

Maximizing hot-climate durability and brake energy recuperation: an automotive workshop on battery technology and standards

DCA and Heat: Testing Charge Acceptance and High Temperature Durability for Advanced Lead 12 V Batteries

The Consortium for Battery Innovation (CBI, formerly ALABC), in collaboration with European Committee for electrotechnical standardization (CENELEC), is holding a workshop bringing together global technical experts from the advanced lead battery and automotive industries to discuss testing methods and research challenges. This follows meetings in Kloster Eberbach (2017), Alcalá de Henares (2018), and Bruges (2019). Following travel restrictions due to the Covid19 pandemic, the 2020 edition will be organized as fully virtual event. After 3 short web sessions in May that covered some aspects of the original agenda, **3 full days with highly interactive sessions will be offered in November.**

The “DCA and Heat” Workshop will trigger discussion and establish co-operation between battery experts working in all parts of the value-added chain, emphasizing:

- ◆ Battery durability in hot climate vehicle applications and validation of the new 75°C life test
- ◆ Improved understanding of reaction mechanisms and electrode structure effects
- ◆ Measurement and optimization of dynamic charge acceptance (DCA)
- ◆ From small test cells to real batteries: how to evaluate performance and durability through R&D
- ◆ New requirements for automotive 12V batteries: small sizes, functional safety

Compact plenary talks will expose up-to-date material on each of the following 6 topics to all participants. In subsequent break-out sessions, each participant will have the opportunity to discuss in depth 3 of the topics and plan collaborative work streams associated with them.

17-19 November 2020
Virtual Workshop

Wrap-up & Intro Talks
Video-streaming 1 week before live sessions

Topic	Plenary and Breakout topics
1. New Key Life Test (nKLT) for battery durability in hot climate	<ul style="list-style-type: none"> • Can nKLT predict water consumption in the field? • Can nKLT predict corrosion-limited high-temperature battery life? • Charge balance – weight loss – gas emissions: Quantifying EFB side reactions • Taxi fleet evaluation of EFB with high DCA • Introduction scenario for a new standard test?
2. Dynamic Charge Acceptance (DCA): Definitions and test methods	<ul style="list-style-type: none"> • OEM perspective: DCA motivation and observations • Comparing battery bench simulations of vehicle CO₂ homologation (WLTP) • Run-in vs. fresh battery: Which test predicts which use case? • Elements and sequences for a new global DCA test
3. Sharing insights for high-temperature durability cell testing	<ul style="list-style-type: none"> • nKLT results for test cells in comparison to 12V batteries • Discussing a 5Ah test-cell construction for NAM evaluation in nKLT • Reality check of CBI proposed best practices – invitation for a compact round-robin test • Exchange about common lab implementation topics
4. Positive electrodes under high-temperature microcycling duty	<ul style="list-style-type: none"> • Compare morphology & material parameters of positive vs. negative active mass • Can PAM additives reduce water consumption? • Analytical Techniques for PAM and positive grid • Corrosion under microcycling conditions: Do we need new evaluation methods? • Can impedance spectra (EIS) track corrosion layer growth in-situ? • In-situ information about grid corrosion from gassing and half-cell measurements
5. Negative electrodes' structure – function relationship behind the DCA Memory Effect	<ul style="list-style-type: none"> • The physical attributes of the DCA “memory effect”: A rapid shared experiment • Voltage effect on DCA: new experimental data for 12 battery types • A simple impedance spectroscopy experiment: in-situ DCA tracking? • Origin of the DCA Memory Effect: The Pb²⁺/organic buffering theory • Origin of the DCA Memory Effect: Role of Ostwald ripening & recrystallization • Alternative hypotheses and experimental ideas to verify or falsify thm
6. New requirements and standards: Auxiliary batteries and functional safety	<ul style="list-style-type: none"> • Market trends for “auxiliary” 12V batteries • DKE/IEC draft for standardizing new small AUX battery sizes • Do we need a norm for “FIT batteries” assuring ASIL compliance? • Power tests for 12V batteries beyond CCA • Example of a tier-1 solution: Breakdown of Functional Safety requirements to battery, pole-niche sensor and other power supply system components • A generic approach to state-of-function (SoF) verification

The “DCA & Heat” 2020 workshop will focus on the 6 topics listed above, offering for each one a plenary introduction, a breakout session for practical coordination of joint test-development and research activities, and a concluding panel discussion. In addition, 13 “DCA & Heat” wrap-up talks will summarize objectives, activities and results of the joint activity since Kloster Eberbach 2017 and provide reviews of current research topics.

All talks and session introductions (more of 7 hours of streaming videos with additional pdf material) will be available for all registrants prior to the virtual live event. Questions and answers, breakout sessions, panel discussions, and virtual coffee breaks will be presented as highly interactive live web sessions, from 11⁰⁰ to 16⁰⁰ CET each of

the three days. Additional discussion sessions, both on pre-defined and free topics, will be offered for additional expert discussions. The agenda is outlined in more detail on the following pages.

The “DCA & Heat” workshop will be preceded on 12 and 13 November by a Consortium for Battery Innovation (CBI) Technical Workshop, to discuss the progress of the newly launched CBI technical program and new requests for proposals.

Registration for both events can be made at rb.gy/vmejxu.

Registration fees:

DCA & Heat 2020 full registration: 199€

DCA & Heat day-pass (2 breakouts): 99€

CBI Technical Workshop: 99€

Day 1: Tuesday, 17 November 2020

Automotive Requirements

1	New Key Life Test (nKLT) for battery durability in hot climate	6	New requirements and standards: Auxiliary batteries and functional safety
Wrap-up Talks (20 min., streaming as of 12 Nov, with online Q&A) Panel discussion: 17 November, 11:00 CET (plenary session)			
New micro-hybrid durability test (MHT 2019): validation results; <i>Torsten Hildebrandt, Clarios</i>		Battery standards reflect industry trends <i>Torsten Hildebrandt, Clarios</i>	
New hot life test: Development and validation <i>Jonathan Wirth, RWTH Aachen Univ. ISEA</i>		Functional Safety requirements for automotive lead batteries; <i>Jörn Albers, Clarios</i>	
Topic Introduction Talks (approx. 5 min., streaming as of 12 Nov, with online Q&A)			
Examples of nKLT test & teardown results for various battery types <i>Roberto Aliberti, Fiamm FET</i>		Market trends for "auxiliary" 12V batteries <i>Dirk Weber, Clarios and Bernd Engwicht, East Penn Manufacturing</i>	
Failure mechanisms of low-cost aftermarket batteries in nKLT; <i>Mike Miao, Leoch International Technology Limited</i>		DKE/IEC draft for standardizing new small AUX battery sizes; <i>Torsten Hildebrandt, Clarios</i>	
Can nKLT predict water consumption in the field?; <i>Egbert Lodowicks, Audi</i>		Can we standardize a methodology to determine ASIL compliance of batteries? <i>Luca Brisotto, Exide Europe</i>	
Can nKLT predict corrosion-limited high-temperature battery life? <i>Luca Brisotto, Exide Europe</i>		Beyond cold cranking: Pulse-power characterization for batteries; <i>Joaquín Mascareñas Hinojosa, RWTH Aachen Univ. ISEA</i>	
Charge balance – weight loss – gas emissions: Quantifying EFB side reactions; <i>Jonathan Wirth, RWTH Aachen Univ. ISEA and Eberhard Meissner, Battery Specialist</i>		New OEM requirements for „FIT“ batteries and their diagnostics <i>Rolf Naumann and Jan Hammer, Audi AG</i>	
Taxi fleet evaluation of EFB with high DCA <i>José Otávio Peroba, Acumuladores Moura</i>		A generic approach to state-of-function (SoF) verification; <i>Dennis Kurzweil, Ford Motor Co.</i>	
Introduction scenario for a new standard test? <i>Torsten Hildebrandt, Clarios</i>		Example of a tier-1 solution: Breakdown of Functional Safety requirements to battery, pole-niche sensor and other power supply system components; <i>Martin A. Lohrmann, Robert Bosch</i>	
Breakout Sessions: 17 November, 12:00 or 13:30 CET (each participant chooses 3 out of the 6 topics for breakout active participation) Panel discussion: 17 November, 15:00 CET (plenary session)			

Day 2: Wednesday, 18 November 2020

DCA toward 2 A/Ah

5	Negative electrodes' structure – function relationship behind the DCA Memory Effect	2	Dynamic Charge Acceptance (DCA): Definitions and test methods
Wrap-up Talks (20 min., streaming as of 12 Nov, with online Q&A) Panel discussion: 18 November, 11:00 CET (plenary session)			
NAM classics: Is low DCA caused by Ostwald ripening? <i>Eberhard Meissner, Battery Specialist</i>		DCA in vehicles: definition, tests, memory effects <i>Eckhard Karden, Ford Motor Company</i>	
NAM additives: types, effects, mechanisms <i>Paul Everill, Black Diamond Structures</i>		DCA in labs: cell design effects, scalability <i>Sophia Bauknecht, Tech. Univ. Berlin</i>	
Topic Introduction Talks (approx. 5 min., streaming as of 12 Nov, with online Q&A)			
The physical attributes of the DCA "memory effect": A rapid shared experiment <i>Begüm Bozkaya, Fraunhofer ISC Würzburg</i>		OEM perspective: DCA motivation and observations <i>Markus Hollas, Volkswagen</i>	
Voltage effect on DCA: new experimental data for 12 battery types <i>Jonathan Wirth, RWTH Aachen Univ. ISEA</i>		Comparing battery bench simulations of vehicle CO ₂ homologation (WLTP) <i>Luca Brisotto, Exide Europe</i>	
A simple impedance spectroscopy experiment: in-situ DCA tracking? <i>Sophia Bauknecht, Tech. Univ. Berlin</i>		Run-in vs. fresh battery: Which test predicts which use case? <i>Jonathan Wirth, RWTH Aachen Univ. ISEA</i>	
Origin of the DCA Memory Effect: The Pb ²⁺ /organic buffering theory <i>Paul Everill, Black Diamond Structures</i>		Elements and sequences for a new global DCA test <i>Nico Rust and Ernst Ferg, Nelson Mandela Univ., Port Elizabeth</i>	
Origin of the DCA Memory Effect: Role of Ostwald ripening and recrystallization <i>Eberhard Meissner, Battery Specialist</i>		Alternative hypotheses and experimental ideas to verify or falsify them <i>Shane Christie, ArcActive</i>	
Breakout Sessions: 18 November, 12:00 or 13:30 CET (each participant chooses 3 out of the 6 topics for breakout active participation) Panel discussion: 18 November, 15:00 CET (plenary session)			

Day 3: Thursday, 19 November 2020

High-temperature testing / positive electrodes

4	Positive electrodes under high-temperature microcycling duty	3	Sharing insights for high-temperature durability cell testing"
Wrap-up Talks (20 min., streaming as of 12 Nov, with online Q&A) Panel discussion: 18 November, 11:00 CET (plenary session)			
Compare morphology & material parameters of positive vs. negative active mass <i>Eberhard Meissner, Battery Specialist</i>		Best Practices for cell tests and sample preparation - now in focus: high-temperature durability <i>Matt Raiford, CBI</i>	
Review of PAM additives <i>Paul Everill, Black Diamond Structures</i>		Grid classics: What can metallurgy tell for modern batteries? <i>Mark Stevenson, Global Lead Technologies and Matt Raiford, CBI</i>	
Corrosion layer growth: a literature review <i>Shawn Peng and Phil Sholtes, Trojan Battery</i>		Topic Introduction Talks (approx. 5 min., streaming as of 12 Nov, with online Q&A)	
Can PAM additives reduce water consumption? <i>Marvin Ho, Hammond Group</i>		nKLT results for test cells in comparison to 12V batteries <i>Benjamin Hübner, Moll Batterien</i>	
Analytical Techniques for PAM and positive grid <i>Matt Raiford, CBI</i>		Discussing a 5Ah test-cell construction for NAM evaluation in nKLT <i>Jochen Settelein, Fraunhofer ISC Würzburg</i>	
The role of the separator in high-temperature microcycling <i>George Brilmyer, Microporous</i>		Reality check of CBI proposed best practices for high temperatures <i>Jonathan Wirth, RWTH Aachen Univ. ISEA</i>	
Can impedance spectra (EIS) track corrosion layer growth in-situ? <i>Michael Verde, Trojan Battery</i>		Organizing a round-robin test for water consumption in lab cells <i>Paul Wulfert-Holzmann, Fraunhofer ISC Würzburg</i>	
In-situ information about grid corrosion from gassing and half-cell measurements <i>Jonathan Wirth, RWTH Aachen Univ. ISEA</i>		Exchange about common lab implementation topics; <i>Matt Raiford, CBI</i>	
Breakout Sessions: 19 November, 12:00 or 13:30 CET (each participant chooses 3 out of the 6 topics for breakout active participation) Panel discussion: 19 November, 15:00 CET (plenary session)			

EFB & Heat 2020 agenda lay-out



“Virtual Workshop”

Wrap-up talks
will summarize the evolution of current automotive battery R&D topics since the “Kloster Eberbach” workshop 2017. For this virtual event, you will review hand-outs and video talks (20-30 min each) prior to the live Q&A session and have the opportunity to discuss papers in a chat already.

Plenary sessions
Based on your feedback during the week, speakers and experts will discuss research status and directions.

Break-out sessions
Short introductions on aspects of the session topic (approx. 5* 6min per session) will be available for all participants (streaming 1 week ahead). Each participant selects 3 of the 6 live sessions, where the topic is discussed in small groups with experienced peers. Following in-depth technical / scientific analysis, our priority is on advancing technology and test methods by joint pre-competitive activities.

Virtual lobby
Between breakout sessions, and during those you are not attending, join (by webcam) additional informal “topic tables” or meet your colleagues for “coffee break” talks.

Plenary sessions
Panel discussion: Take-home messages, joint action plans.

Day 1 Automotive requirements

video talks streaming 1 week ahead:

Battery standards reflect industry trends	New micro-hybrid durability test: MHT 2019	New hot life test: Development and validation	Functional Safety requirements for automotive lead batteries
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Tuesday, 17 Nov, 11:00 CET

live Q&A

12:00 - 15:00 CET

12:00 New Key Life Test (nKLT) for battery durability in hot climate	 The virtual lobby: topic tables, group meetings, 1:1 chats
13:30 New requirements and standards: Auxiliary batteries and functional safety	

15:00 - 16:00 CET

live panel discussion

Day 2 DCA toward 3 A/Ah

video talks streaming 1 week ahead:

DCA in vehicles: definition, tests, memory effects	NAM classics: Is low DCA caused by Ostwald ripening?	NAM additives: types, effects, mechanisms	DCA in labs: cell design effects, scalability
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Wednesday, 18 Nov, 11:00 CET

live Q&A

12:00 - 15:00 CET

12:00 Negative electrodes' structure – function relationship behind the DCA Memory Effect	 The virtual lobby: topic tables, group meetings, 1:1 chats
13:30 Dynamic Charge Acceptance (DCA): Definitions and test methods	

15:00 - 16:00 CET

live panel discussion

Day 3 High-temperature testing/ Positive electrodes

video talks streaming 1 week ahead:

Morphology and material parameters of PAM vs. NAM	Review of PAM additives	Grid classics: metallurgy for modern batteries	Corrosion layer growth: literature review	Best practices for cell tests & sample prep.
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Thursday, 19 Nov, 11:00 CET

live Q&A

12:00 - 15:00 CET

12:00 Positive electrodes under high-temperature microcycling duty	 The virtual lobby: topic tables, group meetings, 1:1 chats
13:30 Sharing insights for high-temperature durability cell testing	

15:00 - 16:00 CET

live panel discussion