Date: 15 June 2024
RTCA Paper No. 113-24/SC235- 073

Summary of the 34th Plenary
Special Committee 235 - Non-Rechargeable Lithium Batteries

Meeting Summary:

The 34th Plenary Meeting of Special Committee 235 (SC-235) was held on May 14-16, 2024. The meeting was conducted at the RTCA Facility in Washington, DC with in-person and virtual 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
Jim Dellinger **	National Institute for Aviation Research
Tom Jaeger **	American Airlines
Pankaj Kalore **	Collins
Nazih Khaouly **	Federal Aviation Administration
Tom Maloney **	Federal Aviation Administration
Sam McCrory **	National Institute for Aviation Research
Frederic Menard	Safran Electronics and Defense Beacons
Kathryn Mulhollen **	U.S. Air Force
Tom Pack	ACR Electronics
Paul Pfeifer	Textron
Alan Rudnai **	Leonardo DRS
Fernando Menedez Rodriguez **	EASA
Adrian Sfetcu **	Bell Helicopter
Greg Smith	U.S. Air Force
Nisrine Zahir **	Exail Aerospace
Jeremy Zee	The Boeing Company

** Attended Virtually

Opening Plenary

- The 34th Plenary meeting of SC-235 was convened on May 14, 2024 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.
- 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 #33 was reviewed and approved with two minor edits: correction of a typo from "hep" to "help" and updating the FRAC Comment Summary table to correctly reflect the items reviewed and resolved during the meeting. The revised meeting summary has been posted on AerOpus.

- All documents and presentation material reviewed during Plenary #34 have been uploaded and are available in the RTCA AerOpus documents folder for this meeting.

Plenary #33 Action Item Review

There were three open Action Items following Plenary #33

1) Consult with Cell and Battery OEM's regarding transient OCV variation (timing and characteristics) as a result of the vibration environment. These inputs will help shape the monitoring requirements.
    a. Assigned to: ~~Jim Russell~~ John Trela
    b. Status: **OPEN**. With Jim's retirement, this action was reassigned to John Trela
2) Delegate resolution of the requirements rationale changes proposed by Antonio Chiesa
    a. Assigned to: ~~Jim Russell~~ Jeremy Zee
    b. Status: **OPEN**. With Jim's retirement, this action was reassigned to Jeremy Zee
3) Create a DO-227A vs DO-227B comparison Table for Insertion into the document
    a. Assigned to; Jeff Densmore and John Trela
    b. Status: **OPEN**. This action cannot be completed until all of the FRAC comments have been resolved.

DO-227B Final Review and Comment

Plenary #34 was the second plenary of SC-235 following the second Final Review and Comment (FRAC) process for DO-227B. Entering Plenary #34, the status of all comments was as follows. Note that during working group meetings, some comment types were re-classified.

Comment Type	Total	Resolved	Percentage	Unresolved	Percentage
Non-Concur	1	1	100.0%	0	0.0%
High	30	23	76.7%	7	23.3%
Medium	124	74	59.7%	50	40.3%
Low	98	58	59.2%	40	40.8%
Editorial	98	85	86.7%	13	13.3%
	351	241	68.7%	110	31.3%

Comment Discussion and Resolution

<u>High, Medium, Low, and Editorial Comments</u>

The following table summarizes the comments reviewed and resolved during the Plenary meeting.

Id	Category	Section	Subject	Comment	Disposition	Resolution
68067	High	2.4.3.3.2	Harmonization	"This test may use the same End Item or may use different End Items." -> To be clarified	Accepted	5/15/24: added "... Per Figure 2-28."
68158	High	2.4.3.3.2	confusing analysis	Unclear what the difference is between the first analysis (line 2067) the second analysis (line 2069) is.	Accepted	5/15/24: updated to remove "the second analysis".
68163	High	2.4.3.3.2	unclear reportable	Is Reportable Item k. for the End Item or the Battery?	Accepted	5/15/24: removed (k) as it's covered as pass/fail criteria is covered in Table 2-6.
68165	High	2.4.3.3.2	vague requirement	If more than one cell enters thermal runaway we require the tester to "provide an analysis of the battery design and the events that took place". Vague requirement. What should this analysis include? What data are we wanting to be provided? Is it considered a fail if propagation occurs?	Accepted	5/15/24: added details on needing to perform analysis and compare to trigger cell selection.
68166	High	2.4.3.3.2	un-needed requirement	Why require mass measurements from a cell that we placed into thermal runaway? What is the data to be used for. Is there a pass/fail if the mass isn't reduced by XX%?	Accepted	5/15/24: deleted requiring mass measurement.
68065	High	2.4.4	Harmonization	Discrepancies between requirements and table in terms of quantities	Accepted	5/16/24: need to update figure.
68066	High	2.4.4	Harmonization	Discrepancies on notes 3, 4, 5, 6 with the notes in the Table	Superseded	5/16/24: table 2-5 note numbering was already updated.
68361	Medium	1.6	Test Procedures	The document seems to have a terminology inconsistency problem with the terms "Environmental" and "Functional". These two terms are used to describe the same thing.	Accepted	Assure consistent usage of environmental vs functional tests. Perhaps Environmental is the better way to describe these tests, imported from DO-160. 5/16/24: replaced all "env test" and "env req" to "functional".
68109	Medium	3.3	SOC measurement and indication	There are some small cell/batteries where providing this measure complexifies the item up to an unfeasible level.	Rejected	5/15/24: section 3.3 aligns with SC 7 and 8. This is a concern on the installation and for batteries supporting CSFL (dependent on criticality and safety assessment).
68360	Medium		Test Procedures	The statement in line 162 (one way to validate compliance) and the statement in line 74 that other methods may be acceptable seems to be in conflict with section 2.2, which states that the requirements shall be verified by the tests in section 2.4.	Accepted	5/16/24: removed "that provide one way" in Section 2. Removed "alternate procedure in section 1.6. Within this document, the only way to meet Section 2.2 req is to run tests in Section 2.4.
68358	Medium		Test Setup Instruction	Organization of the Test Setup instructions are not written with consistent language throughout the test sections. Example 2.4.1.1.3 vs 2.4.2.1.3. Instrumentation instructions are missing in some sections. Example 2.4.1.1.2 (no accelerometers are required by the Test Setup). Is not clear if the instrumentation instructions only cover measurements during test or also before and after test. Some Test Procedures include instructions to perform measurements before and after others do not. Example 2.4.1.1.3 vs 2.4.2.1.3.	Unresolved	5/16/24: overall scanning of the doc is needed to check for consistency.
68354	Medium		Pre-Test Cell Capacity Test	Should the 4 standard headings for each test section — Test Setup, Test Procedure, Evaluation Criteria and Reportable Items — be present in all tests with N/A when not applicable? If that is the case: In section 2.4.1.1.1 Test Setup is missing; In section 2.4.1.1.6 is written Reportables instead of Reportable Items; In section 2.4.1.1.7 Test Setup is missing; In section 2.4.2.1.1 Test Setup is missing; In section 2.4.2.1.7 is written Reportables instead of Reportable Items; In section 2.4.2.2.7 Test Setup is missing; In section 2.4.3.3.2 there is the additional heading Test Conditions not found anywhere else. If such a heading is required here, why is it not required for other tests where the test conditions are different from the Standard Test	Unresolved	5/16/24: overall scanning of the doc is needed to check for consistency.

Id	Category	Section	Subject	Comment	Disposition	Resolution
				Conditions for temperature, pressure and humidity? In section 2.4.3.3.3 Test Setup is missing		
68355	Medium		Sample x Test Article	Section 2.3.6 under the heading Requirement states "Test articles employed in the following test shall be conformed and ...". However, the word "sample" is used throughout the document in place of test article. I don't think they are interchangeable. Sample is a more generic expression that means one representative of a production batch or design P/N. Test article is a more precise and specific word that means the part or component being tested, which as we know may include changes that make it different from the representative of a production batch or design P/N.	Unresolved	5/16/24: need to review offline.
68101	Medium	2.2.2.2.6	Maximum allowable test temperature	The value of 204 ºC seems arbitrary. The maximum target should depend on the application and mounting location of the Battery or end Item	Partially Accepted	5/1/2024: Discussion - suggestion add a comment for mitigating at airplane level. The 204°C requirement was established due to auto ignition temperature from DO-160. 5/16/24: added allowance to mitigate at end item level in requirement.
68344	Medium	2.4.1.2.4	Cell Drop Test	(1) I have no experience in conducting this test but I suspect that in order to have consistent and repeatable test conditions some test set up is needed to control release orientation and height. Items b and c of the Test Procedure are Test Setup items not Test Procedure items. (2) Item e of the Reportable Items calls for documentation of post-test warming. How is this accomplished without instrumenting the test article for temperature measurement during the 8 h observation period?	Accepted	5/8/24: comment (2) is superseded as test setup (b) was added for measuring post-test warming. Comment (1) will be addressed later. 5/16/24: addressed comment (1) by moving (b) and (c) from Test Procedure to Test Setup.
68099	Medium	2.4.1.2.5	Test temperature	91 ºC has been selected as a value due to it being the value in the 1995 DO 227 release. Many chemistries might have appear since then, so a revision of this figure is required.	Unresolved	5/8/24: 91C is carried over from DO-227. Threshold is not related to certain cell chemistry. No background info on background on 91C. 5/16/24: Paul/John conducted research and cannot find background on where 91C comes from.
68365	Medium	2.4.1.2.6	discussion	rate not exceeding 0.33°C / minute as shown in	Superseded	5/16/24: matches DO-227A language.
68135	Medium	2.4.2	Test order	Requirement to follow the specific test order in figure 2-27 seems un-needed and puts additional burden on the tester. Allowing alternate order will provide greater ability to schedule available lab resources.	Rejected	5/16/24: discussed previously and test order per fig 2-27.
68136	Medium	2.4.2	sample size	Line 1351 states 36 batteries (which I believe is correct), but figure 2-27 states 35 batteries.	Accepted	5/16/24: need to fix the figure.
68366	Medium	2.4.2.1.1	missing info?	This test is performed using three batteries. Again this is applicable to all batteries and maybe batteries within End Items as well.	Superseded	5/16/24: "undischarged" is moved up to Section 2.4.2.
68356	Medium	2.4.2.2.6	Battery External Short Circuit with Protection Disabled	In line 1854 instrumentation of the battery is required. Nothing is said about instrumenting the cell inside the battery. However, Reportable Item b includes cell temperature during test period. In line 1854 is required instrumentation to measure battery voltage. However, I don't see the need for that in the Test Procedure or Reportable Items. In line 1861 the Figure called up is wrong.	Accepted	5/16/24: removed cell temp in reportable. Added battery voltage and current in reportable. Need to make sure wording is consistent.
68368	Medium	2.4.3.1	clarification	The end items SHALL be tested in a state that does not draw current, such as in the “off”, disabled, non-operational state, or with the battery electrically disconnected.	Acknowledged	5/16/24: Comment - correct, the battery is to be disconnected from the End Item circuitry.
68085	Medium	2.4.3.3.2	Non-Representative	There is currently an allowance for reuse of end items that have already had cells go into thermal runaway inside. Given the extreme temperatures that can be generated by a thermal runaway reaction, the structure of the end	Rejected	5/15/24: reusing an end item is conservative and reusing is optional.

Id	Category	Section	Subject	Comment	Disposition	Resolution
				item will likely be weakened even if not visibly so. Simply repainting the end item does not ameliorate this. A weakened structure is not representative of the installation.		
68074	Medium	2.4.3.3.2	Harmonization	reference to "Figure 2-29." does not exist.	Accepted	5/15/24: updated to Figure 2-28.
68159	Medium	2.4.3.3.2	confusing analysis	Line 2072 requires an explanation as to why a specific location provided the highest external temp. Does this need to be completed if the location was determined solely by test?	Rejected	5/15/24: the analysis is supporting by the engineering test.
68291	Medium	2.4.3.3.2	conformity	is conformity appropriate terminology for MOPS? Do the other tests need to be conformed?	Accepted	5/15/24: removed test setup related to conformity as no other test setup in other tests.
68086	Medium	2.4.3.3.2	Practicality Questionable	Some chamber designs allow for fairly uniform heating around the end item but not uniform heating at the extremities of the chamber. I suggest that measuring closer to the end item is a more reasonable requirement.	Accepted	5/15/24: updated to allow TC between end item and vessel top/bottom.
68087	Medium	2.4.3.3.2	Unnecessary	The requirement for minimum free air volume is unnecessary. If a fire burns itself out, that is captured by the carbon monoxide measurement during gas sampling. I don't see this requirement as value-added.	Rejected	5/15/24: the min free air volume is needed to support combustion (if there is one).
68357	Medium	2.4.3.3.2	End Item Thermal Runaway Containment Test	Some explanation needs to be included (as a Note) about how to determine the number of cells that will go into TR in the formula of the test vessel Free Air Volume. That determination must be done before the performance of the test, which is technically impossible.	Accepted	5/15/24: added clarification to Note.
68294	Medium	2.4.3.3.2	Start of TR test	The current draft of is confusing as it implies TR has to be reached prior to test article dropping less than 10C from pre-heating. Instead the intent is to "start" the test prior to dropping more than 10C.	Superseded	5/15/24: updated to ensure the end item not dropping below 50C.
68295	Medium	2.4.3.3.2	Temperature drop from pre-heat	The current draft states that the End Item housing cannot drop for more than 10C from pre-heat. Instead, it should be the trigger cell temperature no dropping for more than C prior to start of test.	Superseded	5/15/24: updated to ensure the end item not dropping below 50C.
68296	Medium	2.4.3.3.2	Test cannot be driven to TR	Allowance should be added to use data from tests that didn't reached TR for analysis for cells/designs that cannot be driven to TR.	Rejected	5/15/24: outside the scope of this MOPS.
68161	Medium	2.4.3.3.2	Difficult requirement	1% for temperature stabilization requirement seems very tight. Due to thermal transfer from the gas to the chamber could the cooling rate exceed 1% in 10 seconds making it impossible to meet this requirement?	Rejected	5/15/24: there is a "or" approach for 3 minutes for temp stabilization.
68298	Medium	2.4.3.3.2	Ideal Gas Law	define all variables in ideal gas law equation, specifically R ideal gas constant	Accepted	5/15/24: added definition for ideal gas law variables.
68088	Medium	2.4.3.3.2	Bad Presentation of Data	Step h of the Test Procedure section requires that the gas released be measured in liters rather than moles. It makes far more sense to present the gases in moles rather than liters as moles are universal but liters rely upon standardized conditions which may not always be present.	Rejected	5/15/24: moles is already part of the calculation. Moles can be easily be back calculated from liters. Added reportable (h) to report volume in liters.
68299	Medium	2.4.3.3.2	Off-site gas analysis	There are multiple ways to perform gas analysis. Current draft implies off-site gas analysis is "required".	Accepted	5/15/24: removed wording for "off-site".
68089	Medium	2.4.3.3.2	Impractical	Step j of the test procedure section refers to collecting sample gasses for off-site analysis. This analysis is not viable given the decay time of some of the gasses such as HF.	Accepted	5/15/24: removed wording for "off-site".
68090	Medium	2.4.3.3.2	Clarity of Data	The standard requires that the gas composition must be reported as fractional composition as part of a sealed container volume. This is not a universalized measurement and should not be used when a universalized unit like moles is available.	Rejected	5/15/24: moles is already part of the calculation. Moles can be easily be back calculated from liters. Added reportable (h) to report volume in liters.
68091	Medium	2.4.3.3.2	Unreasonable Requirement in Some Cases	The requirement to monitor the temperature for a minimum of 12 hours after thermal runaway has occurred does not make sense for single-cell battery installations as delayed propagation is not possible.	Accepted	5/15/24: added "single cell battery does not require observation period."

Id	Category	Section	Subject	Comment	Disposition	Resolution
68092	Medium	2.4.3.3.2	Need to Rework	Step m is far more complicated than it may at first read. If a multi-cellular battery installation is being tested and a delayed secondary or tertiary thermal runaway event occurs an hour after the initial event, gas sampling will have already been conducted, and you will have a very difficult time calculating the total amount of gas expelled because your adjusted chamber volume for gas sampling will have changed to an unknown volume due to the initial sample extraction.	Rejected	5/15/24: multiplying the volume would be a worse case/conservative estimate. Also, there is no way to measure temp and pressure if the end item is not within the vessel for the 12-hour observation period.
68359	Medium	2.4.3.3.2	End Item Thermal Runaway Containment Test	Why is the word "Rationale" capitalized and underlined midsentence?	Accepted	5/15/24: removed underline. Error due to RTCA universal formatting.
68094	Medium	2.4.3.3.2	Impractical	Given that the test operator is only guessing at where the gasses might escape the end item, temperature of gasses emitted from the end item should not be a required reportable item.	Superseded	5/15/24: gas release location can be determined by eng test. Reportable (g) is reworded to be more open-ended.
68095	Medium	2.4.3.3.2	Detection Problem	The location where the majority of the gasses escaped from the end item is an almost impossible requirement. Sometimes the gasses are invisible visually. Also, how are we to know if a gas plume contains more gas than another gas plume escaping from another area of the end item when we can see all of the gasses escaping.	Superseded	5/15/24: gas release location can be determined by eng test. Reportable (g) is reworded to be more open-ended.
68307	Medium	2.4.3.3.2	Cell mass post TR test	It is often difficult to remove the trigger cell from the end item/battery post TR test. This measurement is also not critical for end item TR test. This measurement is much easier to perform as a cell-level test. This also requires a mass measurement prior to battery pack manufacturing.	Superseded	5/15/24: deleted requiring mass measurement.
68321	Medium	2.4.3.3.2	Criteria	Objective evidence of TR is not sufficiently clear	Acknowledged	5/15/24: discussed and determined existing list is consistent with DO-311A.
68314	Medium	2.4.4	Incorrect Battery Number	Flow chart says 35 batteries and 32 batteries remain but it should be 36 and 33. Throughout the text of the document it is referenced as 36 batteries.	Accepted	5/16/24: need to update figure.
68227	Medium	2.4.4	Figure 2-27: Battery Test Sequence	There are two issues with this figure: (1) The number of battery test articles don't add up. There are 37 test articles listed in the "non environmental" block - four of which can be "reused". This leaves 33 (not 32 as stated). 39 is correct. (2) Sequence is confusing. Why is discharge current after capacity check, but appears otherwise in the document. If because it can occur in any order, the same should be true for the post capacity test?	Accepted	5/16/24: need to update figure.
68167	Medium	2.4.4	missing notes	Figure only includes one note reference (note 4) but we have 4 notes below figure. Additionally the note numbering has been removed.	Unresolved	5/16/24: need to add numbering for notes back.
68353	Medium	Figure 2-28	End Item Test Sequence	It seems slightly better when changed as suggested in the next column.	Accepted	5/16/24: updated note.
68231	Low	1.4	numbering	The numbering / multilevel organization of this section was removed in FRAC version of document.	Accepted	5/14/24: already corrected.
68169	Low	3	Un-needed section	Section is only "motherhood and apple pie" statements applicable to any aircraft installation. Doesn't seem appropriate for a End Item MOPS	Superseded	5/16/24: removed all "shall" in section 3.
68340	Low		Word shall	(3) In line 2363 in section 3.3, the paragraph as written establishes a requirement for all aircraft that uses non-rechargeable lithium batteries. That is outside the scope of this document and this section.	Accepted	5/16/24: section 3 is guidance, removed "shall".
68110	Low	2.1.15	Unsafe system operating conditions	There are some small cell/batteries where providing a signal or similar complexifies the item up to an unfeasible level.	Superseded	5/16/24: Sectoin 2.1.15 is now guidance and changed from "shall" to "should".
68191	Low	2.2.2	Missing Reference to Figure 2-27	This paragraph does not reference Figure 2-27 for the sequence of tests similar to paragraph 2.2.1 which points to Figure 2-26.	Superseded	5/14/24: references are added to the test procedure 2.4 section.

Id	Category	Section	Subject	Comment	Disposition	Resolution
68259	Low	2.4.1.2.3	data rate	move requirement from reportable items to test set-up to avoid confusion	Accepted	5/6/2024: need to scan the whole document for data sample rate in test setup (and not in test procedure/reportable). 5/14/24: added Section 2.3.7. still need to clean up test setup.
68200	Low	2.4.1.2.3	Cell External Short Circuit with External Protection Disabled Test	Data sample rates should be allowed to be reduced during the observation periods.	Partially Accepted	5/8/24: need to review all the test that has observation period. Potential add a general statement for reducing sampling rate during the observation period in Section 2.3.2. 5/8/24: discussion on pass/fail criteria applies to the test AND the observation period. potential to add note in pass/fail criteria Tables. 5/14/24: addressed in new section 2.3.7. Additional wording on the observation period in the req section.
68202	Low	2.4.1.2.6	Cell Pressure Control (Venting) Test	the parenthetical statement: (I.e., sudden cooling of the cell due to Joule-Thompson expansion of the escaping internal gases) does not add value or classification to what a vented cell	Accepted	5/14/24: removed
68206	Low	2.4.2.1.2	Battery Vibration Test	Test Setup step h prescribes a sample rate. Sample rate is not specified or required for the Cell Vibe test. Why require it here. It should be left to the applicant	Accepted	5/14/24: removed (h) returned to DO-227A language.
68142	Low	2.4.2.1.4	procedure	Test procedure for the Cell Temp cycling test required a ramp time no greater than 28 min to align with DO-160G cat B (ref line 1088 in section 2.4.1.1.4). Should we have the same requirement for the battery level test?	Superseded	5/16/24: Comment: The temp rate was relaxed for battery testing due to the variable degree of thermal coupling from the outside to the cells. Well-insulated cells would require excessive external temperatures to drive the cell heating rate to match.
68143	Low	2.4.2.1.6	general reportable	General comment applies throughout the document. I notice we require Commanded and Actual chamber pressure/temperature/humidity etc as a recordable. Why do we need the Commanded data? Commanded is irrelevant as long as the Actual values are what the test requires	Accepted	5/16/24: Comment - the commanded and actual rates were requested in order to show the decompression and compression rates were at the desired rate or limited by chamber performance. 5/16/24: went through the doc and removed "commanded" measurements in selected sections.
68213	Low	2.4.2.1.8	Battery Discharge Current Test	Reportable item b should allow for a lower sample rate during the observation period as a high data resolution is not required during this portion of the test.	Partially Accepted	5/14/24: addressed in new section 2.3.7.
68367	Low	2.4.2.2.6	clarification	Allow temperature stabilization at 55°C, to take place per section 2.3.4.	Superseded	5/16/24: only doing 55C.
68150	Low	2.4.2.2.6	Reportable requirement	Reportable item b, is required "until the current condition in procedural step d. has been met". Step d. is an observation period while step c. has the current requirement. Should this reportable point to procedural step c.?	Superseded	5/16/24: removed reference to procedure in reportable.
68154	Low	2.4.3.3.1	test setup	Test Setup step a. only includes temp sensor instrumentation. Test procedure step c. requires current measurement and Reportable Items step c. requires voltage measurements.	Accepted	5/16/24: revised test setup to include battery voltage and current measurement.
68289	Low	2.4.3.3.2	Pre-heating temperature	DO-227B draft has pre-heating is at 55C. Should the pre-heating threshold be 55C or the highest operation temperature?	Accepted	5/15/24: the standard now only test at 55C.
68288	Low	2.4.3.3.2	Pre-heating hold time	DO-311A has pre-heat hold time of 1 hour. DO-227B draft does not have hold time for pre-heating at 55C.	Accepted	5/15/24: moved test condition to test procedure. Added reference to Section 2.3.4 for thermal stabilization. Deleted test condition.
68220	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Test Conditions state: The test articles shall be pre-heated to 55°C and the test shall be conducted before the test article temperature has changed by more than 10°C. The battery temp is more critical than test article. Change to Battery	Accepted	5/15/24: already resolved by test procedure (a) and (c).
68290	Low	2.4.3.3.2	Trigger cell determination/analysis	A large number of engineering tests are potentially needed if tests are required to determine trigger cell location. How does heating up the entire battery help determine the trigger cell?	Rejected	5/15/24: updated to "heating all cells within the battery".

Id	Category	Section	Subject	Comment	Disposition	Resolution
68221	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Test setup step a says "a second analysis". This implies two analyses are required. Suggest changing to read "an alternate analysis"	Superseded	5/15/24: updated wording to remove "second" analysis.
68292	Low	2.4.3.3.2	Conformity	The test article should be conformed (not only the End Item).	Accepted	5/15/24: removed test setup related to conformity as no other test setup in other tests.
68160	Low	2.4.3.3.2	redundant requirement	Step h. seems to be a duplicate of step d.	Accepted	5/15/24: deleted step (h).
68222	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Test procedure step d states Induce a thermal runaway in the worst-case cell location before the external temperature of the End Item housing varies by more than 10°C . The battery temperature is more critical. Change to battery	Superseded	5/15/24: updated to ensure the end item not dropping below 50C.
68223	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Test procedure steps I and j should be combined into one paragraph. It is confusing having them separated because it talks about sending gas samples off site. This is applicable if step I is used	Accepted	5/15/24: move discussion about T3/P3 to (h).
68300	Low	2.4.3.3.2	Sampling rate for 12-hr monitoring period	The 12-hr monitoring period post-test is not as important. It should allow slower sampling rate than 5/sec to avoid collect excessive data.	Accepted	5/14/24: addressed in new section 2.3.7.
68162	Low	2.4.3.3.2	incomplete eval criteria	If no analysis is performed in step a. of the test setup (line 2067) an allowable alternate is heating the entire battery until multiple cells fail in a TR (line 2075). The eval criteria does not account for multiple cells in TR	Accepted	5/15/24: added statement for full battery TR method that at least one cell entered TR.
68093	Low	2.4.3.3.2	Request for Clarification	Where does the 204C requirement come from?	Acknowledged	5/15/24: from DO-160. Note from prior: the 204C combustion threshold was established by the fire marshal per the 400 deg F combustion threshold of greasy lint, such as may collect on or around End Items.
68224	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Reportable item d requires a separate report substantiating the worst case location. A separate report is not necessary as this should be included in the DO-227 test report.	Partially Accepted	5/15/24: "provide a report" was changed to "a report".
68225	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Gas volume is calculated, not measured. Change reportable item g to reflect this.	Superseded	5/15/24: "measure and reported" is deleted.
68306	Low	2.4.3.3.2	simplification	is item k needed as a reportable since this would be considered a test failure per Table 2-6 and video / pictures are also reportable?	Accepted	5/15/24: removed (k) as it's covered as pass/fail criteria is covered in Table 2-6.
68164	Low	2.4.3.3.2	un-needed reportable	Heating rate for the cell is the critical data item. Voltage and current used to achieve that heating rate is irrelevant.	Accepted	5/15/24: reject as heater voltage/current is useful info esp when the heater is shutoff.
68226	Low	2.4.3.3.2	End Item Thermal Runaway Containment Test	Reportable item q requires the mass change be reported of the trigger cell. Not sure of the mechanics or value of this. The trigger cell mass will not be representative of a typical cell as it will be highly instrumented (heaters applied, control wires added, sense wires added, etc).	Superseded	5/15/24: deleted requiring mass measurement.
68156	Low	2.4.3.3.3	reportable items	Reportable Item b. only asks for load profile data (voltage and current) but the test also has a required test temperature. Should temp data also be included	Rejected	5/16/24: rejected. Test is conducted in room temp and not important.
68102	Low	2.4.4	Number of batteries required for the test sequence	The test sequence shows 39 batteries at the "start" box, from which there are only 6 units that are used for destructive testing: 3 units for pre-capacity test and 3 units for post-capacity test. However, once the first sequence of environmental tests is performed, the diagram shows an arrow with "32 batteries remaining". 39 units at the start minus 6 units is 33 units. Where is the missing battery used? It is not described in the diagram.	Accepted	5/16/24: need to update figure.
68341	Low	Appendix D	Glossary of Terms	(1) The test procedure in line 306 does not belong in the Glossary. (2) The test procedure in line 421 does not belong in the Glossary.	Unresolved	5/16/24: need to look at putting the constant discharge method into test procedure sections.
68293	Editorial	2.4.3.3.2	consistency	add i.e. in front of data recording	Accepted	5/15/24: deleted the step as we don’t have similar step in other tests.

Id	Category	Section	Subject	Comment	Disposition	Resolution
68305	Editorial	2.4.3.3.2	simplification	consider deleting (i.e., from the release…..) since it doesn't really add any value to this step and cross references another item	Accepted	5/15/24: deleted "i.e. " and rewrote (g) and (h). Added TC installation in test setup for venting location.
68369	Editorial	Appendix B	Typo	Two alternative methods are described in this appendix. To employ either method, replaced the Test Setup and Test Procedure sections of 2.4.3.2.2 with the sections below.	Accepted	5/16/24: fixed

During Plenary #34, the committee successfully reviewed and resolved 87 comments. The resulting status of all comments is shown below.

Comment Type	Total	Resolved	Percentage	Unresolved	Percentage
Non-Concur	1	1	100.0%	0	0.0%
High	30	30	100.0%	0	0.0%
Medium	124	108	87.1%	16	12.9%
Low	98	87	88.8%	11	11.2%
Editorial	98	89	90.8%	9	9.2%
	351	315	89.7%	36	10.3%

Requirements Rationale

During the working group meetings, Antonio Chiesa from Transport Canada identified inconsistencies with the requirements rationale throughout the document. As a result, he submitted a proposal of suggested changes to improve the document.

These items continue to be reviewed during working group meetings. As of the close of this Plenary, 33 of the 56 (59%) changes have been reviewed and resolved. It was agreed that these rationale changes continue to be worked and resolved during future working group meetings.

DO-227B Final Review and Comment (FRAC) Schedule Update

John Trela reviewed the schedule progress towards closure of the FRAC process as summarized below. Because the committee was unable to resolve all comments during Plenary #34, it was agreed to continue to use the Working Group meetings to complete this task and schedule an additional Plenary in June with the objective of closing the FRAC.

- Second FRAC Start: 14 Nov 23
- FRAC Comments Due: 12 Jan 24
- Plenary #33 (WDC): 3-7 Mar 24
- Plenary #34 (WDC): 14-16 May 24
- Plenary #35 (Virtual): 26 Jun 24
- FRAC Closure – planned: 26 Jun 24
- DO-227B Transmitted to RTCA: Early July 2024
- RTCA PMC Approval: Sep 2024

Action Item Summary
Three actions were generated during Plenary #34:

1) Review the Test Setup and Test Procedure sections for the Cell, Battery, and End Item and remove "Shall" statements.
    a. Assigned to: John Trela
    b. Status: OPEN
2) Review items identified as "Reportable" for consistency with the test setup and procedures.
    a. Assigned to John Trela
    b. Status: OPEN
3) Update Shock Profile Figures (incorrect) and the Vibration / Shock Setup Figures (make generic for both tests).
    a. Assigned to: John Trela
    b. Status: OPEN

Working Group Meetings
Working Group meetings will continue Mondays and Wednesdays from 10:00am to 11:30am (Eastern).

Next Plenary
Plenary #35 was scheduled for 26 June 2024 as a Virtual Meeting.

-S-
Jeff Densmore
Secretary

CERTIFIED as a true and accurate summary of the meeting.

-S-
John Trela
Chairman