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## Technical Bulletin SP-13

### Outgassing of SciCron Technologies Static Dissipative Plastics

This bulletin discusses outgassing as it relates to static dissipative acrylic and polycarbonate products manufactured by SciCron Technologies for use in ultra-clean environments.

#### Outgassing - the Problem

Outgassing of plastics in ultra-clean environments is a serious ongoing concern since some plastics outgas contaminating entities that can compromise air quality and condense on work product surfaces. The result of this contamination can be reduced manufacturing yields and field failures of sensitive semiconductor devices. Some of the best known of these contaminating entities are liquid plasticizers, silicone oils, and bromine containing fire-retarding compounds.

#### Testing Plastics for Outgassing

There is general agreement among contamination control professionals about the kinds of outgassing entities that are the most damaging in ultra-clean environments. There is less agreement about how to measure for these materials in real life settings. At present, there is no universally accepted test protocol which has become an industry standard for determining the amounts of harmful contaminants which outgas in service from plastic materials used in these environments. We are aware of only one test protocol that is sometimes referred to as a "standard" procedure for screening materials for these applications. That procedure is ASTM E 595, "Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment".

The ASTM E 595 test measures the total mass loss and collected volatile condensable materials of specimens that have been heated to 125 degrees C in a vacuum. The purpose of subjecting the specimens to elevated temperature and low pressure vacuum conditions is to force a rapid outgassing of relatively low molecular weight entities in sufficient quantities to be measurable. In most cases, these entities do not outgas sufficiently at normal room temperature and pressure conditions to be measured by any simple method. Critics of the method argue that the test specimens are subjected to temperature and vacuum conditions that are never present in the environments in which the plastic materials are normally used. Consequently, it measures outgassing under abnormal, forced conditions yielding distorted outgassing results for the tested materials. In addition, the test does not identify entities, other than water, which are forced to outgas. This method is often used because it yields results relatively quickly at a relatively low cost.

Some semiconductor manufacturers have developed outgassing test protocols that better simulate the environments in which the tested materials are used. These protocols, which in many cases employ mass spectrometry and gas chromatography analytical techniques, more accurately measure the amount of outgassing and identify the outgassed entities and their concentrations. While more accurate, these protocols are more expensive to utilize and require more time and more sophisticated equipment.

#### SciCron Technologies Cleanroom Products

StatiCon® AC-300™ Acrylic, AC-350™ Acrylic, PC-300™ Polycarbonate and PC-350™ Polycarbonate static dissipative plastic sheets manufactured and sold by SciCron Technologies have been submitted for outgassing testing on several occasions. In all cases the outgassing of these products has been found to be very low. Testing under vacuum conditions at elevated temperatures (ASTM E 595) has confirmed that outgassing from these sheet products is minimal.

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Samples of glazing grade static dissipative acrylic and polycarbonate sheet products have also been submitted for more precise outgassing testing by researchers and semiconductor manufacturing companies. A variety of sophisticated test protocols have been used, including a test for metal ion generation using a flameless atomic absorption spectroscopy technique. This method measured very low ion generation from the sheet surfaces for nine metal ions. On another occasion SciCron Technologies static dissipative polycarbonate and acrylic sheets were submerged for 7 days in water by a semiconductor manufacturer to determine leaching of a wide variety of identified inorganic entities. Analysis, which included the use of Inductively Coupled Plasma Mass Spectrometry, indicated levels of leached contaminants well below the semiconductor manufacturer's specification. The sheets were also tested for organic outgassing using gas chromatography techniques. This testing again indicated very low outgassing levels that were well within the manufacturer's specification.

Many of our customers have approved our acrylic and polycarbonate static dissipative sheet products after testing the materials for outgassing using their own test protocols. Subsequently they have used these sheet products to help prevent contamination and electrostatic discharge related defects in a wide range of ultra-clean processes, including Class 1 (ISO Class 3) wafer fab clean rooms and Class 0.1 (ISO Class 2) mini-environment enclosures.

#### **Customer Qualification Testing**

Our customers often have different specifications, contaminants, and conditions for which they wish to test. We encourage them to do so employing the test protocol which best fits their requirements. We believe that they, like many other companies that have already tested our products, will find that our static dissipative sheet products meet their expectations for very low outgassing of contaminating entities.