SEMI C69-0611
TEST METHOD FOR THE DETERMINATION OF SURFACE AREAS OF POLYMER PELLETS

This Standard was technically approved by the Liquid Chemicals Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on May 13, 2011. Available at www.semiviews.org and www.semi.org in June 2011.

1 Purpose

1.1 This Document provides a test method for the determination of the surface area of polymer pellets.

NOTE 1: An alternative test method that has not been validated is contained within Related Information 1 of this Document.

1.2 The determination of relatively accurate surface areas in polymer pellets is important in applications reaching across various microelectronics industries. For example, polymer pellets are used in the blow molding, rotomolding, injection molding, or extrusion of high purity components used in chemical distribution systems or lining sheets. Knowing the surface area is important when calculating surface contamination values and relating them to the finished component.

2 Scope

2.1 This Document outlines a test method using enhanced Euclidean techniques, where polymer pellets are treated as geometric shapes and measured to determine the dimensions.

2.2 Formulae are provided in Table A1-2 for calculating the surface area of a pellet, using the measured dimensions.

2.3 Values obtained using this method (m^2 surface area per kilogram weight) can be used with documents such as SEMI F57 to determine contamination per unit of surface area.

NOTE 2: Related Information 1 of this Document contains a Laser Outlining Test Method for reference only. That test method requires that coated pellets are mounted onto a support fixture and scanned.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 Attention is required in situations where pellet materials are soft. Deformation is possible during the measurement process.

3.2 This method considers that tails or ridges or both found on pellets will not contribute a significant amount of area to the overall total area of the pellet and should not be measured.

3.3 In some cases, it may be necessary to make gross approximations when dealing with complex shapes.

3.4 This Test Method assumes that a statistically significant sample size is taken so that the inherent variation in shapes and sizes can be realized within the population.

3.5 This Test Method determines the outer surface area only. Leachout results obtained of a given surface area of the pellet while using SEMI F40 and SEMI F57 should not be extrapolated to assess the contamination level of a finished product. The manufacturing process, such as heat required to melt the pellets or mixing during processing, can have a significant influence on the outcome of the leachout.

3.6 In the case of determining inner trace metal contamination, SEMI F48 or another suitable bulk measurement technique should be used.

3.7 It is conceivable that the same pellet material manufactured under slightly different operating conditions could have a different surface finish, resulting in the possibility of dramatically different results when using some of these measurement methods.

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4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI F40 — Practice for Preparing Liquid Chemical Distribution Components for Chemical Testing

SEMI F48 — Test Method for Determining Trace Metals in Polymer Materials

SEMI F57 — Provisional Specification for Polymer Components Used in Ultrapure Water and Liquid Chemical Distribution Systems

4.2 *Other Documents*

4.2.1 Technical Formulas, Kurt Gieck, ISBN-10: 3-920379-27-6, ISBN-13: 9783920379272, 9th Edition, Enlarged and Revised, English.

4.2.2 Suggested drying times for pellets (Table A1-1)[1].

5 Terminology

5.1 *Definitions*

5.1.1 *enhanced Euclidean* — Euclidean geometry formulae that have been altered to encompass irregularities seen in nature.

NOTE 3: For example, a pellet that is mostly a cylinder shape may in fact have an hourglass shape upon closer examination. In such cases the formula for the determination of the surface area of a cylinder must be modified to take this into account.

5.1.2 *laser outlining* — the use of a laser to determine the outer surface shape and area of an object.

6 Pellet Preconditioning

6.1 Due to the hygroscopic nature of polymer materials, dry the pellets in an oven before weighing.

6.2 Refer to Table A1-1 for drying conditions based on the type of material being tested.

6.3 Proceed to the sampling process as soon as the pellets have cooled to the touch.

7 Sampling

7.1 Determining the uniformity of the masses of the pellets within the submitted sample.

7.1.1 Take 200 representative pellets from the submitted sample and divide up into 10 sets of 20 pellets each.

7.1.2 Weigh and record each of the 10 sets to the nearest 0.001 grams.

7.1.2.1 Calculate the average and standard deviation from the values obtained in ¶ 7.1.2.

7.1.3 Next, calculate and record the relative standard deviation (RSD), where the RSD = standard deviation × 100/average.

NOTE 4: The RSD is an indication of the uniformity of the pellets within the population. That is, an RSD higher than 5% may indicate multiple geometric shapes present.

8 Enhanced Euclidean Method

8.1 *Defining the Shape Characteristics of a Selected Set of Pellets*

8.1.1 Select at random one set of 20 pellets from the 10 sets.

8.1.2 View the pellets under 2× to 10× magnification to determine their shape. Microscopic examination and selection of the proper formula is critical to determining the surface area.

8.1.3 Using Table A1-2 or the reference found in ¶ 4.2, search for a formula that best fits the pellet shape and determine the dimensions needing to be measured.

[1] Table A1-1 excerpt courtesy of RTP Company, 580 East Front Street, Winona, MN, 55987, USA.

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8.2 *Measuring the External Dimensions of the Selected Set of Pellets*

8.2.1 Measure and record the required dimensions for all 20 representative pellets to the nearest 0.1 mm using:

- a caliper,
- a reticulated slide, or
- a microscope outfitted with a camera and software that allows the analyst to measure the image directly using the microscope.

NOTE 5: *Laser Outlining* — See Related Information 1.

9 Calculating the Area

9.1 Calculate and record the area in mm^2 of each individual pellet.

9.2 Sum the surface area (mm^2) of the 20 pellets and divide by the total weight (g) of the selected set.

9.3 Convert the result to m^2/kg, using 1000 mm^2/g = 1 m^2/kg.

9.4 Calculate the average and standard deviation of the surface areas (mm^2) of the twenty pellets.

10 Reporting

10.1 Complete Report Form (Appendix 1) by filling in all requested information.

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APPENDIX 1
TABLES AND REPORT FORM

NOTICE: The material in this Appendix is an official part of SEMI C69 and was approved by full letter ballot procedures on May 13, 2011.

A1-1 Pellet Sample Drying Times

Table A1-1 Pellet Sample Drying Times

Polymer Type		*Drying*	
		Time (Hrs)[#1]	*Temp (°C)*[#1]
Acrylonitrile Butadiene Styrene	ABS	2	82
Ethylene chlorotrifluoroethylene	ECTFE	2	121
Ethylene Tetrafluoroethylene	ETFE	2	121
Fluorinated Ethylene Propylene	FEP	2 to 4	121
High Density Polyethylene	HDPE	2	79
Liquid Crystal Polymer	LCP	8	149
Low Density Polyethylene	LDPE	2	79
Nylon	PA	2 to 4	79
Polybutylene Terephthalate	PBT	4	121
Polycarbonate	PC	4	121
PC/ABS Alloy	PC/ABS	4	93
Polycarbonate/Acrylic Alloy	PC/PMMA	3 to 4	82
Polyetheretherketone	PEEK	3	149
Polyetherimide	PEI	4	149
Polyethersulfone	PES	6	149
Polyethylene Terephthalate	PET	4	121
Modified Polyethylene Terephalate Glycol	PETG	4	93
Perfluoroalkoxy	PFA	2	121
Aliphatic Polyketone	PK	4	60
Acrylic	PMMA	4	93
Acetal	POM	2	121
Polypropylene	PP	2	79
Polyphthalamide	PPA	6	79
Hot Water Moldable Polyphthalamide	PPA	6	79
Modified Polyphenylene Oxide	PPO	2	93
Polyphenylene Sulfide	PPS	6	149
Polystyrene	PS	2	82
Polysulfone	PSU	4	135
Polysulfone/Polycarbonate Alloy	PSU/PC	4	121
Polytrimethylene Terephthalate	PTT	4 to 6	127
Polyvinylidene Fluoride	PVDF	2	121
Rigid Thermoplastic Polyurethane[#2]	RTPU	4 to 6	107
Rigid Thermoplastic Polyurethane[#3]	RTPU	4 to 6	132
Styrene Acrylonitrile	SAN	2	82

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