MATERIAL TEST REPORT

STATIC DECAY AND SURFACE RESISTIVITY TESTING OF SOCK AND SPUNBOND SAMPLES

NEW PIG CORPORATION

FEBRUARY 28, 2008

MATERIAL EVALUATION REPORT
Static Decay and Surface Resistivity Testing
of Sock and Spunbond Samples
New Pig Corporation
February 28, 2008

GENERAL

Electrostatic characterization tests were performed by ETS Testing Laboratories on samples submitted by New Pig Corporation. Three (3) sample materials were tested for static decay and surface resistivity compliance.

TEST CONDITIONS

Date of Test:	2/28/08
Humidity:	50.1% RH
Temperature:	72°F
Conditioning Time:	50 Hours

TEST APPARATUS

HUMIDITY CONTROL

ETS Series 5000/5500 Controller and Chamber are used to provide the controlled environment to condition and test the samples at the specified relative humidity. The system is capable of controlling the humidity to within 1% of the desired level with an accuracy of ±2% RH and is calibrated to standards traceable to NIST.

STATIC DECAY

An ETS Model 406 Static Decay Meter is used to perform static decay measurements. An ETS STM-1 System Test Module is used to verify the calibration of the Static Decay Meter.

SURFACE RESISTIVITY

Surface resistivity and surface resistance measurements of planer material are performed using a Dr. Thiedig Milli-TO-2 Wide Range Resistance Meter in conjunction with an ETS Model 803B Surface/Volume Resistivity Probe. An ETS Model 809B Calibration Check Fixture is used to verify the calibration of the resistance test set-up.

TEST METHODS

The following test methods and specifications were used in the evaluation of the test material:

STATIC DECAY

CALIBRATION CHECK

Prior to a static decay evaluation, a performance system check is made on the 406 using the ETS Model STM-1 System Test Module. The STM-1 is placed in the Faraday Test Cage in lieu of a test specimen. It produces a known decay time when plus and minus 5kV is applied. This test checks both the accuracy of the decay time measurement and the balance in decay times between positive and negative charging voltage polarities.

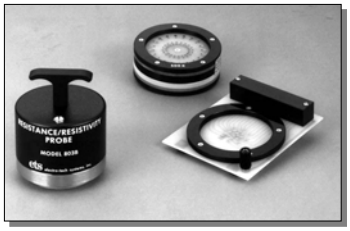
INITIAL CHARGE AND ACCEPTED CHARGE

Material that is static dissipative or conductive will have no measurable static charge on the surface and will be able to conduct the 5kV charging voltage across the surface when applied. A sample that has a measurable initial charge prior to applying the charging voltage indicates that the sample is either insulative or contains both dissipative and insulative characteristics on the surface. The magnitude of the initial charge is listed in the *IC Volts* column of the data sheet. Generally, a material that has both an initial charge and accepts the applied 5kV will not have a measurable decay time if the cutoff selected is below the level of the initial charge.

Material with an initial charge, a very long or no charge/decay characteristics can be evaluated by noting the amount of charge conducted across the surface of the test material after applying 5kV for one (1) minute. The more charge accepted after one minute, the more dissipative the material. This value is listed in the *AC Volts* column of the data sheet. No readings would be recorded under *Decay Time.*

SURFACE RESISTIVITY

Surface resistivity per ASTM-D 257 has generally been the property used to describe the conductive, dissipative or insulative range of static control material. The ETS Series 800 probes conform to the concentric ring design specified. The ratio between the inner and outer electrodes results in a surface resistivity equal to 10X the measured resistance. It should be noted that surface resistivity is expressed in ohms per square, without regard to the size of the square.



Surface resistance per ESD S11.11 is used to evaluate static dissipative material. This resistance is equal to the actual resistance measured with the Model 803B Probe. A test voltage of 10 volts is specified for resistances between 10^4 and 10^6 ohms. A test voltage of 100 volts is required for resistances between 10^6 and 10^{11} ohms. Surface resistance is expressed in ohms. Resistance measurements below or above these values may require different test voltages. Conductive materials (those materials with surface resistances below 10^4 ohms) are measured using either a current source (cs) or voltages equal to or less than 10 volts.

TEST RESULTS

The actual data taken is contained in the enclosed data sheets.

STATIC DECAY

The samples were charged to ±5kV and the time to dissipate 90% of the charge (10% cutoff) when grounded was measured.

GROUP	**MIN**	**MAX**	**AVERAGE** (Seconds)
A) Eco-Boom	0.08	0.18	0.12
B) 104PS	0.04	0.10	0.07
C) 130357	0.01	0.05	0.03

No initial charges were recorded and the full 5kV charge was accepted.

SURFACE RESISTIVITY

GROUP	**MIN**	**MAX**	**AVERAGE** (Ohms/Square)
A) Eco-Boom	4.43×10^{10} Ω/sq.	7.21×10^{10} Ω/sq.	5.53×10^{10} Ω/sq.
B) 104PS	4.46×10^{10} Ω/sq.	5.79×10^{10} Ω/sq.	5.07×10^{10} Ω/sq.
C) 130357	5.97×10^{10} Ω/sq.	8.47×10^{10} Ω/sq.	7.01×10^{10} Ω/sq.

Testing was performed using a test voltage of 100 volts.

CONCLUSIONS

STATIC DECAY

NFPA 99, which references MIL-STD-3010 (formerly FTM 101C), is commonly referenced for hospitals and hazardous locations and is also used as a guideline for packaging, filtering, paper, consumer products, Cleanrooms and many other applications. This specification, which references Method 4046, requires conditioning at 50% R.H. Acceptable materials should have a static decay time of less than 0.50 seconds when measured to the 10% (500 volt) cutoff level.

With average measurements ranging from 0.03 to 0.12 seconds, all three sample groups met the static decay requirements for a dissipative material.

RESISTIVITY

Resistance measurements are used in the static control industry to help categorize materials. Although resistance and resistivity measurements alone cannot tell everything about a material's electrostatic performance, it is a good indicator, can help to establish a baseline, indicate differences between additives or additive levels, show differences within a sample group and characterize the effects of relative humidity on a material's performance. Depending on the specification referenced and the composition of the material, either surface resistivity or surface resistance (or both) may be applicable.

NFPA 99, which uses test method ASTM-D-257**,** has an upper acceptance limit of 1×10^{11} Ω/sq at 50% R.H. Materials with resistivity measurements below this limit are considered acceptable.

With surface resistivity measurements ranging from 5.07 to 7.01×10^{10} ohms/sq., all three sample groups would be classified as dissipative.

Static decay and surface resistivity testing indicates that the samples should be acceptable for use in Static Safe applications.

REVIEWING YOUR DATA SHEETS

HEADER
Lists the purchase order, sample description, test conditions, date of test and the equipment used.

TEST RESULTS
Lists the individual measurements taken on each sample along with the polarity of the test voltage.

DATA ANALYSIS OF INDIVIDUAL SAMPLES
Average, standard deviation, range, minimum & maximum analysis for individual samples.

DATA ANALYSIS OF GROUPS
Average, standard deviation, range, minimum & maximum for each group of specimens giving the customer an overview of the performance of a group. This section is useful in providing information on specification compliance, group uniformity, etc.

AVERAGE
The mean value of all readings. The readings are summed and divided by the total number of data points.

STANDARD DEVIATION
The standard deviation represents the reliability of the data obtained. The higher the standard deviation, the more likely it is that readings far from the average will be obtained in subsequent tests. The standard deviation is calculated by taking the square root of the sum of the squares of the numeric difference between the reading and the average for each sample, divided by the number of readings considered.

MINIMUM
The lowest reading obtained in a sample group.

MAXIMUM
The highest reading obtained in a sample group.

NPC

P.O.# 13085dlm Static Decay Testing of Socks

Date in Chamber	: 02/26/08	Date Tested	: 02/28/08
Time in Chamber	: 09:00	Time Tested	: 11:00
Ambient Humidity	: 21.0% R.H.	Test Humidity	: 50.1% R.H.
Ambient Temperature	: 74°F	Test Temperature	: 72°F
Hours Conditioned	: 50 hours		
Electrode Type	: Clamp Electrodes		
Meter	: ETS Model 406 Static Decay Meter		
Chamber	: ETS Model 506 Humidity Control Chamber		
Controller	: ETS Model 514 Automatic Humidity Controller		

Test Results

SAMPLE	I.C. Volts	A.C. Volts	C/O	DECAY @ +5kV Seconds			DECAY @ -5kV Seconds			R.C.
Calibration	0	5000	1%	0.23	0.22	0.22	0.22	0.23	0.22	
Group A:										
Eco-Boom-1	0	5000	10%	0.08	0.09	0.08	0.08	0.08	0.08	
Eco-Boom-2	0	5000	10%	0.11	0.13	0.14	0.13	0.11	0.11	
Eco-Boom-3	0	5000	10%	0.18	0.16	0.15	0.14	0.14	0.14	
Eco-Boom-4	0	5000	10%	0.11	0.11	0.12	0.11	0.11	0.10	
Eco-Boom-5	0	5000	10%	0.11	0.10	0.10	0.09	0.09	0.09	
Eco-Boom-6	0	5000	10%	0.12	0.12	0.11	0.11	0.12	0.12	
				Group Min:		0.08	Group Max:		0.18	
Group B:										
104PS-1	0	5000	10%	0.10	0.09	0.10	0.10	0.10	0.10	
104PS-2	0	5000	10%	0.07	0.07	0.06	0.06	0.06	0.06	
104PS-3	0	5000	10%	0.06	0.06	0.05	0.06	0.06	0.06	
104PS-4	0	5000	10%	0.05	0.07	0.06	0.08	0.10	0.05	
104PS-5	0	5000	10%	0.06	0.07	0.07	0.05	0.05	0.06	
104PS-6	0	5000	10%	0.06	0.06	0.06	0.04	0.08	0.05	
				Group Min:		0.04	Group Max:		0.10	
Group C:										
130357-1	0	5000	10%	0.01	0.02	0.03	0.03	0.02	0.02	
130357-2	0	5000	10%	0.03	0.02	0.03	0.02	0.03	0.03	
130357-3	0	5000	10%	0.04	0.04	0.05	0.05	0.04	0.04	
130357-4	0	5000	10%	0.02	0.03	0.02	0.02	0.03	0.03	
130357-5	0	5000	10%	0.02	0.02	0.03	0.02	0.03	0.03	
130357-6	0	5000	10%	0.02	0.02	0.03	0.02	0.02	0.02	
				Group Min:		0.01	Group Max:		0.05	

NPC

P.O.# 13085dlm Surface Resistance/Resistivity Testing of Socks

Date in Chamber	: 02/26/08	Date Tested	: 02/28/08
Time in Chamber	: 09:00	Time Tested	: 11:00
Ambient Humidity	: 21.0% R.H.	Test Humidity	: 50.1% R.H.
Ambient Temperature	: 74°F	Test Temperature	: 72°F
Hours Conditioned	: 50 hours		
Meter Type	: Dr. Theidig Milli TO-2		
Probe Type	: ETS Model 803B		
Calibration Fixture	: ETS Model 809B (5.00		x 10 5 ohms)

Test Results

Sample	Ve	Surface Resistance Ohms	Surface Resistivity Ohms/Square
Calibration	10	5.05 x 10 5	
Group A:			
Eco-Boom-1	100	4.56 x 10 9	4.56 x 10 10
Eco-Boom-2	100	4.43 x 10 9	4.43 x 10 10
Eco-Boom-3	100	5.17 x 10 9	5.17 x 10 10
Eco-Boom-4	100	7.21 x 10 9	7.21 x 10 10
Eco-Boom-5	100	6.33 x 10 9	6.33 x 10 10
Eco-Boom-6	100	5.47 x 10 9	5.47 x 10 10
Group B:			
104PS-1	100	5.79 x 10 9	5.79 x 10 10
104PS-2	100	5.26 x 10 9	5.26 x 10 10
104PS-3	100	4.57 x 10 9	4.57 x 10 10
104PS-4	100	4.86 x 10 9	4.86 x 10 10
104PS-5	100	4.46 x 10 9	4.46 x 10 10
104PS-6	100	5.46 x 10 9	5.46 x 10 10
Group C:			
130357-1	100	6.52 x 10 9	6.52 x 10 10
130357-2	100	6.51 x 10 9	6.51 x 10 10
130357-3	100	7.00 x 10 9	7.00 x 10 10
130357-4	100	5.97 x 10 9	5.97 x 10 10
130357-5	100	7.59 x 10 9	7.59 x 10 10
130357-6	100	8.47 x 10 9	8.47 x 10 10

Data Analysis

	Surface Resistance Min	Avg	Max	Surface Resistivity Min	Avg	Max
A	4.43 x 10 9	5.53 x 10 9	7.21 x 10 9	4.43 x 10 10	5.53 x 10 10	7.21 x 10 10
B	4.46 x 10 9	5.07 x 10 9	5.79 x 10 9	4.46 x 10 10	5.07 x 10 10	5.79 x 10 10
C	5.97 x 10 9	7.01 x 10 9	8.47 x 10 9	5.97 x 10 10	7.01 x 10 10	8.47 x 10 10