



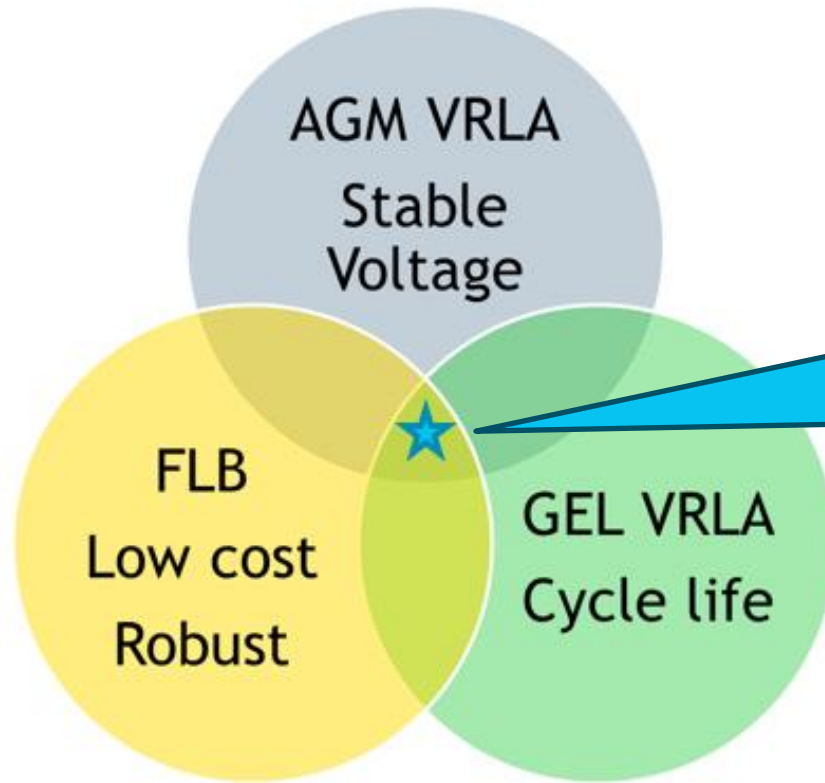
Empowering the Next-Generation Flooded and AGMe-VRLA Batteries to Transcend Stratification

[Daramic 2024 Stratosphere Separator Technology Award \(vimeo.com\)](#)

Daramic Technology Team

Mike Maul VP

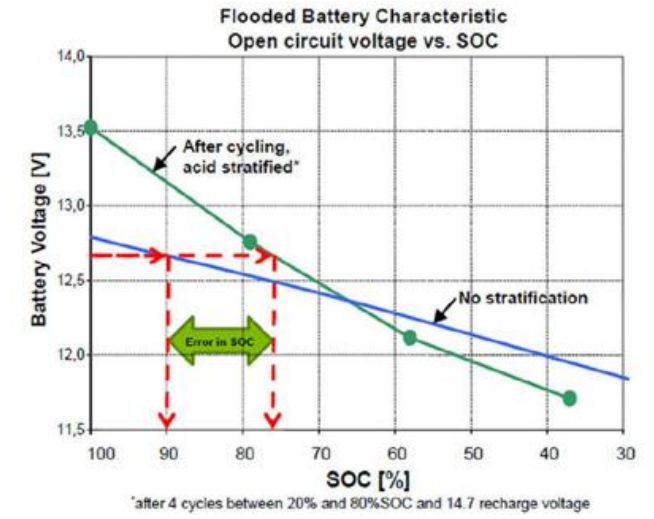
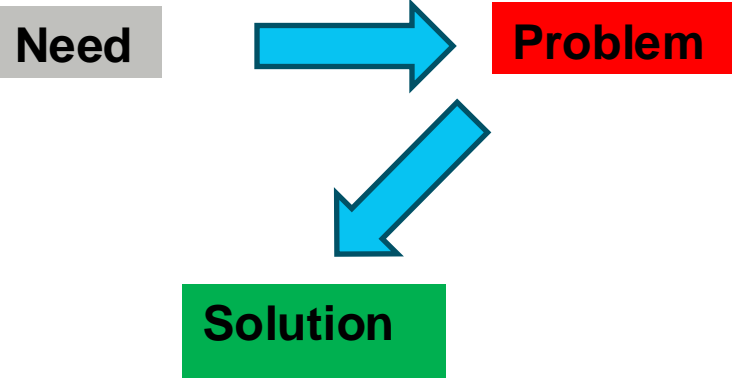
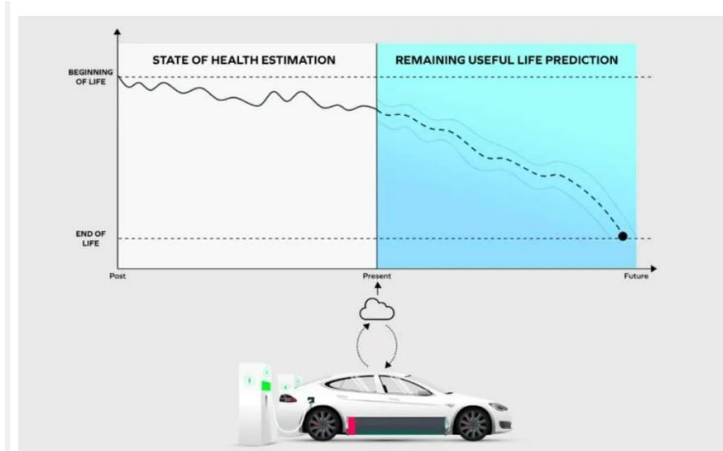
September, 2024



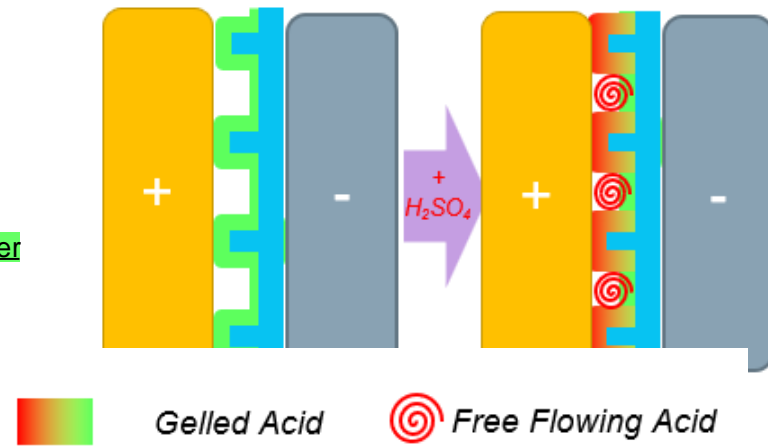
1. No need to reinvent the wheel.
2. Do what we do best leveraging our proven technologies in Lead Batteries
3. Fast customer acceptance and speed to market using existing capital and FLB process

“Stratosphere” Novel Separator Technology for both FLB & VRLA to advance LAB performance and reduce cost.

Automotive BMS system



Stratosphere Layer

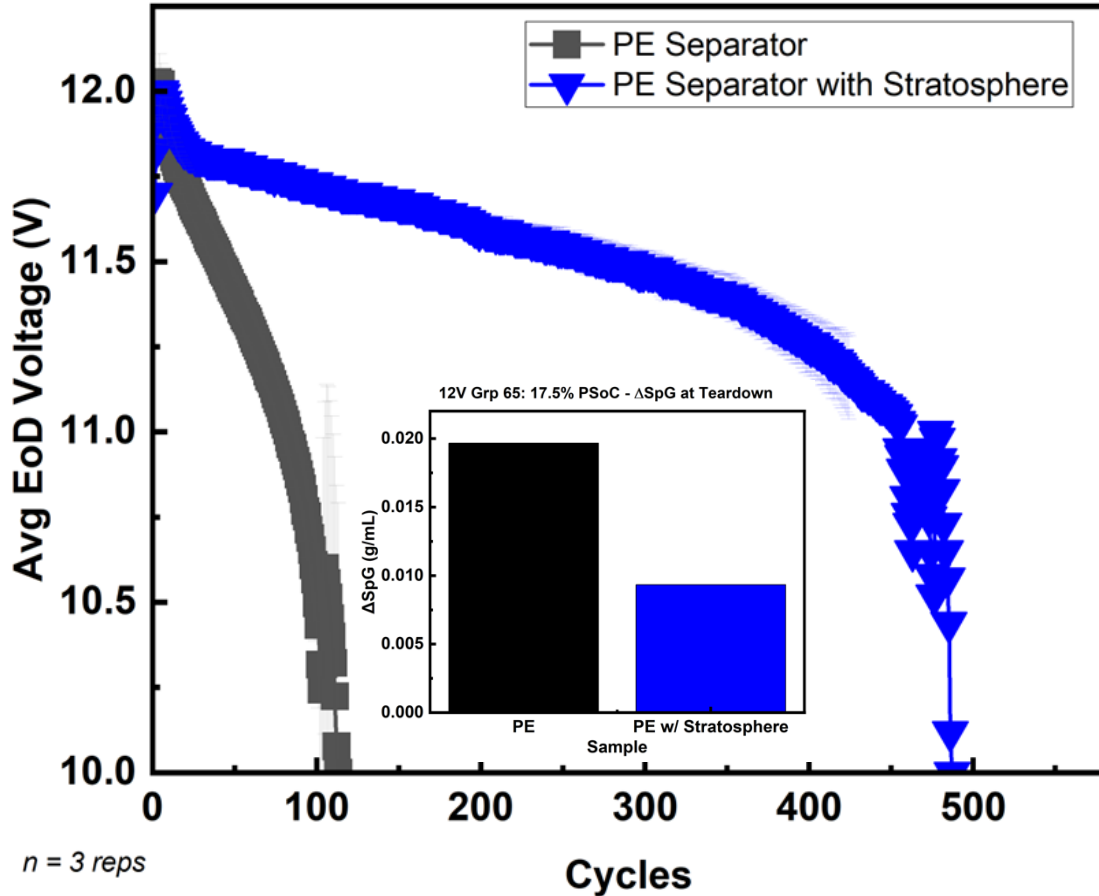


Stratosphere substrate holds the H_2SO_4 at right place addressing stratification which is the key for improving BMS communication

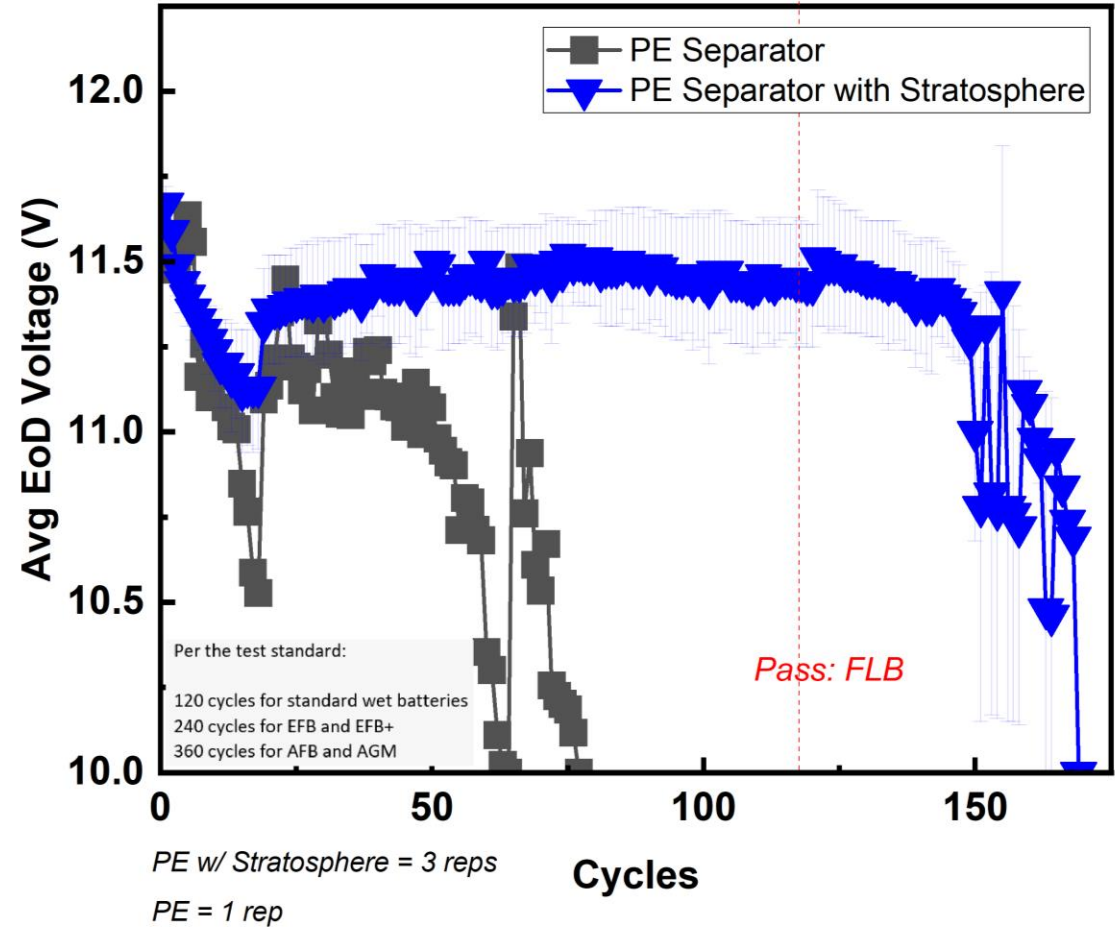
FLB Stratosphere Extends PSoC Cycle Life & Reduce Stratification



**12V Grp 65 Standard SLI FLB Results
VW 17.5% PSoC Cycle Life Performance**



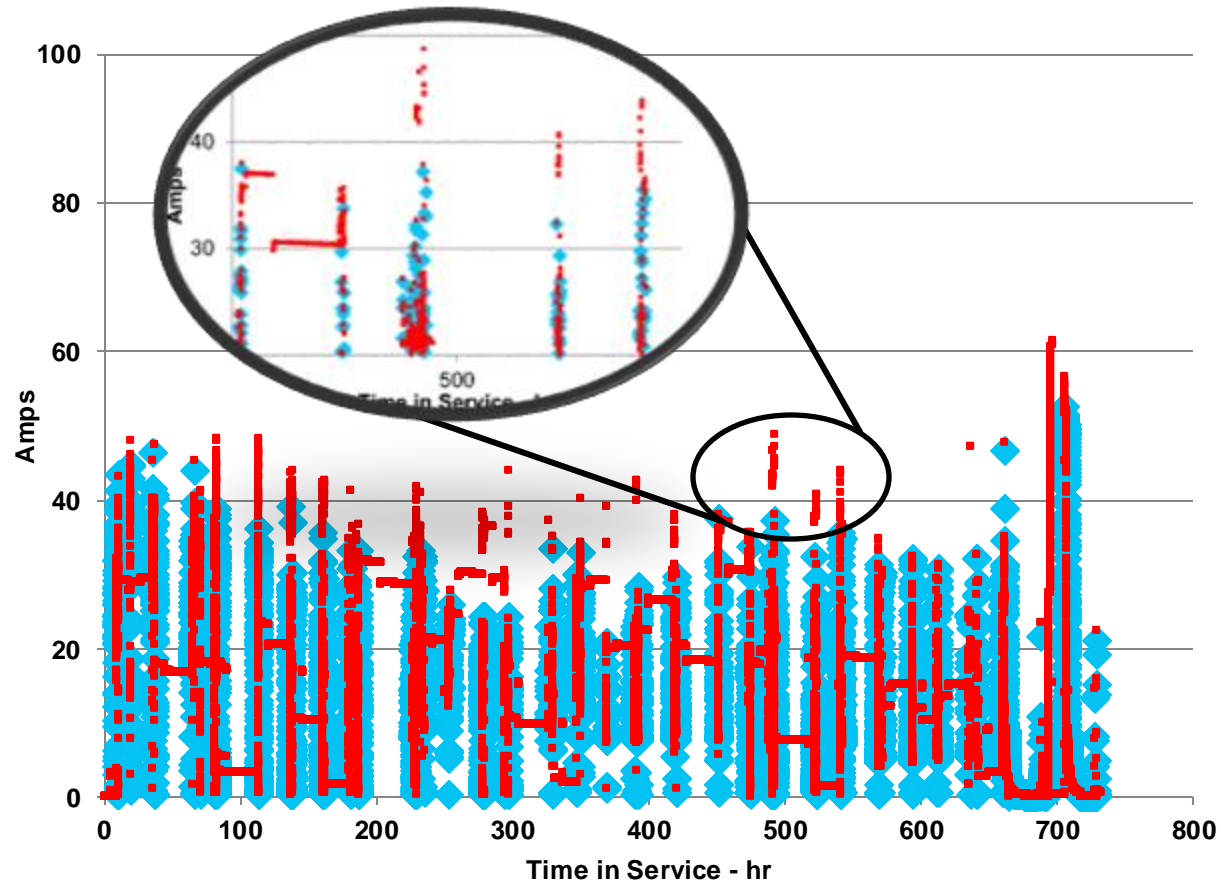
**12V Grp 65 Standard SLI FLB
EN 50% PSoC Cycle Life Performance**



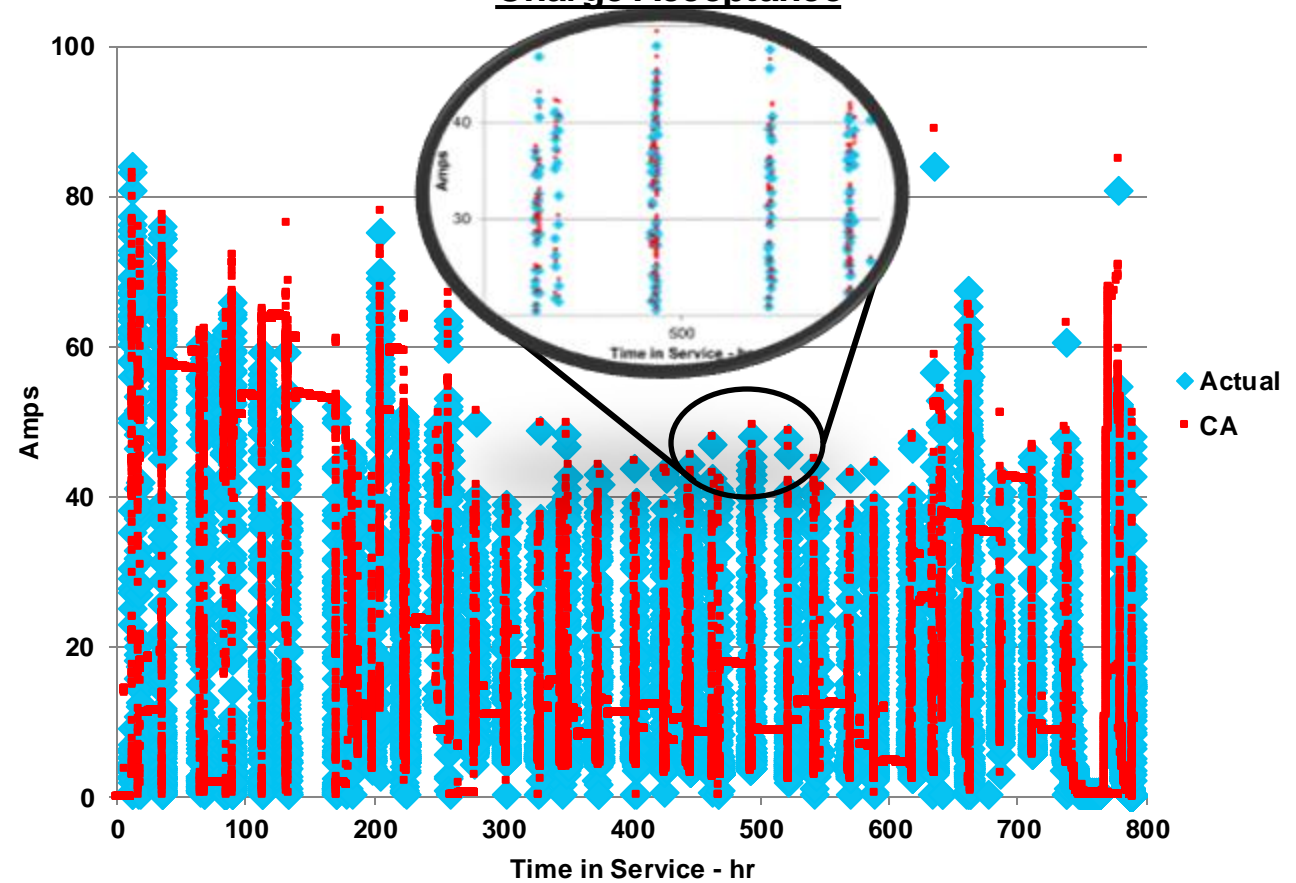
Stratosphere improving 17.5% and 50% PSoC Cycle life by 500% and 200%, respectively

FLB Stratosphere Improves BMS Communications

12V Grp 65 Standard SLI FLB: PE Separator
Charge Acceptance



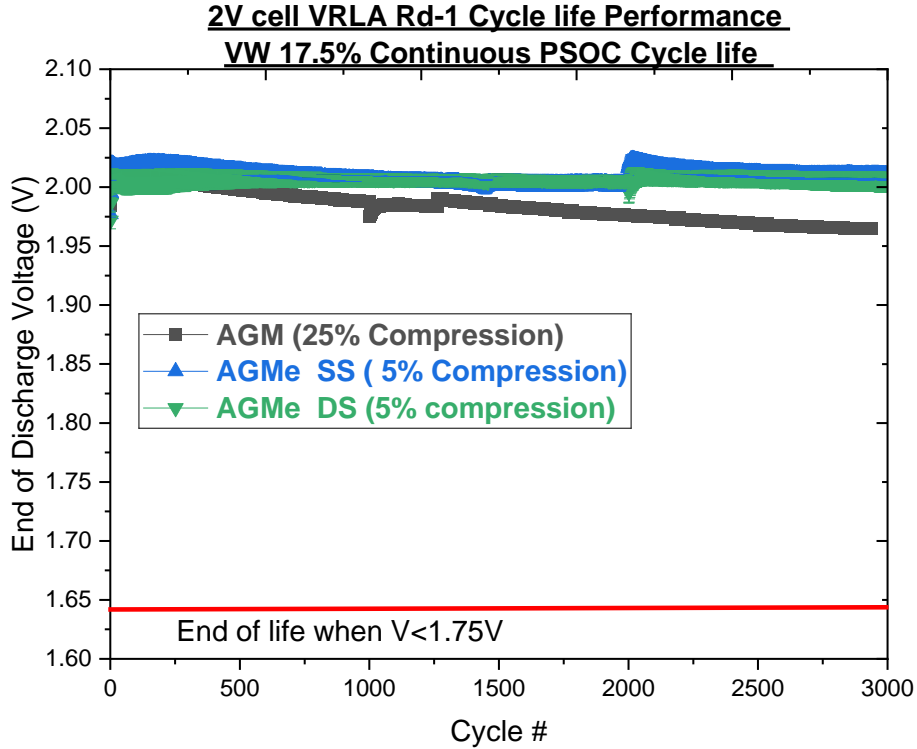
12V Grp 65 Standard SLI FLB: PE w/ Stratosphere Separator
Charge Acceptance



Tested on: Volvo S90 2019 Start-Stop Diagnostic Data Gp65 80Ah/825CCA

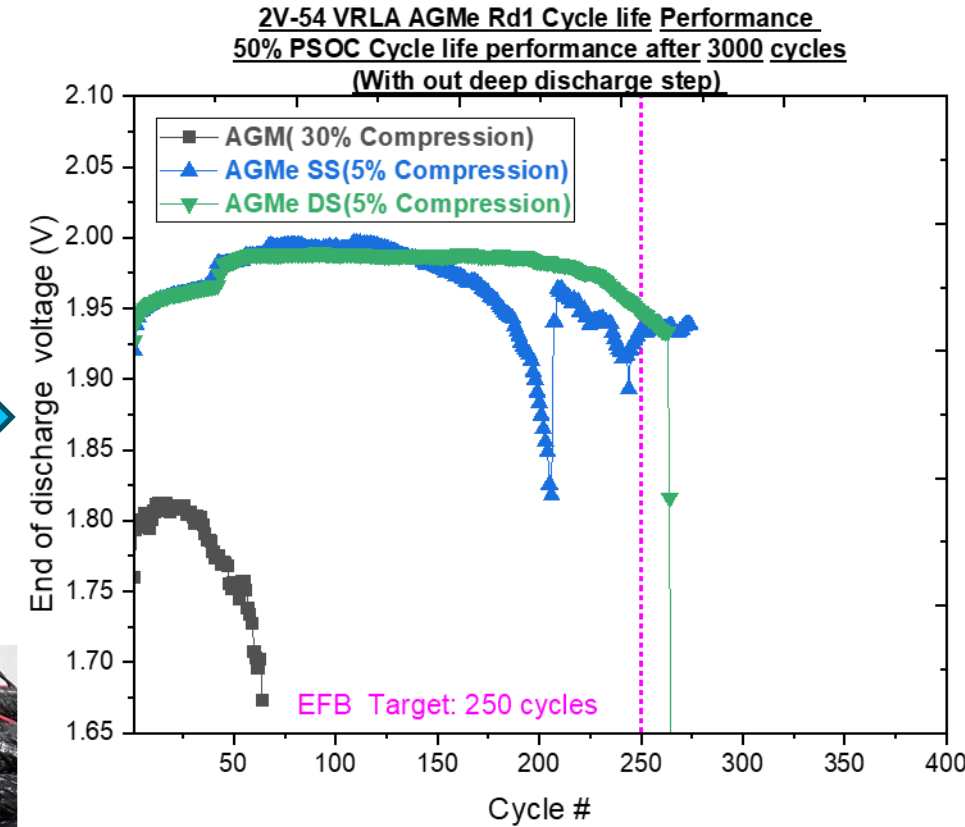
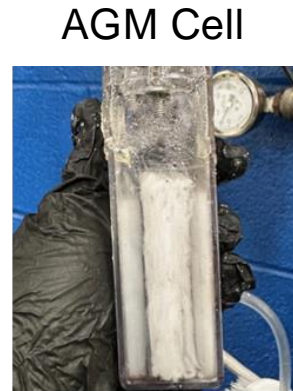
Stratosphere Decreasing Residual Error Between Predicted and Actual Values

VRLA AGMe -Lab scale Concept Validation



* Avg of 3 cells

Pushing the limits of separator after 3000 cycles



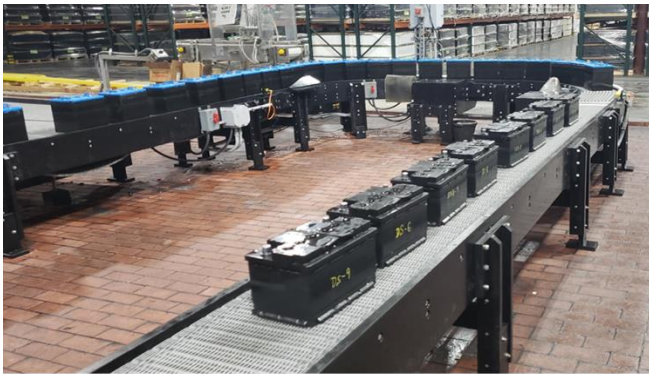
AGMe cell outperformed AGM in PSOC life cycle test

VRLA AGMe Scale up

Concept validation in 12V batteries

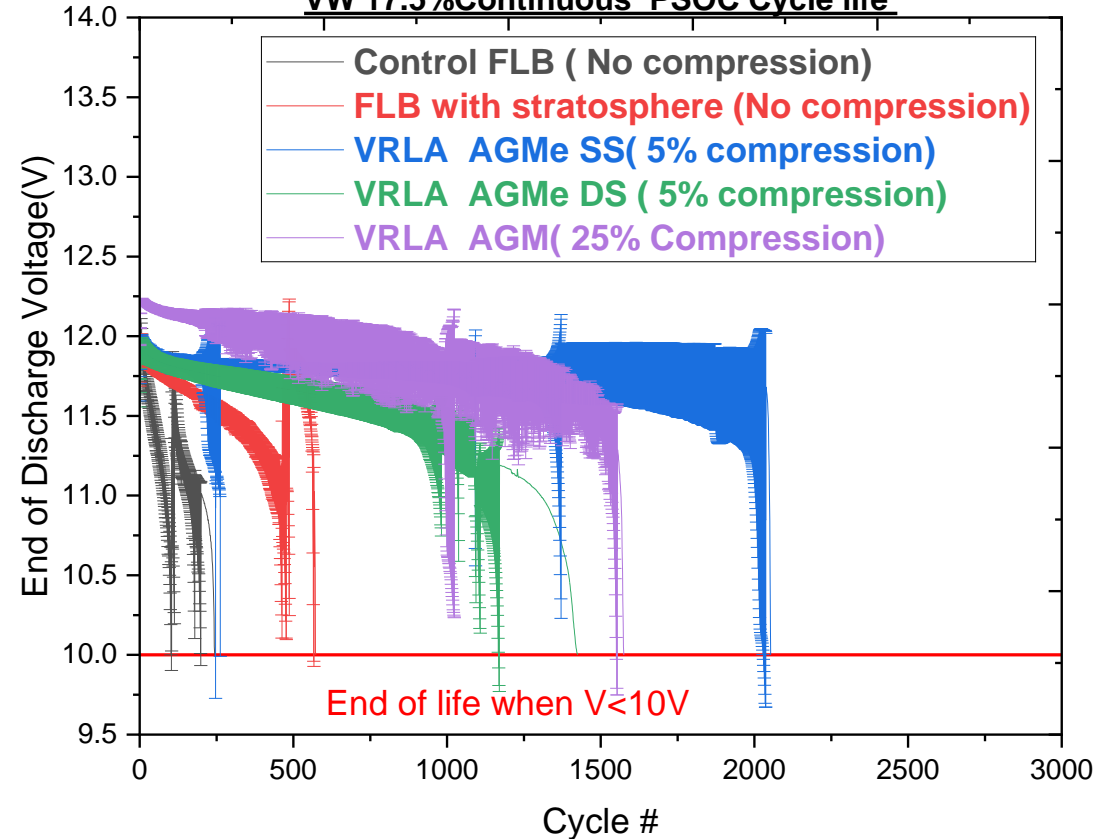


Normal FLB 2- shot process filling and formation



Addition of final dump and valve insertion for VRLA Performance

FLB /VRLA Separator Development using Gr 65
12V SLI battery design
VW 17.5%Continuous PSOC Cycle life



*** Avg of 3 batteries**

Manufacturing Feasibility using existing low cost FLB SLI battery design
VRLA AGMe outperformed FLB and performs like AGM



Flooded Lead Batteries:

Improve FLB PSoC 17.5% & 50% similar to VRLA

- Significant stratification reduction
- Improve BMS Communications
- Low Cost



New AGM Alternative to a Non-Glass Fiber separator

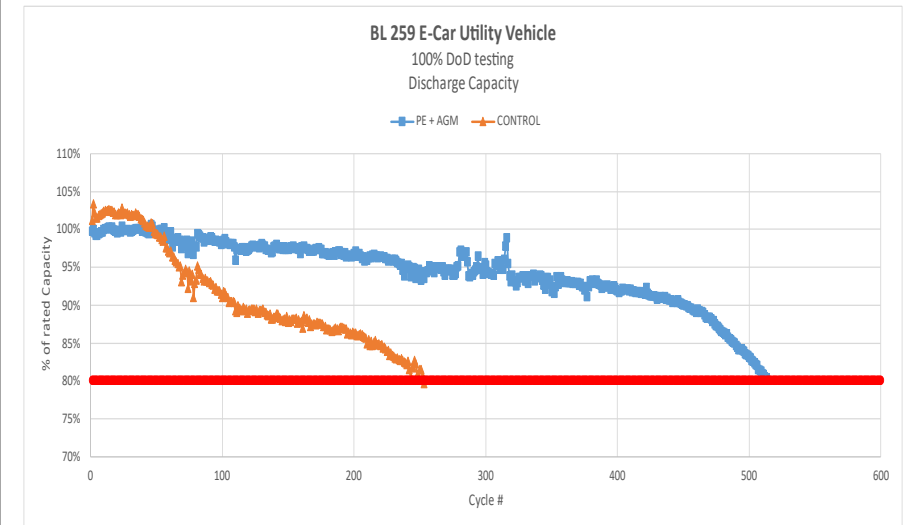
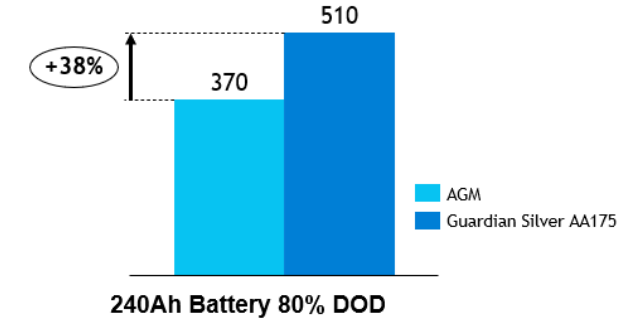
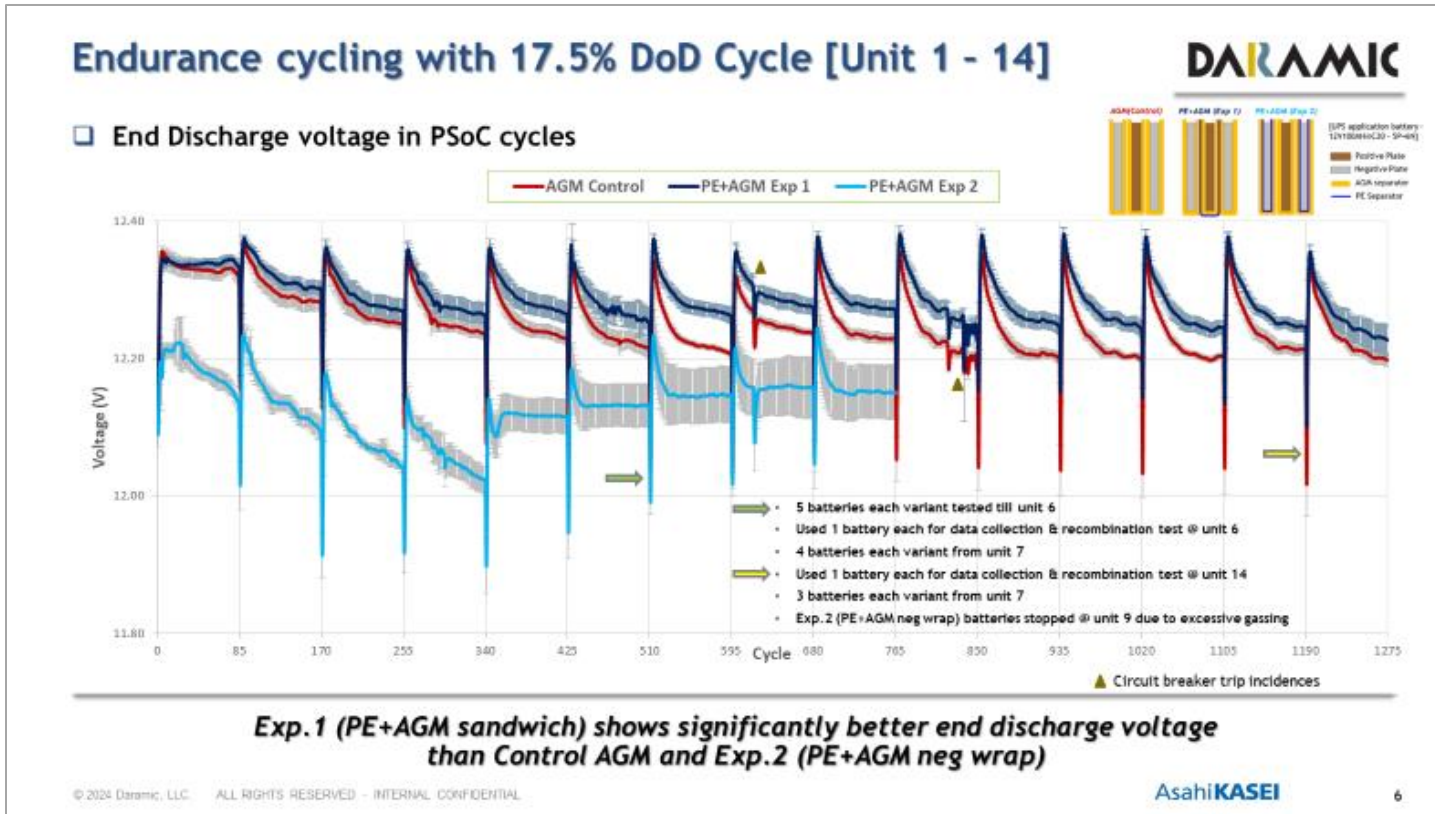
Low Cost VRLA Alternative

- Equal VRLA Performance in both 2v & 12v LAB's
- Use existing installed FLB capital
- High speed battery assembly and formation

Enabling VRLA Performance with FLB Manufacturing Simplicity & Cost.

Thank You

Back up



Daramic PE Separator Can be Utilized in a Recombinant System

Stratosphere Performance Mechanism in FLB & VRLA



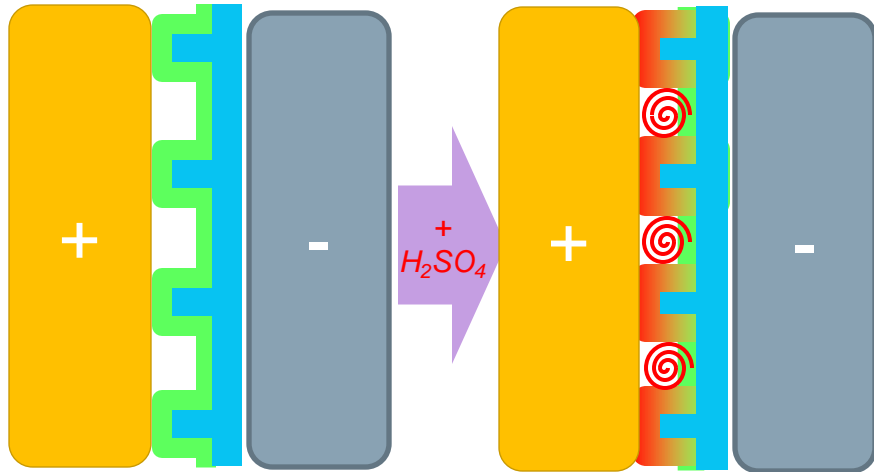
Gelled Acid



Free Flowing Acid

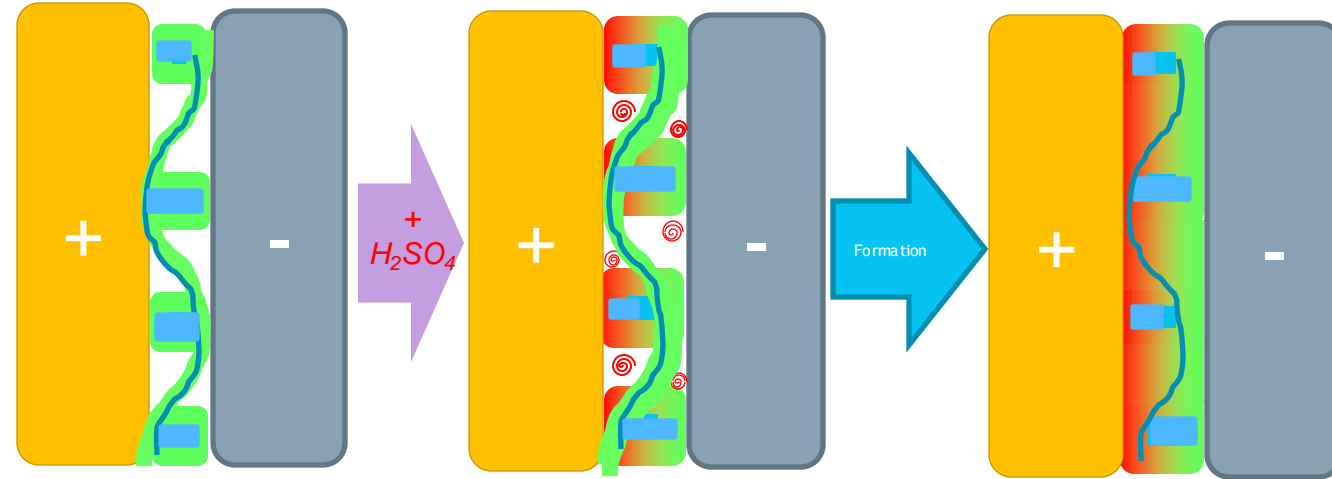
*Top macro view of cell

FLB Acid filling and swelling



Stratosphere on Single side

“VRLA” Acid filling and swelling
Absorbent Gelation Membrane evolution “AGMe”



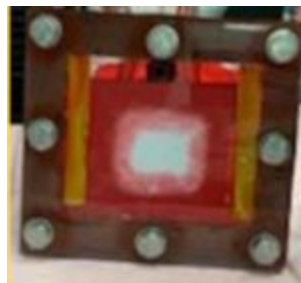
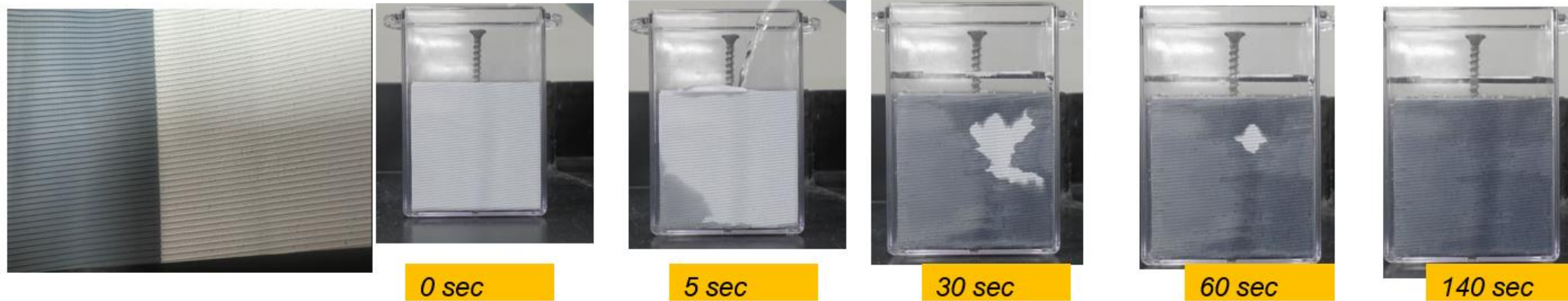
Compressible, >5kpa, high porosity PE separator allows channels fast filling
And during formation Stratosphere substrate swells closing the gaps.

Stratosphere on Both Sides

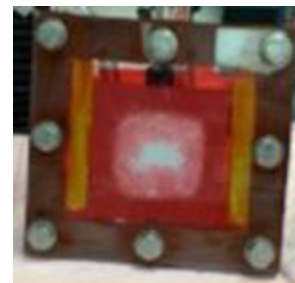
Stratosphere Substrate Retains H₂SO₄ in Place in Both Flooded and VRLA Applications

Benchmarking VRLA Filling Speed AGM vs. AGMe

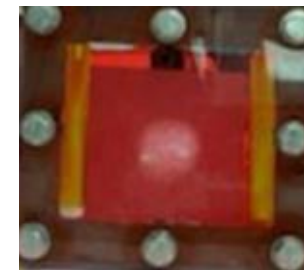
AGMe with Stratosphere



AGM 1 minute
under vacuum



AGM 2 minutes
under vacuum



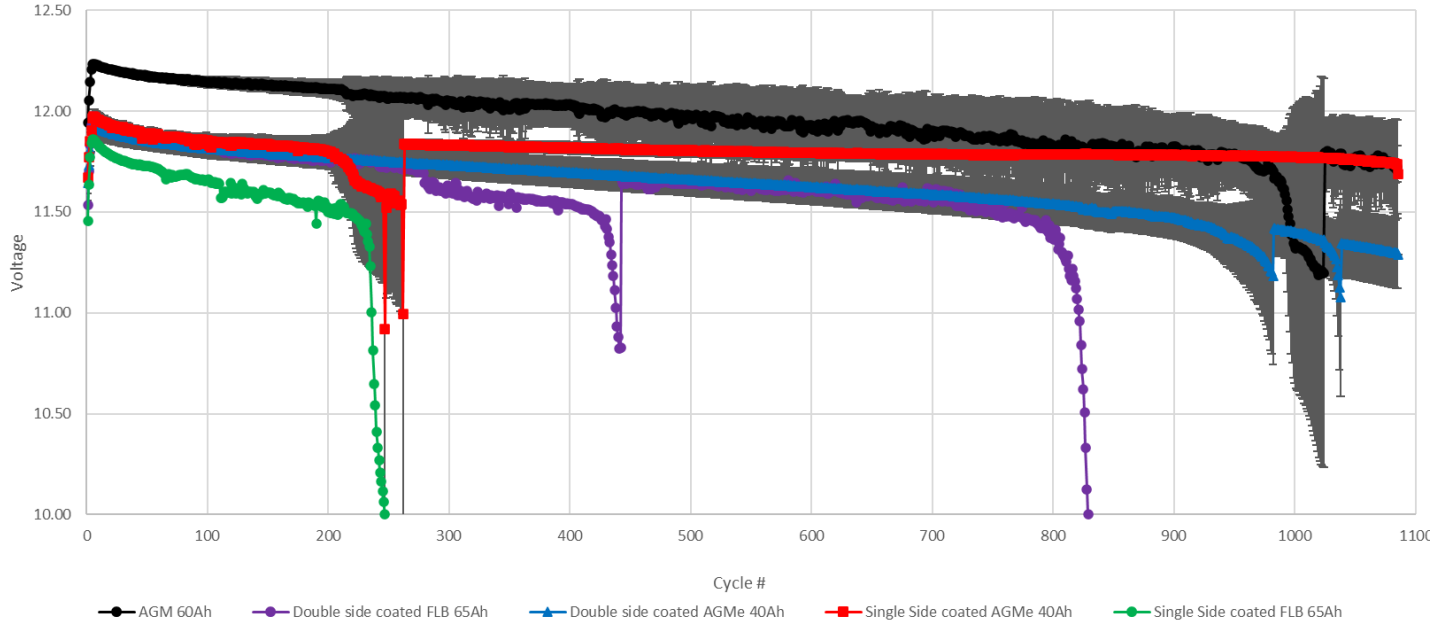
AGM 20 minutes
under vacuum

Stratosphere AGMe Filling and Formation Times Align Closer to Flooded Batteries

Superior VRLA AGME performance validation



BL# 433 Superior VRLA AGMe Round 1
 VW 17.5PSoC Continuous
 End of Discharge Voltage



Battery	Wet Weight (lbs)	C-20 capacity(Ah)	Insertion pressure(N)
AGM	48	60	May be 20 Kpa(?)
Single Side (Acid dumped)	38	40	17 N(1 Kpa)
Single Side (Acid retained)	41	60	17N(1 Kpa)
Double Side (Acid dumped)	38	40	100N (6 Kpa)
Double Side (Acid retained)	44	61	100N(6 Kpa)

AGMe batteries with Acid rich conditions with valves have failed earlier than expected. This may be due to one of the following reasons (need to be validated)

1. Faulty batteries in the lot
2. Valves added might have increased the pressure due to gassing and might have dry spots. This might have led to failure.

AGMe has slightly lower end of discharge voltage with limited acid conditions compared to AGM similar to 2V cell test results trend