5,652,326

USP 5,886,098

USP 5,604,284

EP 0,613,919

TW NI - 83,929

KR 300,273

## Hazards Description

PELESTAT NC6321 is a polyether-ester-amide block copolymer.

This product is insoluble in water.

This product has no flash point (by COC) below 280°C (536°F).

UN dangerous goods regulations are not applied to this product.

Vapor or fume from molten material causes eye and nose irritation.

Based on data from a similar product by Sanyo Chemical, this product may have low acute oral toxicity and may have no acute dermal irritation.

Acute oral toxicity (rat): LD<sub>50</sub>> 2,000 mg/kg (similar product)

Acute dermal irritation (rabbit): Non-irritant (similar product)

This product is for industrial use only.

### Important :

Before handling this product, refer to the Material Safety Data Sheet for recommended protective equipment, and detailed precautionary and hazards information.

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