

# EESTOR INC.

# TEST REPORT

**SCOPE OF WORK**

Performance testing of capacitive samples (Polymer thin flexible samples called Ultra 1, Ultra 2, Ultra 3, Ultra 4, Ultra 5)

**REPORT NUMBER**

103362995DAL-001

**ISSUE DATE**

12-JAN-2018

**PAGES**

7

**DOCUMENT CONTROL NUMBER**

GFT-OP-10a (6-March-2017)

© 2017 INTERTEK



## TEST REPORT

1/15/2018

Intertek Report No. 103362995DAL-001  
Intertek Project No. G103362995

Bryan Kelly  
EEstor Inc.  
715 Discovery Blvd Ste 107  
Cedar Park, TX 78613 – USA  
email: bryan\_kelly@eestor.us

**Subject:** Performance testing of capacitive samples (Polymer thin flexible samples called Ultra 1, Ultra 2, Ultra 3, Ultra 4, Ultra 5)

Dear Bryan Kelly,

This letter report represents the results of our evaluation of the above referenced samples.

### SECTION 1 SUMMARY

Five unique samples were tested at the EESTOR Inc. facility at 715 Discovery Blvd. Ste: 107, Cedar Park, Texas, 78613, USA on the 4<sup>th</sup> of Jan 2018. There, samples were identified as Ultra 1, Ultra 2, Ultra 3, Ultra 4, Ultra 5. Samples were subjected to the measurements outlined in section 2 of this report.

---

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

**TEST REPORT**

**SECTION 2**  
**TESTING**

The items below represent a summary of the tests and results.

**Test Location:** 715 Discovery Blvd. Ste:107, Cedar Park, Texas 78613

**Test Date:** 4-JAN-2018

**Test Site Ambient Conditions:** 20.7°C, 15.6%RH

**Parameters measurement:**

Parameters measured at 1V 1KHz						
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Dissipation Factor DF in %	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	0.047	1	1.35
Ultra 2	Round	10	8.94	0.034	1	1.12
Ultra 3	Round	10	8.94	0.027	1	1.6

Parameters measured at 300V 60Hz						
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Dissipation Factor DF in %	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	0.12	300	1.65
Ultra 2	Round	10	8.94	0.13	300	1.57
Ultra 3	Round	10	8.94	0.1	300	1.99

Parameters measured at 1000V 60Hz						
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Capacitance C (nF)	
Ultra 1	Square	10	6.35	1000	1.91	
Ultra 2	Round	10	8.94	1000	1.81	
Ultra 3	Round	10	8.94	1000	2.14	

Parameters measured at 300VDC						
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Leakage current (nA)	Capacitance C (nF)
Ultra 1	Square	10	6.35	300	76.9	1.93
Ultra 2	Round	10	8.94	300	34.7	2.98
Ultra 3	Round	10	8.94	300	36.9	2.48

**TEST REPORT**

Parameters measured at 1200V 60Hz					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	1200	1.98
Ultra 2	Round	10	8.94	1200	1.93

Parameters measured at 1300V 60Hz					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	1300	2.01
Ultra 2	Round	10	8.94	1300	1.99

Parameters measured at 1400V 60Hz					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	1400	2.02
Ultra 2	Round	10	8.94	1400	2

Parameters measured at 1500V 60Hz					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS)	Capacitance C (nF)
Ultra 1	Square	10	6.35	1500	2.05

Breakdown measured at 60Hz					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (RMS) AC	Breakdown Occurred at Peak Voltage V in AC
Ultra 1	Square	10	6.35	1600	2263
Ultra 2	Round	10	8.94	1500	2121

Breakdown measured to 3000VDC					
Sample ID	Electrode shape	Electrode Thickness in Micron	Electrode width in mm	Voltage V (DC)	Breakdown Occurred in V (DC)
Ultra 3	Round	10	8.94	3000	2297
Ultra 4	Round	10	8.94	3000	2655
Ultra 5	Round	10	8.94	3000	2593

**Equipment List:**

Equipment Asset Number	Equipment Type	Manufacturer Name	Model Number	Calibration Date	Calibration Due Date
(Intertek) 260	Temperature /	Extech	445580	9/20/2017	9/20/2018

**TEST REPORT**

	Humidity Monitor				
(Intertek) 1479	LCR Meter	BK Precision	878B	5/14/2017	5/14/2018
(Intertek) 1191	Micro meter	Accuremote	0-1"	10/23/2017	10/23/2018
(EESTOR)	IR Meter	VITREK	957i	12/15/2017	12/15/2018

**SECTION 3**

**CALCULATIONS/RESULTS**

The items below represent calculations based on test results.

**Formula used to find relative permittivity of the dielectric material (k):**

- $k = dC / \epsilon_0 A$   
 Where:  
 d = Sample thickness (m)  
 C = Measured capacitance (F)  
 $\epsilon_0$  = Permittivity of space ( $8.854 \times 10^{-12}$  F/m)  
 A = Area of circular plate based on measured diameter (m<sup>2</sup>)

**Formula used to find Energy Density W of the sample (in Hour/ Litre):**

- Energy W in Joule =  $1/2 CV^2$   
 Where  
 C = Measured capacitance (F)  
 V = Measured peak voltage (V)
- Volume in cm<sup>3</sup> / m<sup>3</sup> = Area x Thickness x 1,000,000  
 Where  
 Area of electrode = Calculated in m<sup>2</sup>  
 Thickness of electrode = Calculated in meter
- Energy density W in Hour/Litre = (Energy W in Joule/3600) / (Volume in cm<sup>3</sup>/m<sup>3</sup>/1000)

Parameters measured at 1V 1KHz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant $k = dC / \epsilon_0 A$	Energy Density W(Hour/Litre)
Ultra 1	1	1.35E-09	1.00E-05	4.03E-05	37.81	4.65E-07
Ultra 2	1	1.12E-09	1.00E-05	6.28E-05	20.15	2.48E-07
Ultra 3	1	1.60E-09	1.00E-05	6.28E-05	28.79	3.54E-07

**TEST REPORT**

Parameters measured at 1000V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	1414.2	1.91E-09	1.00E-05	4.03E-05	53.50	1.32E+00
Ultra 2	1414.2	1.82E-09	1.00E-05	6.28E-05	32.75	8.05E-01
Ultra 3	1414.2	2.14E-09	1.00E-05	6.28E-05	38.50	9.47E-01

Parameters measured at 300V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	424.3	1.65E-09	1.00E-05	4.03E-05	46.22	1.02E-01
Ultra 2	424.3	1.57E-09	1.00E-05	6.28E-05	28.25	6.25E-02
Ultra 3	424.3	1.94E-09	1.00E-05	6.28E-05	34.91	7.73E-02

Parameters measured at 1200V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	1697.1	1.98E-09	1.00E-05	4.03E-05	55.46	1.96E+00
Ultra 2	1697.1	1.82E-09	1.00E-05	6.28E-05	32.75	8.05E-01
Ultra 3	1697.1	2.14E-09	1.00E-05	6.28E-05	38.50	9.47E-01

Parameters measured at 1300V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	1838.5	2.01E-09	1.00E-05	4.03E-05	56.30	2.34E+00
Ultra 2	1838.5	1.99E-09	1.00E-05	6.28E-05	35.80	1.49E+00

Parameters measured at 1400V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m2	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	1979.9	2.02E-09	1.00E-05	4.03E-05	56.58	2.73E+00
Ultra 2	1979.9	2.00E-09	1.00E-05	6.28E-05	35.98	1.73E+00

**TEST REPORT**

Parameters measured at 1500V 60Hz						
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m <sup>2</sup>	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)
Ultra 1	2121.3	2.05E-09	1.00E-05	4.03E-05	57.42	3.18E+00

Parameters measured at 300VDC								
Sample ID	Peak Voltage (V)	Capacitance C (F)	Sample electrode thickness (d) in meter	Sample Electrode Area A=m <sup>2</sup>	Dielectric Constant k=dC/e0A	Energy Density W(Hour/Litre)	Measured Leakage Current (nA)	Calculated Insulation resistance IR in Ω
Ultra 1	300	1.93E-09	1.00E-05	4.03E-05	54.06	4.65E-07	7.69E-08	3901170351
Ultra 2	300	2.98E-09	1.00E-05	6.28E-05	53.62	5.93E-02	3.47E-08	8645533141
Ultra 3	300	2.48E-09	1.00E-05	6.28E-05	44.62	4.94E-02	3.69E-08	8130081301

**SECTION 4  
PHOTOGRAPHS**

No photographs provided per the request of EESTOR Inc.

**SECTION 5  
PROJECT STATUS & ACTION**

Issuance of this letter report completes the testing portion covered by Intertek Project No. G103362995.

If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact your dedicated Intertek Project Engineer.

Completed by:	Bhaul Patel (BD)	Reviewed by:	Javier Lozano
Title:	Project Engineer	Title:	Industrial Team Lead
Signature:	 <hr/>	Signature	 <hr/>
Date	1/15/2018	Date:	1/17/2017