EASA	COMMENT RESPONSE DOCUMENT
	EASA Proposed CM – HS – 001 Issue: 01 **[Published on 2 June 2010 and officially closed for comments on 24 June 2010]**

Commenter 1 : The Boeing Company

Comment # 1 – General

Boeing considers the CM's proposed new requirements to be above and beyond the existing harmonized FAA/EASA regulations and Technical Standard Orders TSO/ETSO-C135. However, this response is not intended to affect previous Boeing responses or Boeing/EASA agreements concerning individual projects.

EASA response:

Not Accepted. The purpose of a CM is explained on the front page of the document. It is "to clarify the Agency's general course of action on specific certification items." And "Certification Memoranda are provided for information purposes only and must not be misconceived as formally adopted Acceptable Means of Compliance (AMC) and Guidance Material (GM). Certification Memoranda are not intended to introduce new or modify existing certification specifications …". Regulatory requirements and guidance information (CS, ETSO and AMC) take precedence.

Comment # 2a – EASA regulatory requirements

Boeing agrees with the statement in the reference in the proposed CM that ETSO-C135 is a minimum performance standard and that it is an acceptable means of compliance with CS 25.735(a). Boeing compliance data is in alignment with this EASA position, and uses ETSO-C135 approval as the basis for demonstrating compliance with CS 25.735(a).

EASA response:

Noted.

Comment # 2b – EASA regulatory requirements

Boeing does not agree that the KE absorption capability of the brakes on an airplane be reduced operationally if the in-service initial temperature exceeds the qualification test initial temperature. As noted in the advisory and regulatory material, the minimum performance standard is "typical" latent heat energy. Therefore, it is assumed that there may be circumstances where this temperature is exceeded operationally; but other conservative factors from the qualification test (100% worn brake mass, 100% maximum brake energy, and no credit for thrust reverse usage) assure safe operations. Over the past 40 years of Boeing service experience, there are no known accidents attributed to excessive latent brake heat energy prior to a landing or rejected takeoff.

EASA response:

Not Accepted.

EASA is concerned that Boeing seems to have misunderstood the intent of this CM, and has misrepresented the regulatory and guidance material.

The first sentence is not understood. If it means "Boeing does not agree that the KE absorption capability of the brakes on an airplane SHOULD be reduced operationally …" then it is not the intent of this CM to reduce the KE absorption capability of the brakes, but merely to ensure correct management of the temperature of the qualified brake during aircraft operations.

However, if it means "Boeing does not agree that the KE absorption capability of the brakes on an airplane CAN be reduced operationally …" then, although EASA certainly disagrees with this, it is not relevant to the intent of this CM. The brake has demonstrated, during qualification, the capability to absorb a certain Kinetic Energy, at a certain start temperature.

The term "typical latent heat energy" does not appear in the CS, the AMC or the ETSO. "Typical" is used as follows:

*AMC 25.735(f)(2) provides guidance for the Heat Sink Condition at the commencement of the stop. The word "typical" is used here twice - for "(a)(i) The brake temperature following a previous **typical** landing," and*

*"(b) … the **typical** time the aeroplane will be on the ground …".*

The guidance material goes on to allow either a rational analysis or a 10% KE_{RT} allowance to account for the temperature increase before the start of an HERTO test (5% for a MSL test).

The "typical" phase ends the moment the aircraft leaves the stand – from that point on, temperature of the brake at the start of the test is determined by either the rational analysis, or the percentage increase.

The statement "it is assumed that there may be circumstances where this temperature is exceeded operationally" is incompatible with the scenario described by the AMC, and highlights the need for this CM.

Comment # 2c – EASA regulatory requirements

Published EASA guidance extends the minimum standard to the regulatory requirements for applicable airplanes [see AMC 25.735]. In addition to TSO/ETSO-C135, EASA and FAA advisory information state that "typical" latent heat energy (via either a rational analysis or a percentage of KE_{RT}) is appropriate for the acceptable demonstration of brake energy qualification (TSO/ETSO-C135 qualification) and certification (14 CFR and CS 25.735 compliance). Further, AMC 25.735 is consistent with TSO/ETSO-C135 in allowing for the use of 10% KE as an option to the rational analysis.

EASA response:

Noted. A 10% KE_{RT} increase is allowed in lieu of a rational analysis in the case of an HERTO test (5% for a MSL test).

Comment # 2d – EASA regulatory requirements

Boeing also notes that harmonization of TSO qualification requirements and regulatory guidance is appropriate, since TSO/ETSO-C135 is integrated with airplane requirements via Rejected Takeoff (RTO) and Most Severe Landing Stop (MSLS) energy requirements, with the TSO/ETSO-C135 latent heat represented (optionally) as a percentage of those energies.

EASA response:

Comment not understood – are you proposing that further harmonisation is required, or are you agreeing that is currently harmonised?

Comment # 2e – EASA regulatory requirements

If the proposed CM is adopted, Boeing believes that future applicants and specialists will find conflict between the memorandum and AMC 25.735. In particular, Boeing notes the option in AMC 25.735 of the use of 10% KE latent heat, in combination with the use of the word "typical" in lieu of "conservative'"for an optional rational analysis. If EASA intends to require that it not be possible for a takeoff to occur with more latent energy in worn brakes than can be absorbed along with a 100% RTO, then the EASA guidance material and regulations should be revised as follows:

(1) Replace AMC 25.735 guidance for brake latent heat with the proposed CM.

(2) Revise and harmonize TSO/ETSO-C135 to set the minimum standard for latent heat as 10% KE or the result of a rational analysis.

*of **conservative** landing conditions, **whichever is greater**.*

EASA response:

Not Accepted.

Boeing is the only company not to understand that this CM is a clarification of the existing rules, and not an extension of them. Again, the temperature of the heat sink at the start of the test is determined by a sum of the following:

- *the brake temperature following a previous **typical** landing, (AMC 25.735(f)(2)(a)(i)),*
- *the effects of braking during taxi-in, (AMC 25.735(f)(2)(a)(ii)),*
- *the temperature change while parked, (AMC 25.735(f)(2)(a)(ii)),*
- *the effects of braking during taxi-out, (AMC 25.735(f)(2)(a)(iii)),*
- *and the additional temperature change during the takeoff acceleration phase, up to the time of brake application. (AMC 25.735(f)(2)(a)(iv)).*

The AMC goes on to allow either the rational analysis, or the percentage increase, neither of which are preferred by EASA (as stated in the CM "EASA has no preference for either of the two methods …").

The same guidance is also included in the ETSO/TSO C-135 paragraph 3.3.3.3 "These temperatures must be based on a rational analysis of a braking cycle, taking into account a typical brake temperature at which an aeroplane may be dispatched from the ramp, plus a conservative estimate of heat sink temperature change during subsequent taxiing and takeoff acceleration, as appropriate." The typical temperature refers to the temperature at which the brake is dispatched from the ramp – the rational analysis or the percentage increase is added to this.

Comment # 3a – EASA proposed policy

If a Brake Temperature Monitoring System (BTMS) is to be used as a dispatch limiting system, it would be required for dispatch. Some Boeing production models do not incorporate BTMS in the basic airplane configuration. Rather, it is an option – and in the case of the Model 737, BTMS is seldom installed. Currently, the BTMS, if installed, is an advisory system and is not required to be operational for dispatch. However, it is an alternative means of complying with the Maximum Quick Turnaround Weight (MQTW) wait times. For all current Boeing production models, including all those that have been type validated by EASA, the MQTW only considers the immediately previous landing, with no consideration for repeated landings or taxi.

In accordance with the proposed CM, section 3.1.(b), limiting brake energy by brake cooling charts is not manageable by the airlines. The accurate use of brake cooling charts requires the user to have direct knowledge of how the airplane was previously operated and an understanding of the energy dissipation over time. This proposed CM would require an impossible effort on the part of airline operations to

ensure that brake energy qualification limitations are never exceeded. Further, application of the advisory material affects primarily the Airplane Flight Manual (AFM). Therefore, the performance/operations section of the FAA and EASA should be involved in application of this proposed CM guidance information.

EASA response:

Not Accepted.

The CM is not requiring a BTMS, but this is identified as an acceptable means of demonstrating compliance with the brake temperature thresholds, it is not the only one. Other methods are acceptable. The CM states "Acceptable methods of demonstrating this include, ***but are not limited to****, the following…" so applicants are free to propose any other method that would demonstrate how the temperature of the brake at the start of braking will be managed in operation.*

The CM makes no mention of repeated landings, merely that the method used must allow the brake temperature to be managed so that the qualification threshold is respected.

It is not understood why it is argued that airlines can use a MQTW wait time chart, but not a brake cool down chart. Either method could be used, provided it was properly correlated with the brake threshold used during qualification testing, and the assumptions made therein.

Comment # 3b – EASA proposed policy

The combination of high actual brake energy on landing, short turn time, and maximum brake energy (MBE) limited takeoff is very unusual. Higher takeoff weights result in longer ground times to load additional passengers and cargo, and to fuel the airplane – which reduces heatsink latent heat. In addition, runways are longer for MBE-limited V1 decision speeds on takeoff. As such, landing distances tend to be longer, which tends to result in longer landing rollouts and lower brake energy (latent heat).

EASA response:

Noted. EASA agrees that a HE RTO is a rare event.

Comment # 3c – EASA proposed policy

Boeing considers that the installation of brakes that meet the 10% requirement addresses the rejected takeoff (RTO) energy requirements for typical operations of any airplane model fleet. Further, Boeing considers that it is not a practical condition of the vast majority of operations to land and takeoff with energies that exceed 110% of RTO energy. In fact, the only airline takeoffs that are maximum-brake-energy-limited are under hot/high conditions. The study mentioned in Reference (a), above, [Boeing Letter, BDCO-10-01403, "Revised 737NG Carbon Worn Brake Analysis (Closure for Action Item 20 of 25 Feb 2010 Boeing/FAA/EASA PM/PCM Meeting)," dated April 2, 210

(sic)] indicates that 10% is representative of short haul, quick turnaround operations.

EASA response:

Noted, but the continued reference to "typical" denotes a misunderstanding of the nature of the high KE brake testing. Both the RTO and MSL tests are not representative of typical aircraft operation, as indicated by Boeing's own references. Brakes have been qualified to a defined KE_{RT} and KE_{SS}, at a pre-determined start temperature. Steps are taken to ensure that the KE_{RT} and KE_{SS} are not exceeded in service, and similar steps need to be taken to ensure that the start temperature is also not exceeded in service.

The CM is not requesting "energies that exceed 110% of RTO energy", merely that the temperatures established during those qualification tests are respected in service.

Comment # 3d – EASA proposed policy

According to the FAA statistics contained in Reference (b), above, [FAA Training Aid, "Pilot Guide to Takeoff Safety," Section 2] high energy RTO events occur at a rate of 1 out of every 150,000 takeoffs, regardless of brake wear state or latent energy. Further, the likelihood of an RTO decision speed limited by MBE is significantly lower. A still lower probability results from the lack of credit for using thrust reverse in establishing RTO MBE. The likelihood of having multiple fully worn brakes, along with significantly higher than 10% MBE residual energy, reduces the probability of the event that this CM attempts to safeguard against to a value so low as to be negligible. The proposed CM provides no added safety benefit, but would likely result in increased cost and complexity relative to practical airplane operations.

EASA response:

Noted. EASA agree that a HE RTO is a rare event. The CM is not attempting to deal with a perceived unsafe condition, but protecting already qualified equipment from being operated outside it's qualification envelope. If any other piece of equipment was qualified to a certain temperature limit, and the AFM allowed operations outside that temperature limit, then the AFM would need to be changed irrespective of the probability of the extreme temperature being reached.

Comment # 3e – EASA proposed policy

If adopted, the proposed CM would effectively remove the option to use 10% latent heat energy in the TSO/ETSO-C135 qualification. The basis of the 10% latent heat is intended to be representative of "typical" operations for the entire fleet of a particular airplane model on which the approved wheel and brake is installed. Rather than "de-harmonize" regulations and guidance material related to latent brake energy assumptions by releasing the proposed CM, Boeing recommends that the proposed CM be retracted and/or cancelled.

EASA response:

Not Accepted. As already stated the percentage increase is NOT intended to be representative of "typical" operations, and this CM is completely consistent with the harmonised rules and guidance and it states that the percentage increase is still a valid method of determining the temperature of the heat sink at the start of the HE brake testing.

Comment # 4 – Summary

The basis for the EASA policy proposed in this proposed CM may logically be interpreted as being in disagreement or incongruent with existing regulations prescribed in TSO/ETSO-C135 and AMC 25.735, as well as FAA harmonized regulations and guidance material. Additionally, limiting KE absorption capability of the brake in the Airplane Flight Manual (AFM) via BTMS or brake cooling charts is not operationally feasible – given the current AFM format as well as the design and installation options for the BTMS.

Boeing recommends retracting or cancelling the proposed CM. If that is not possible, Boeing recommends coordination of the proposed CM with the performance/operations branch of the FAA and EASA. As discussed, this guidance information affects primarily the AFM.

Again, this response is not intended to supersede specific agreements regarding the Model 747-8, 737NG, or 787 programs currently being type validated by EASA, but is intended to prevent the de-harmonization of existing FAA and EASA requirements.

EASA response:

Not Accepted. The CM maintains the harmonised rules and guidance material.

Commenter 2 : CAA UK

Comment # 1

UK CAA has no comments regarding the above referenced Proposed Certification Memorandum.

EASA response:

Noted.

Commenter 3 : Goodrich Wheels and Brakes

Comment # 1

Thank you for sending this Notification for our review. We at Goodrich have reviewed the draft and have no issue with this memorandum. We see this as a logical interpretation of the existing requirements and guidelines. Thank you again for the opportunity to comment.

EASA response:

Noted.