



VRLA vs Hybrid Supercapacitor – Performance, Energy and Power Density

The 12V, 1.587kWh Group 31 hybrid supercap has 12,560 cubic centimeters volume in the case although the cells probably take up less than 50% of the case volume (I have opened one up). $1587 \text{ Wh} / 12,560 \text{ cm}^3 / 50\% = \mathbf{0.25272 \text{ Wh/cm}^3 \text{ module}}$
Volumetric Density. This is its approximate Volumetric Density. The **HSC Mass Density is $1587\text{Wh}/20\text{kg} = 79 \text{ Wh/kg}$.**

The individual 31Ah HSC cell is 3.2V nominal so provides 99.2Wh at a weight of 0.650kg. This is a cell mass density of 170Wh/kg. Volume is $1.1\text{cm} \times 31\text{cm} \times 10.3\text{cm} = 351.23 \text{ cm}^3$. $99.2\text{Wh} / 351.23 = 0.2824 \text{ Wh/cm}^3$ cell Volumetric Density.

With capability to deliver 100% DoD, the useable density is equal to the volumetric or mass density, whichever you prefer. 20,000 cycle-life.

For comparison, a Deka Group 31 lead acid AGM battery is rated at 47.5Ah for a capacity of 570Wh. ($47.5 \times 12\text{v}$). It's volumetric density, assuming the same Group 31 dimensions is $570\text{Wh} / 12560 \text{ cm}^3 = 0.0454 \text{ Wh/cm}^3$, at 100% DoD. The cells and electrolyte probably take up 90% of the case volume. So $0.0454 / 0.9 = 0.050 \text{ Wh/cm}^3$. But they cannot deliver 100% DoD without complete failure in under 20 cycles. So at 50% DoD, which would cut cycle life to less than 100 cycles, the **AGM useable Volumetric Density drops to 0.0227 Wh/cm^3 .**

With a mass of 32.4kg, the Mass Density of a Deka VRLA is $570 / 32.4 = 17.59 \text{ Wh/kg}$.
Useable AGM Mass Density is 8.79 Wh/kg .

- Our useable **Volumetric Density is 11x greater than a VRLA.** ($0.2527 / 0.0227$)
- Our **Mass Density is 9x greater than a VRLA.** ($79 / 8.79$)
- Our **Cycle Life is 40x greater than a VRLA.** ($20,000 / 500$)

This will vary somewhat depending on the VRLA selected.

Considering all metrics, but particularly cycle-life, there is no comparison of performance between a VRLA and an HSC.