EASA	COMMENT RESPONSE DOCUMENT
	Proposed Special Condition F-xx on Non-rechargeable Lithium Battery Installations (Applicable to Large Aeroplane)

Commenter 1 : Boeing Commercial Airplanes

Comment #1 : Special Condition

Boeing concurs with the proposed SC based on our understanding of "foreseeable operating conditions" to mean "airplane operating and environmental conditions over which proper functioning of the equipment, systems, and installation is required to be considered includes the full normal operating envelope of the airplane as defined by the Airplane Flight Manual together with any modification to that envelope associated with abnormal or emergency procedures." [but] recommend that EASA ensure consistency with existing definitions / guidelines per referenced documentation.

Comment :

The current wording :

1. Be designed so that safe cell temperatures and pressures are maintained under all foreseeable operating conditions to preclude fire and explosion.

is proposed to be amended to be in line with :

- AC/AMJ No. 25.1309, "System Design and Analysis," dated: 10 June 2002, page 12, section 9.a., or
- AC 25-11A, "Electronic Flight

EASA response: Disagreement.
"All foreseeable operating conditions" stated in this SC is addressed not only at A/C level but also at cell level.

Comment #2 : Special Condition

Boeing would like it made clear that the intent of SC #2 is addressing the non-rechargeable lithium battery pack and system. Design mitigation and/or analysis at the airplane level may be applied to show the design is compliant.

Comment :

The current wording :

2. Be designed to preclude the occurrence of self-sustaining, uncontrolled increases in temperature or pressure.

is proposed to be amended as followed :

2. ~~Be designed to~~ Preclude the occurrence of, or mitigate the effects of, self-sustaining, uncontrolled increases in temperature or pressure.

EASA response: Disagreement.
This SC is addressed to the battery and it is intended to prevent uncontrollable failures, not relying only on mitigations of a battery failure at aircraft level.

Comment #3 : Special Condition

Boeing recommends adding the phrase "which is not shown to be extremely remote" to be consistent with the FAA's "Rechargeable Lithium Battery Issue Paper, Special Condition #3" and accepted means of compliance with §25.1309.

Comment :

The current wording :

3. Not emit explosive or toxic gases in normal operation, or as a result of its failure, that may accumulate in hazardous quantities within the airplane.

is proposed to be amended as followed :

3. Not emit explosive or toxic gases in normal operation, or as a result of any failure which is not shown to be extremely remote, that may accumulate in hazardous quantities within the airplane.

EASA response: Disagreement.
To ensure that all potential failures that could be introduced by the battery are taken into account, EASA will keep the text of this SC as is.

Comment #4 : Special Condition

Boeing consider 25.863(c) not applicable because there are no foreseeable conditions under which the flight crew (pilots) would be required to take action as the result of fluid leakage from a battery.
We consider 25.863(d) not applicable because non-rechargeable lithium batteries do not constitute a flowing fluid system, and can provide, at the most, only a few drops of potentially combustible fluids. .

Comment :

The current wording proposed:

4. Must meet the requirements of CS 25.863(a) through (d).

Boeing recommends that Special Condition 4 be limited to only 25.863(a) and (b).

EASA response: Disagreement.
CS25.863 historically has been applied to flammable fluids related to propulsion and hydraulic systems. No acceptable means of compliance has been raised by EASA to explain that this section is applicable to Non –rechargeable Lithium batteries which contain flammable fluid. So it has been determined to keep the SC as is.

Comment #5 : Special Condition

Boeing recommends that this Special Condition be reworded to establish clear criteria relative to the airplane-level impact of this condition.

Comment :

The current wording :
5. Not damage surrounding structure or adjacent systems, equipment or electrical wiring of the airplane from corrosive fluids or gases that may escape.

is proposed to be amended as followed :

5. Not allow escape of corrosive fluids or gases that may damage surrounding structure or any adjacent systems, equipment, or electrical wiring of the aircraft in such a way as to cause a hazardous or catastrophic failure condition.

EASA response: Partial agreement.
EASA agree in that some details were missing and will include at the end of the current wording "…that may cause a major or more severe failure condition."

Comment #6 : Special Condition

Boeing considers that the intent of this special condition is to show that the battery design can tolerate a failure of a single cell. Design mitigation and/or analysis at the airplane level may be applied to show the design is compliant.

Comment :

The current wording :

6. Have provisions to prevent any hazardous effect on structure or essential systems caused by the maximum amount of heat it can generate due to any failure of it or its individual cells.

is proposed to be amended as followed :

6. Have provisions to prevent any hazardous effect on airplane structure or ~~essential~~ systems caused by the maximum amount of heat ~~it~~ the equipment can generate due to failure of ~~it or its individual cells~~ a single cell within a battery pack, or mitigate the effects at airplane level."

EASA response: Partial agreement.

- ***EASA accepts to include the word "Airplane" for clarification.***
- ***EASA does not concur with the rest of proposals:***
  - ***a) Reference to the complete set of cells (battery) is kept, and not only address to single cell to assure worst case is covered.***
  - ***b) Mitigation at airplane level is related to compliance with SC and could be treated during the specific project, but does not make part of the text of the SC.***

Comment #7 : Special Condition

Boeing find that, in complying with Special Conditions #1, #2, #4 and #5, the hazard intended to be addressed by Special Condition #7 is prevented.

Comment :

The current wording :

7. Be capable of automatically controlling the discharge rate of each cell to prevent overheating, back charging, charge imbalance, and uncontrollable temperature and pressure.

is proposed to be deleted

EASA response: Agreement.
EASA Condition will be amended.

Comment #8 : Special Condition

Boeing find that, in complying with Special Conditions #1, #2, #3, #4, #5, and #6, the hazard intended to be addressed by Special Condition #8 is prevented.
It is important to note that there are failure modes of non-rechargeable batteries that occur in such a short time frame as to make automatic disconnection ineffective and unnecessary. Tests show that once a self-sustained thermal failure has been initiated, disconnection from the discharge circuit will not serve to halt the generation and release of thermal energy.

Comment :

The current wording :

8. Have a means to be automatically disconnected from its discharging circuit in the event of an over-temperature condition, cell failure or battery failure."

is proposed to be deleted

EASA response: Agreement.
EASA Condition will be amended.

Comment #9 : Special Condition

Boeing recommend deleting this special condition #9 since it duplicates the contents of 25.1309(c).

Comment :

The current wording :

9. Have a means to detect its failure and alert the flight crew in case its failure affects safe operation of the aircraft."

is proposed to be deleted

EASA response: Disagreement.
EASA understands the intention of the proposal, but prefers to keep the SC to explicit state the applicability to Non rechargeable Lithium batteries installation.

Comment #10 : Special Condition

Boeing recommend deleting this special condition #10 since it duplicates the contents of 25.1309(c).

Comment :

The current wording :

10. Have a means for the flight crew or maintenance personnel to determine the battery charge state if its function is required for safe operation of the airplane."

is proposed to be deleted

EASA response: Disagreement.
EASA understands the intention of the proposal, but prefers to keep the SC to explicit state the applicability to Non rechargeable Lithium batteries installation.

Comment #11 : Special Condition

Boeing maintain that the Special Conditions need to clearly state that any potential safety concerns can be mitigated at the airplane level.

Comment :

The current wording is proposed to be added

> Note 5: Design mitigation and/or analysis at the airplane level may be applied to show the design is compliant.

EASA response: Disagreement (as general basis).
In some specific cases it could be possible, but this should be treated during the Means of Compliance phase of the project, not as part of the SC.