UNITED STATES ADVANCED BATTERY CONSORTIUM LLC

USABC Li-Ion Battery Separator Requirements

Table 1. USABC Li-ion battery separator gap chart.[1,2]

Parameter		Units	USABC Goal		Program Target
Thickness		µm	< 25 ± 1		
Permeability	Gurley #	s /10 cm^3	< 11 (power)	25 (energy)	
	MacMullin #	non-dimensional	< 4 (power)	8 (energy)	
Wettability		non-dimensional	wet-out in electrolytes[1]		
Functional Life		years	capable of supporting cell performance for 15 years[2]		
Average Pore size		µm	< 0.2		
Shear Strength[3]		gf / 25.4 µm film	300		
Thermal Stability[4]		% shrinkage/90°C[5]	< 5		
Uniformity (Defects)[6]		pinholes/roll	zero throughout roll length		
Tensile Strength		N/A	<2% offset at 1000 psi		
Cost		$/$m^2$	0.60 @ 25M sqm/yr		
Shutdown Temperature (See Section 6.2)		°C	(105 ± 5) °C		
High Voltage Resistance (See Section 6.2)		V	5.0 V		

Notes:

1. The items highlighted in yellow represent stretch goals.
2. The USABC goals in the gap chart for the cell type (12 V, 48 V, PHEV or EV) chosen as test platform for the separator performance must also be met.

Table 2. USABC Li-ion battery separator goals and recommended test methods.

Parameter		Units	USABC Goal		Test Method
Thickness		µm	< 25 ± 1		ASTM D5947-96, D2103
Permeability	Gurley #	s /10 cm^3	< 11 (power)	25 (energy)	Pat. US 4,464,238
	MacMullin #	non-dimensional	< 4 (power)	8 (energy)	electrolyte resistance ratio
Wettability		non-dimensional	wet-out in electrolytes[1]		relative wicking speed
Functional Life		years	capable of supporting cell performance for 15 years[2]		long-term cell testing
Average Pore size		µm	< 0.2		ASTM E128-99
Shear Strength[3]		gf / 25.4 µm film	300		ASTM F1306-90
Thermal Stability[4]		% shrinkage/90°C (1 h)[5]	< 5		ASTM D1204
Uniformity (Defects)[6]		pinholes/roll	zero throughout roll length		cell manufacturer confirmation
Tensile Strength		N/A	<2% offset at 1000 psi		ASTM D882-00
Cost		$/$m^2$	0.60 @ 25M sqm/yr		N/A
Shutdown Temperature (See Section 6.2)		°C	(105 ± 5) °C		hot ER
High Voltage Resistance (See Section 6.2)		V	5.0 V		glassy carbon electrode & cell performance

Notes:

[1] Wettability: Determined by a test based on wicking of separator sheet with electrolyte. USABC will use this parameter in a comparative fashion relative to state-of-the-art separators, and/or track any improvement/change.

[2] Functional Life: Verification should be done through calendar and cycle life tests at cell level. It is expected that USABC performance goals for the cell design used in the testing will be met or exceeded.

[3] Shear Strength: Determined by ASTM test for puncture of packaging films; to be complemented by mix penetration tests, after its validation by National Labs.

[4] Thermal Stability: An additional HTMI test suite (hot tip, TMA, hi-pot test, and high temperature shrinkage under constrained conditions after 1 hour stand at 150 ºC) will be added to the recommended test procedures after the proposed test methods are validated by National Labs and publicly disclosed.

[5] Hi-T Shrinkage: Determined for an unconstrained film after 1 hour stand. 90 ºC is standard test adopted by the Li-ion battery industry, for manufacturing purposes.

[6] Uniformity (defects): Quality is not extensively listed in the gap chart, but is certainly a requirement. The separator must be free of defects. Defects include pinholes, gels, wrinkles, contaminants, etc.; all are unacceptable. The process for producing separator should include controls that guarantee high quality.