

Summary of the 28th Plenary Special Committee 235 - Non-Rechargeable Lithium Batteries

Meeting Summary:

The 28th Plenary Meeting of Special Committee 235 (SC-235) was held on May 16-17, 2023. The meeting was conducted as a Virtual Meeting with the following attendees participating via WebEx.

John Trela (Chairman)	The Boeing Company
Norman Pereira (Government Authorized Representative)	Federal Aviation Administration
Jeff Densmore (Secretary)	Radiant Power Corporation
Karan Hofmann (Program Director)	RTCA, Inc.
Antonio Chiesa	Transport Canada
Maria Jose	Airbus
Nazih Khaouly	Federal Aviation Administration
Gary Leegate	Basewest
Thomas Maloney	Federal Aviation Administration
Frederic Menard	Orolia
Kathryn Mulhollen	U.S. Air Force
Paul Pfeifer	Textron
Steve Rehn	Federal Aviation Administration
Ray Rodriguez	U.S. Air Force
Jim Russell	The Boeing Company (retired)
Leire Segura	Airbus
Adrian Sfetcu	Bell Helicopter Textron, Inc
Greg Smith	U.S. Air Force
Clayton Vondrasek	Garmin

Opening Plenary

- The 28th Plenary meeting of SC-235 was convened on May 16, 2023 at 9:00am EDT by Chair John Trela (Boeing). Jeff Densmore (Radiant Power) was the SC-235 Recording Secretary.
- Norman Pereira was introduced as the Government Authorized Representative.
- An RTCA overview, including RTCA's Proprietary References Policy was read by Karan Hofmann, the Program Director. Karan also presented RTCA's guidance on *consensus building* as a reminder of our committee's responsibilities for reaching closure on contentious issues and comments.

- Welcoming remarks were made by John Trela. Each person in attendance was invited to introduce themselves.
- The meeting agenda was reviewed.
- The Meeting Summary for SC-235 Plenary #27 was reviewed and approved as written.
- All documents and presentation material reviewed during Plenary #28 have been uploaded and are available in the RTCA AerOpus documents folder for this meeting.

Plenary #27 Action Item Review

There were five open Action Items at the close of Plenary #27, with status as follows:

Draft the Executive Summary for the Release of DO-227B

Assigned to: Nazih Khaouly

Status: CLOSED. In the absence of proposed wording, Jeff presented a suggested statement for inclusion into the Executive Summary section. This was discussed, but not agreed upon. Further editing is required.

Create the Change Log from DO-227A to DO-227B

Assigned to: Jeff Densmore and John Trela

Status: CLOSED. Note that this log cannot be generated until the changes to DO-227B are finalized. During Plenary #28, it was concluded that a second FRAC will be required for DO-227B. As such, this action will be revisited when that process is completed.

Develop a Plan to Resolve FRAC Comments Regarding Orientation During Thermal Runaway and Disabling Cell and Battery Protective Devices

Assigned to: Working Group

Status: CLOSED. This topic was discussed with a proposed resolution that was presented during Plenary #28 as discussed below.

Perform an Engineering tests of JUST battery cells interconnected with TABs in a parallel / series combination to assess proposed Short Circuit with Protections Disabled requirements.

Assigned to: Jeff Densmore and Tom Maloney

Status: CLOSED. Both Jeff and Tom presented their test results. Both showed that unprotected cells in parallel / series combinations will enter thermal runaway when a direct short circuit is applied. The conclusion was that if the current DO-227A Battery Short Circuit test requirements were to change, then it was suggested that allowable mitigation at the next level should be considered.

Create a Proposed Figure for Illustrating the Various End Item Orientations

Assigned to: Jeff Densmore

Status: CLOSED. This action has become “overcome by events.” The orientation discussion took a different turn during working group meetings since Plenary #27 as discussed below.

DO-227B Comment Resolution

The Plenary Meeting began with all FRAC comments resolved, with the remaining open items from the previous Plenary being addressed during Working Group Meetings. There were several key topics that merited discussion with the full committee. Each of these are summarized below.

Battery Short Circuit with Protections Disabled.

Tom Maloney and Jeff Densmore were asked to perform short circuit testing of batteries configured in various parallel / series combinations that contained NO external protections. This included excluding fuses and fusible links. The results of these tests were presented by both Tom and Jeff. The presented data has been uploaded into AerOpus. In summary, thermal runaway occurred during these tests with various cell chemistries and in various configurations. The conclusion was that including fuses and fusible links as disabled devices in the Battery Short Circuit with Protections Disabled test requirements would be a major scope change and most Plenary attendees disagreed the suggested change. The FAA and TCCA representatives, however, were supportive of disabling fuses and fusible links and were assigned an **ACTION** to propose revisions to the applicable requirements and procedures.

Maximum 204°C Temperature Requirement.

During FRAC resolution, a Maximum 204°C Temperature Pass/Fail requirement was added to the Cell Drop Test and Battery External Short Circuit with Active External Protection Disabled Tests. Reviewing the FRAC comment sheet, there does not appear to be a specific comment suggesting that these requirements be added, but were done so as a result of resolution to other comments in these sections.

Textron has voiced objections to the including of 204°C as a Pass/Fail criteria for any cell, battery, or end-item test as this criterion is more applicable to installation requirements. This issue was once again discussed at length. The committee was able to reach consensus to remove the requirement from the Cell Drop test, but not from the Battery External Short Circuit with Active External Protection Disabled or End Item Thermal Runaway testing. This remains a contentious issue.

Thermal Runaway Orientation

During working group meetings, an agreement was reached for recommended wording to address the orientation of the End Item during Thermal Runaway testing. The recommendation was aided by the results of a survey of committee members regarding their experiences with TR testing. The results of the survey were briefly presented, but not shared with the committee (eg uploaded in AerOpus). A brief review of the survey results indicated that during formal (“for score”) TR testing, respondents did not experience a TR Failure of the second Test after passing the first Test. There were responses that stated that during engineering testing, there were failures experienced after a successful first test. These responses were used to justify requiring two (2) TR tests *in the same orientation* to satisfy the MOPS requirements. Further, the orientation should reflect the intended installation orientation. The proposed change was not unanimously agreed upon as it was stated that this was a significant scope change to the document. Additionally, there was a concern expressed that if this change was inserted into the document, then equipment that was previously approved under DO-227A would be subject to retest.

This led to a detailed discussion regarding the acceptability of DO-227A as a means of compliance. The FAA stated that it is not their intention to withdraw or supersede DO-227A approvals. In fact, DO-227A is deemed to be an acceptable baseline demonstrating compliance with the AAIB recommendations and Special Condition 1 and Special Condition 2. Equipment previously approved to DO-227A will continue to be viewed as acceptable. The exception would be if there were an incident that proved DO-227A insufficient.

Executive Summary

The committee discussed updating the Executive Summary to address the applicability of DO-227A after release of DO-227B. The following paragraphs were presented in response to one of the open Action Items to be considered for inclusion in the existing Executive Summary section:

DO-227A was created to address the findings and safety recommendations of AAIB Aircraft Accident Report 2/2015 investigating the fire of a non-rechargeable lithium battery onboard an aircraft on the ground at Heathrow Airport in London. The document also incorporated supplemental testing specified within Appendix 1 of TSO-C142a as well as addressing additional industry concerns. It has become the standard for showing compliance with the various Special Conditions requirements for safe installation of non-rechargeable lithium batteries and is the referenced standard for achieving installation approval for products containing these batteries.

DO-227B was created to address minor issues and questions which arose from applicants following DO-227A and to address prior deviation requests to the document. Additionally, minor refinements to existing testing requirements and procedures have incorporated directly resulting from the use of DO-227A. There have been no substantive changes to DO-227B which would render DO-227A invalid. It is the opinion of SC-235 that DO-227A remains the baseline for compliance to all relevant installation requirements for non-rechargeable lithium batteries and all products qualified to DO-227A continue to be compliant. Existing products qualified to DO-227A do not require requalification to DO-227B.

The committee agreed “in principle” to the sentiment, however, feedback from the regulators stated this document is not the correct place to address compliance with installation requirements. This is typically addressed elsewhere in regulatory documentation. Other comments were made to the above proposal such as disagreement with “minor refinements” and “no substantive changes”. The committee chose not to tackle the wording of this section during this Plenary, though it remains an issue to resolve.

Update of the “Test Flow” Figures (Figure 2-26, 2-27 and 2-28)

There was a comment that these figures were not consistent in appearance and potentially confusing. RTCA stated that they do not have a standard / template for these types of figures and that it is up to the committee to determine what graphical information (and format) should be included in their documents. A separate working group meeting was held to discuss this comment with suggested changes to these figures presented during this Plenary. It was agreed that format was an improvement, though not exactly what was expected. Regardless, the committee reached consensus on the recommended changes.



Section 4 (Membership) Update

The committee discussed who should be included in the list of members contributing to DO-227B. A list of Plenary Attendees was presented and filtered for “Percent of Plenary Meetings Attended”. Reviewing this list, the committee agreed to a minimum 30% attendance for inclusion in the document.

Final Review And Comment (FRAC), Second Round

At the conclusion of the Plenary, the committee was asked to consider a second FRAC process for DO-227B. Given the large quantity of changes to the document, it was agreed that the document should go through FRAC a second time.

Based on this, the committee reviewed the necessary schedule of events. Before the next Plenary meeting, it was agreed that a new “clean” version of DO-227B be uploaded to AerOpus for review by the committee at least one week prior to the next Plenary.

The following proposed milestones were presented and discussed:

- Post the cleaned-up version of DO-227B on AerOpus: June 21
- Plenary #29 to open FRAC #2: June 29
- FRAC #2 Starts: July 3
- FRAC comments due: Aug 4
- FRAC Resolution and Document to RTCA: Nov 2023
- RTCA PMC Approval: Dec 2023

Action Item Summary

There was one new action generated during Plenary #28:

- (1) Propose revisions to the applicable Battery Short Circuit with Protections Disabled requirements and procedures to address Fuses and Fusible Links.
 - a. Assigned to: Norm Pereira and Antonio Chiesa

Working Group Meetings

It was agreed that Working Group meetings should be held on 6/5, 6/12, and 6/19 leading up to the next Plenary.

Next Plenary

Plenary #29 has been scheduled as a Virtual Meeting on 28 June 2023.

NOTE: Due to scheduling conflict, this virtual Plenary was moved to Thursday, 29 June.

-S-
Jeff Densmore
Secretary

CERTIFIED as a true and accurate summary of the meeting.

-S-
John Trela
Chairman