

İNCİ GS YUASA

S022-Repetitive Charge Recovery of Fresh/Fresh+FOTA and Aged L3 70Ah AGM Batteries

ALBA 2026

Hürkan Çatalkaya

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S022-Repetitive Charge Recovery of Fresh/Fresh+FOTA and Aged L3 70Ah AGM Batteries

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1
Repetitive CR with Weekly Charge

2 Hr Charge / Week						
no.	T/°C	Step	t	U/V	I/A	Description
C1	25	PAU	4 h			soak before EN charge
C2	25	CHA	24 h	Uc	5.1 n	EN charge
C3	25	PAU	1 h			rest after EN charge
01	25	PAU	20 ... 36 h			soak to test temperature
02	25	DCH	5 h		1 n	initial discharge part 1
03	25	PAU	15 ... 17 h			rest before cooling
04	0	PAU	20 ... 36 h			soak to test temperature
05	0		connect resistors as defined in EN 50342-6, section 7.3.9			
10b	0	PAU	166 h			Stand time with resistors as defined in EN 50342-6, 7.3.9 (CCA #) / logging U at 1 hr
11	0	PAU	1min			automated OCV record
20	0	DCH	10 sec		(I±20) n	SOI performance test
21	0	CHA	1 min	Ucr15	(I±20) Ln	charge test U1±15
22	0	DCH	10 sec		(I±20) n	SOI performance test
23	0	CHA	9 min	Ucr15	(I±20) Ln	charge test U1±15
24	0	DCH	10 sec		(I±20) n	SOI performance test
25b	0	CHA	20 min	Ucr15	(I±20) Ln	charge test U1±15
26	0	DCH	10 sec		(I±20) n	SOI performance test
27	0	CHA	90 min	Ucr15	(I±20) Ln	charge test U1±15
28	0	DCH	120 sec		(I±20) Ln	SOI performance test
12	0	RPT				Repeat steps 10b-28 for 12 times
13	0		disconnect resistors			

Test Temperature : Repetitive CR @ 0°C & CR Weekend @ -18°C (IEC-60095-8 CD)

Test Plan & Sequence ★ Due to lack of circuit MHT test was done with 150A*2sec

L3 70Ah AGM	Sample-1	Sample-2	Sample-3	Sample-4
EN 50342-1	1.C ₂₀	1.C ₂₀	1.C ₂₀	1.C ₂₀
EN 50342-1	1.CCA	1.CCA	1.CCA	1.CCA
EN 50342-1	2.C ₂₀	2.C ₂₀	2.C ₂₀	2.C ₂₀
EN 50342-1	2.CCA	2.CCA	2.CCA	2.CCA

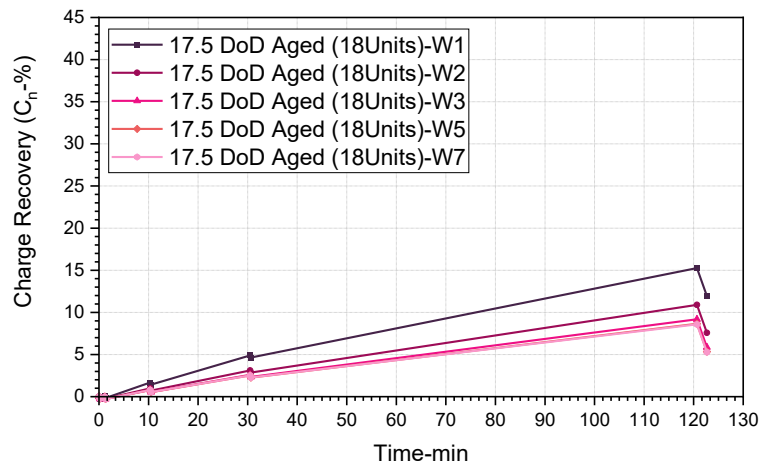
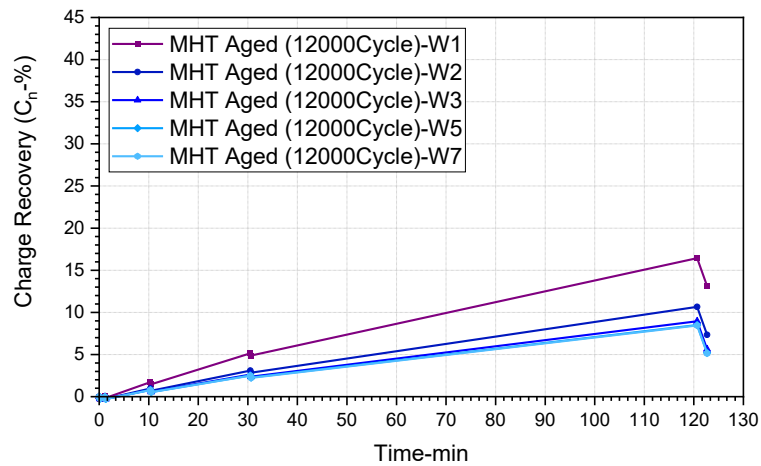
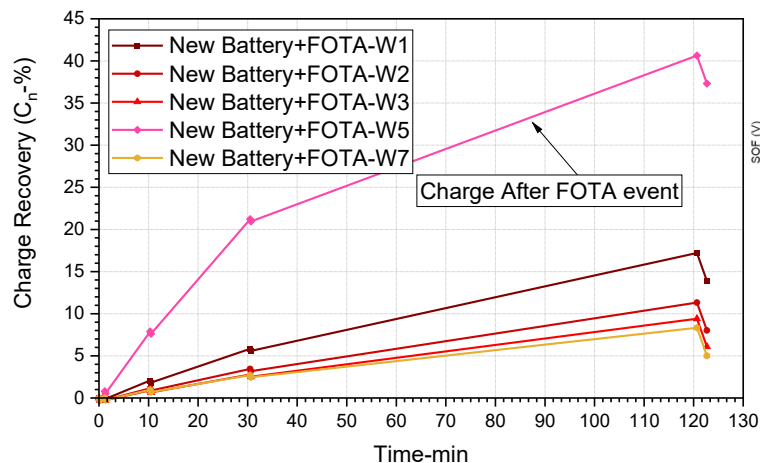
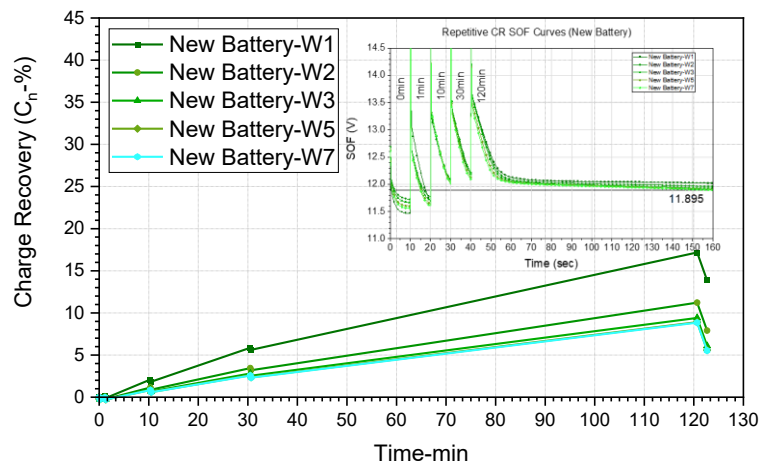
IEC 60095-8 CD	CR_Weekend BOL*	CR_Weekend BOL*	CR_Weekend BOL*	CR_Weekend BOL*
EN 50342-6			1-9. Unit 17.5% DoD	★ MHT 0-4000 Cycle
IEC 60095-8 CD				Full Charge 14.8 V -16 Hours
EN 50342-6				
IEC 60095-8 CD			CR_Weekend Middle of Life*	CR_Weekend Middle of Life*
EN 50342-6			10-18. Unit 17.5% DoD	MHT 4001-12000 Cycle
IEC 60095-8 CD				Full Charge 14.8 V -16 Hours
ALBA, 2025	CR Repetitive Weekly Charge OC	CR Rep_FOTA Weekly Charge OC	CR Repetitive Weekly Charge OC	CR Repetitive Weekly Charge OC

* Capacity & 24 Hrs EN Charge After CR_Weekend Tests

2
Repetitive CR with Weekly Charge
(+ FOTA Event @ After Week 4)

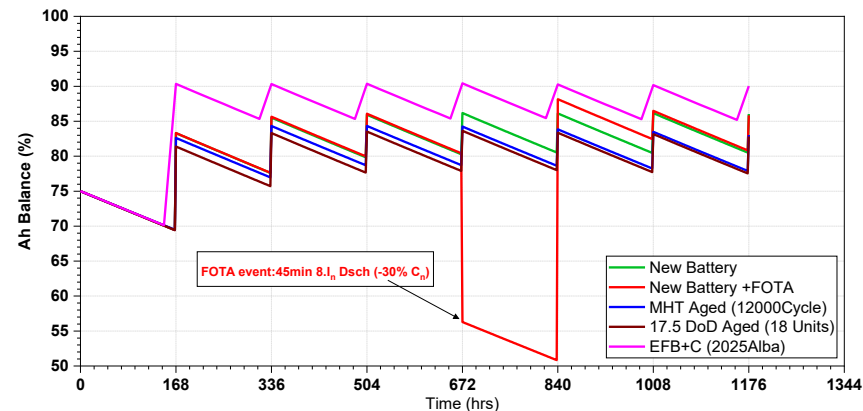
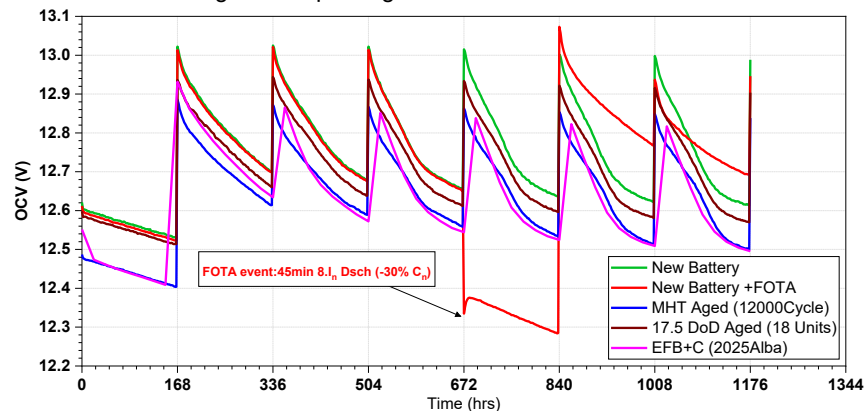
2 Hr Charge / Week (FOTA Variant)						
no.	T/°C	Step	t	U/V	I/A	Description
C1	25	PAU	4 h			soak before EN charge
C2	25	CHA	24 h	Uc	5.1 n	EN charge
C3	25	PAU	1 h			rest after EN charge
01	25	PAU	20 ... 36 h			soak to test temperature
02	25	DCH	5 h		1 n	initial discharge part 1
03	25	PAU	15 ... 17 h			rest before cooling
04	0	PAU	20 ... 36 h			soak to test temperature
05	0		connect resistors as defined in EN 50342-6, section 7.3.9			
FOTA variant		ONCE after 4 DCH	30 min	8.33 In	25.41010101010101 SOC charge once per quarter	FOTA Discharge event will be done in the beginning of 5th Week.
		before the 16th passat	40 min	6 In	20% SOC charge once per quarter	
			45 min	8 In	80% SOC charge once per quarter	CHOSEN 15 Dec 2025
			50 min	8.33 In	34.72222222222222 SOC charge once per quarter	
10b	0	PAU	166 h			Stand time with resistors as defined in EN 50342-6, 7.3.9 (CCA #) / logging U at 1 hr
11	0	PAU	1min			automated OCV record
20	0	DCH	10 sec		(I±20) n	SOI performance test
21	0	CHA	1 min	Ucr15	(I±20) Ln	charge test U1±15
22	0	DCH	10 sec		(I±20) n	SOI performance test
23	0	CHA	9 min	Ucr15	(I±20) Ln	charge test U1±15
24	0	DCH	10 sec		(I±20) n	SOI performance test
25b	0	CHA	20 min	Ucr15	(I±20) Ln	charge test U1±15
26	0	DCH	10 sec		(I±20) n	SOI performance test
27	0	CHA	90 min	Ucr15	(I±20) Ln	charge test U1±15
28	0	DCH	120 sec		(I±20) Ln	SOI performance test
12	0	RPT				Repeat steps 10b-28 for 12 times
13	0		disconnect resistors			

L3 AGM 70Ah CRrep Procedure CR_Input/Week

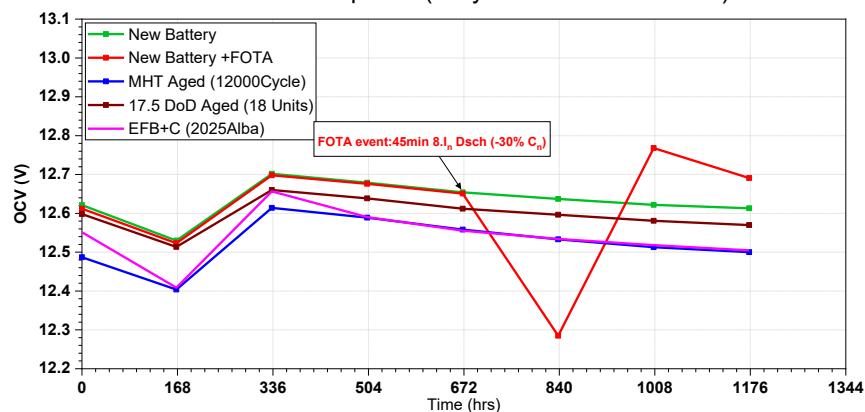


L3 AGM 70Ah CRrep Procedure OCV & Ah Balance During Test

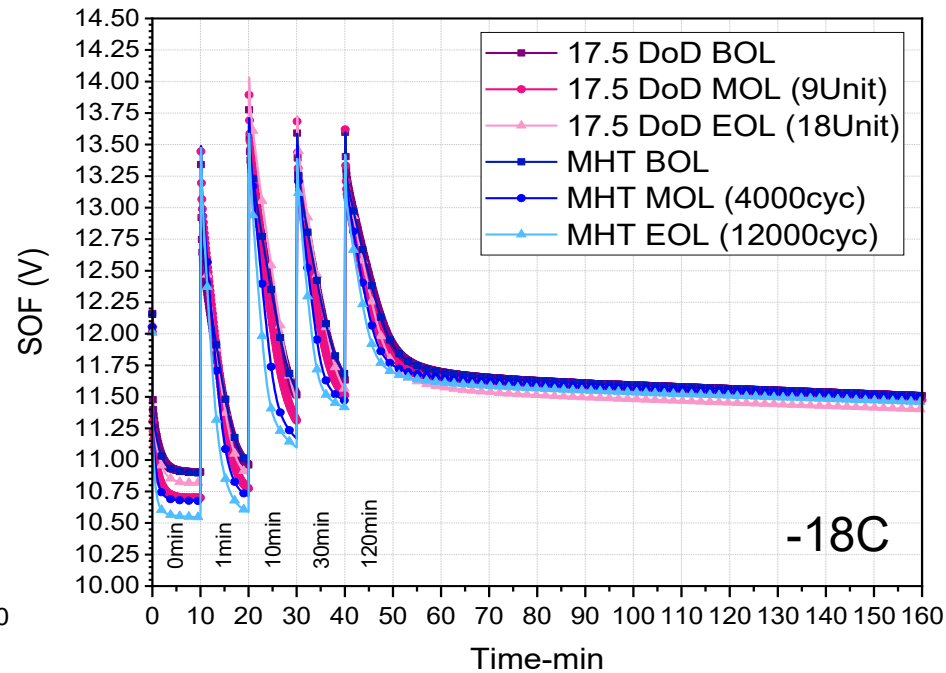
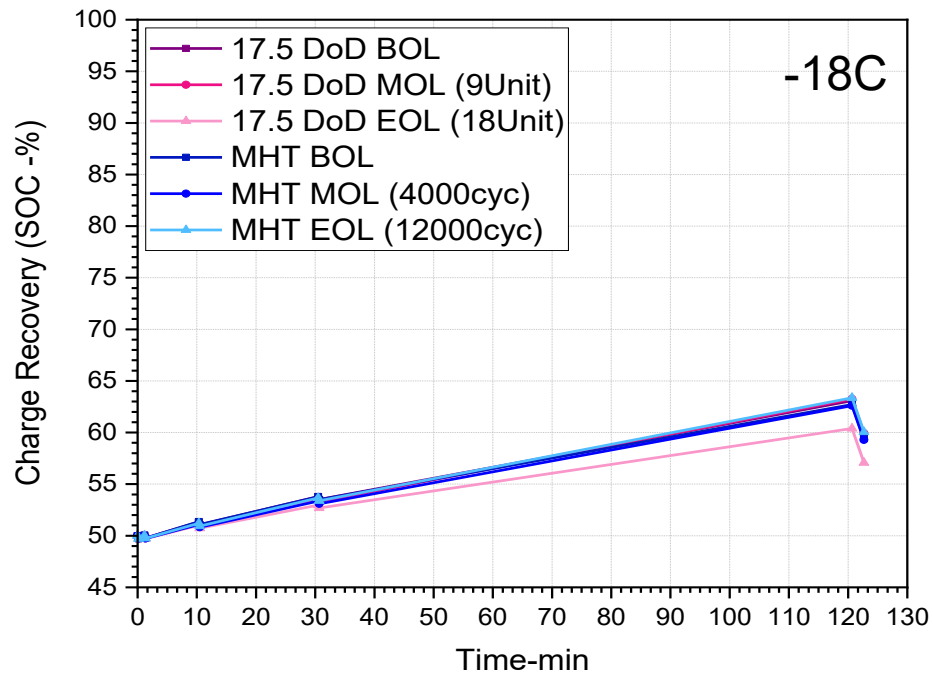
During the repetitive charge recovery test, DCA resistors were connected to the batteries to replicate key-off loads. Additionally, following week 4, 2nd new battery sample (New Battery + FOTA) was subjected to a controlled discharge of $-30\% C_n$ (45 min $\times$ 8 In) to emulate the energy demand associated with a FOTA event during vehicle parking.



OCV Simplified (Only End of Week Values)



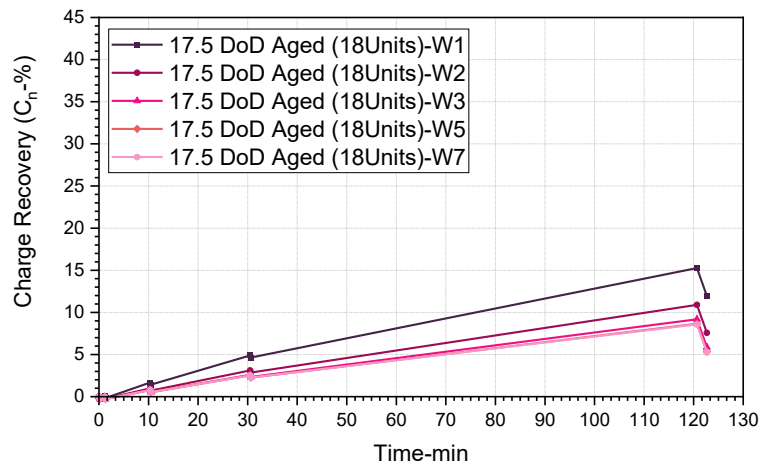
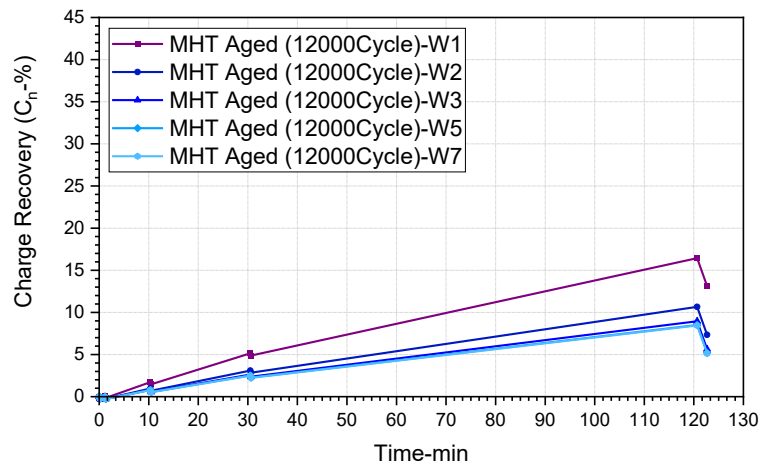
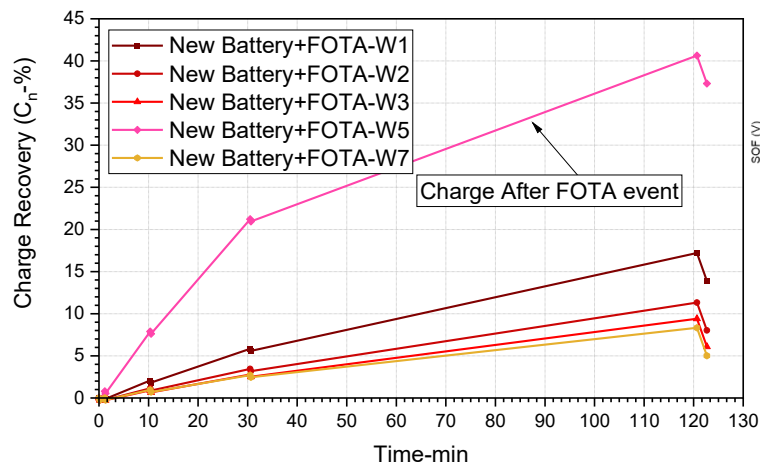
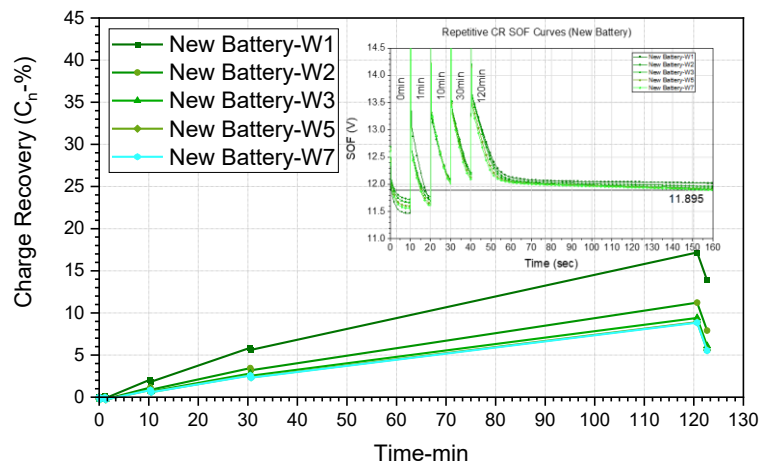
L3 AGM 70Ah IEC 60096-8 Charge Recovery (BOL-MOL-EOL)



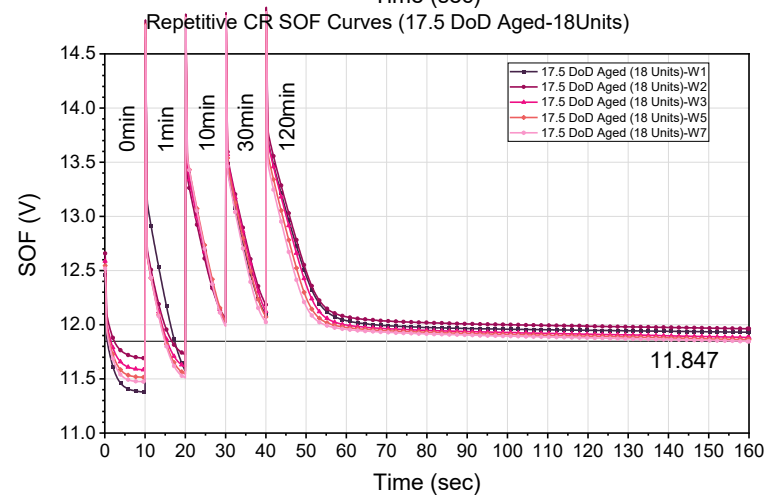
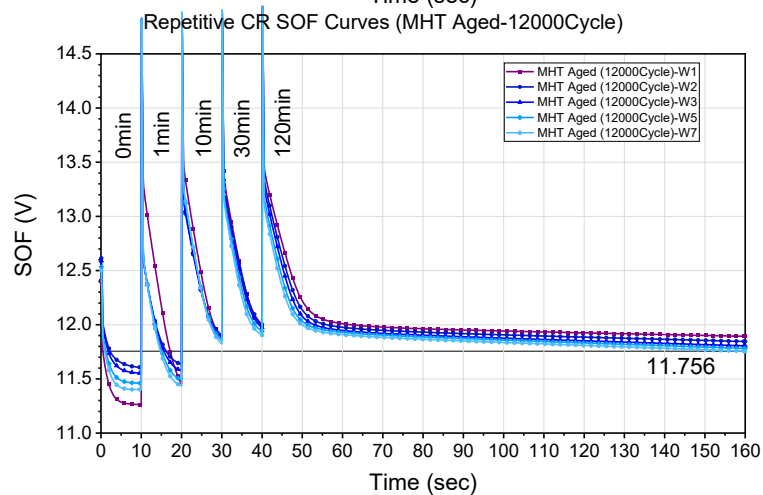
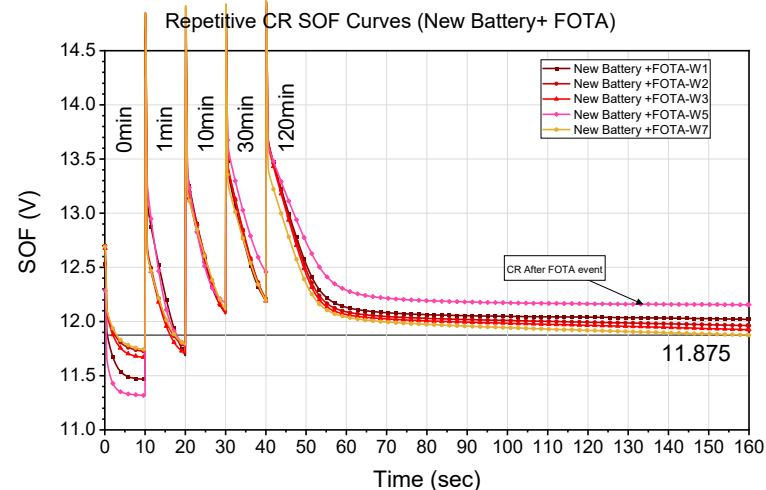
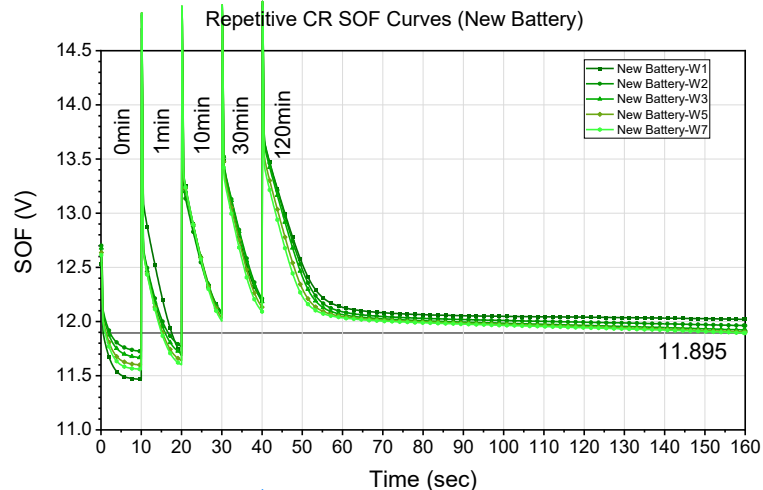
SOC (%)	17.5 DoD			MHT (2016)		
	BOL	MOL	EOL	BOL	MOL	EOL
0min	50.00	50.00	50.00	50.00	50.00	50.00
1min	50.06	50.03	50.00	50.04	50.01	50.02
10min	51.33	51.16	51.00	51.36	51.09	51.21
30min	53.80	53.56	52.97	53.78	53.36	53.67
120min	63.09	63.26	60.40	62.72	62.60	63.37

SOF (V)	17.5 DoD			MHT (2016)		
	BOL	MOL	EOL	BOL	MOL	EOL
0min	10.904	10.701	10.821	10.896	10.675	10.546
1min	10.961	10.773	10.881	10.971	10.714	10.589
10min	11.516	11.312	11.460	11.552	11.169	11.098
30min	11.633	11.513	11.560	11.680	11.470	11.416
120min	11.508	11.476	11.402	11.508	11.492	11.459

L3 AGM 70Ah CRrep Procedure CR_Input/Week



L3 AGM 70Ah CRrep Procedure SOF Curves



L3 AGM 70Ah CRrep Procedure SOF Curves - Simplified (Only End of Dsch Values)

