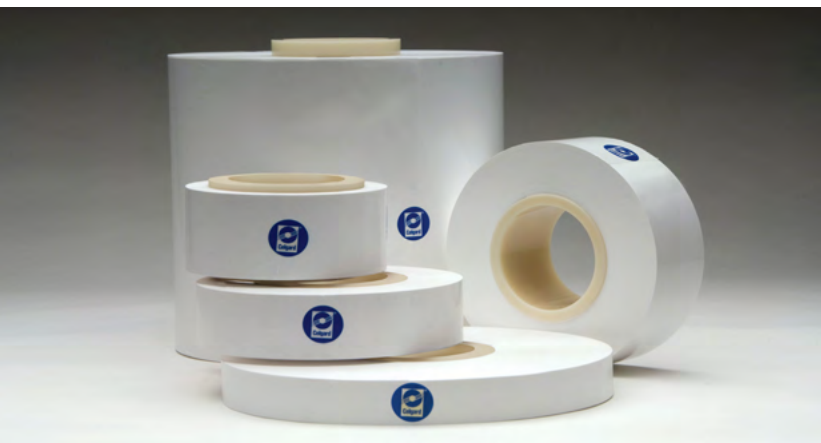


Celgard® Dry-Process Lithium-Ion Battery Separators



Electrification

Application Areas

- Automotive with electric drive (hybrid electric, plug-in hybrid and battery electric vehicle applications)
- Energy Storage Systems - ESS (grid storage, renewables integration, peakshift)
- Other lithium ion battery applications (power tools, military, motorsport, specialty)

Solution / Innovation for the Industry

Celgard® Traditional Trilayer Separators

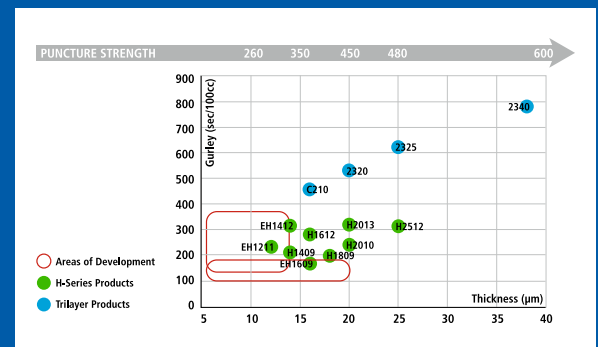
- PP outer layer provides high temperature melt integrity, oxidation resistance and PE inner layer provides high-speed shutdown features
- Exceptional safety and longevity for energy applications

Celgard® H-Series Trilayer Separators

- High porosity Trilayer offers exceptional high rate capability and ultra-low electrical impedance for hybrid electric vehicle applications
- PP outer layer provides high temperature melt integrity, oxidation resistance and PE inner layer provides high-speed shutdown features

Celgard® Q-Series Ceramic Coated Separators

- Offers excellent power performance, increased energy density and excellent safety performance
- Combination of trilayer membrane and ceramic coating provides high-speed shutdown that is sustained over a wide temperature range
- Environmentally friendly water-based binder with excellent peel strength



Selected physical properties for Celgard's Trilayer product portfolio

Celgard®, a subsidiary of Asahi Kasei since 2015, has been developing and producing separators for primary (single-use) lithium batteries since the early 1980s, and for secondary (rechargeable) lithium batteries since the early 1990s.

Today, Celgard® is a global leader in the development and production of high-performance separator technology. Our products uniquely balance the competing demands of performance criteria, including safety, chemical and dimensional stability, and cycle life necessary for success in a broad range of lithium ion battery applications. Asahi Kasei is the world's largest manufacturer and supplier of lithium-ion battery separators.

Key Properties

Non-coated separator, e.g. Celgard® H-Series Trilayer

- Zero TD shrinkage reduces internal shorting
- Uniform pore structure with high chemical & thermal stability
- Excellent cycle performance
- High heat resistance

Ceramic Coated separator, e.g. Celgard® Q-Series

All of the above, plus:

- High temperature structural integrity in x, y and z directions
- Sustained high-speed shutdown over a wide temperature range