



Large Aeroplanes operation on wet or contaminated runways

Certification requirements



Xavier Vergez
Rulemaking Officer
Product Safety\Initial Airworthiness



Introduction

- **Runway excursion still present in the leading accidents categories worldwide in CAT operations¹**
- **Approx 80% at Landing – 20% at Takeoff**
- **Runway contamination is one of the main contributors in weather related factors**
- **Question: what is required for Certification of transport Large Aeroplanes to assess performance over contaminated runways?**

¹In the EU: for aircraft with MTOM>2250Kg registered in EASA MS, CAT operations, 1999-2008: number 3 category for fatal and non-fatal accidents; number 6 category for fatal accidents. Refer to EASA Annual Safety Review 2008.



CS-25 Performance Data Requirements

- CS-25 provides Certification Specifications for Large Aeroplanes (turbine engines, MTOW > 5.700Kg)
- It requires performance data to be established in the AFM for dry, wet and contaminated runways as provided in:
 - Subpart B – Flight
 - Subpart G – Operating limitations and information
- “Wet” means water depth $\leq 3\text{mm}$
- “Contaminated” means covered with standing water ($> 3\text{mm}$), slush, snow, ice or other contaminants (elected by the applicant)



CS-25 Performance Data Requirements

➤ Subpart B – Flight - Performance

★ Takeoff performance data

- CS 25.105(c) Takeoff performance data must be provided (in the AFM) on smooth dry and wet hard-surfaced runways – optional for grooved or porous friction course wet hard-surfaced
- CS 25.109(b) Accelerate-stop distance on a wet runway
 - Note 1: Braking coefficient of friction is defined in 25.109(c) and (d) for smooth wet runway and grooved/porous friction treated wet runway
 - Note 2: Thrust reverser deceleration effect may be included for wet runways (25.109(f))
 - Note 3: Anti-skid efficiency must be demonstrated on a smooth wet runway (25.109(c)(2))
- CS 25.113(b) Takeoff distance on a wet runway
- CS 25.113(c)(2) Takeoff run on a wet runway



European Aviation Safety Agency

CS-25 Performance Data Requirements

➤ Subpart B – Flight - Performance

★ Landing performance data

➤ CS 25.125 (c) Landing distance must be determined on a level, smooth, dry, hard-surfaced runway.

➤ Providing landing performance data for wet runway is thus an option for the applicant, however:



CS-25 Performance Data Requirements

- **EU-OPS 1.520 (for Performance Class A¹ aeroplanes) provides for safety factors when landing on wet or contaminated runways:**
 - Wet RWY: an available landing distance of at least 115% of the required landing distance on a dry runway (determined under EU-OPS 1.515, which requires a full stop within 60% of the landing distance available for turbo-jet and 70% for turbo-propeller)
 - Contaminated RWY: an available landing distance of at least 115% of the required landing distance on a dry runway, or at least 115 % of the landing distance determined in accordance with approved contaminated landing distance data or equivalent, accepted by the Authority, whichever is greater

¹multi-engine aeroplanes powered by turbo propeller engines with a maximum approved passenger seating configuration of more than 9 or a maximum take-off mass exceeding 5 700 kg, and all multi-engine turbojet powered aeroplanes



European Aviation Safety Agency

CS-25 Performance Data Requirements

- **Subpart G – Operating limitations and information – Supplementary information**
 - ★ **CS 25.1591 Performance information for operations with contaminated runway surface conditions**
 - ★ **History:**
 - The rule was introduced in JAR-25 Ch.13 (Oct 1988) and covered both wet and contaminated runways
 - Some discrepancies were noted between the theoretical methods of the advisory material and measured results during certification, with particular reference to smaller jet aeroplanes
 - JAA initiated a revision of the rule, which finally led to CS-25 Amdt 2 (02 Oct 2006) -> CS 25.1591 now only deals with contaminated runways
 - ★ **Supplementary performance information may be provided in the AFM for aeroplanes operated on runways contaminated with standing water, slush, snow, ice or other contaminants**



CS-25 Performance Data Requirements

- **Subpart G – Operating limitations and information – Supplementary information**
 - ✦ **25.1591 Performance information for operations with contaminated runway surface conditions**
 - If supplied, this must include performance data during takeoff and landing on hard surface runways covered by these contaminants
 - Performance data may be established by calculation or by testing
 - If no performance data is provided for a contaminant, the Flight Manual must prohibits operation on contaminated surfaces



CS-25 Performance Data Requirements

- **Subpart G – Operating limitations and information – Supplementary information**
 - ✦ **AMC 25.1591 provides guidelines on how to produce the performance data on contaminated surfaces**
 - **Contaminants definitions: standing water (>3mm), slush, wet snow, dry snow, compacted snow, ice, prepared winter RWY**
 - **Contaminants properties**
 - **Effects of contaminant: drags, braking frictions, aquaplaning speed**
 - **Landing air distance definition**
 - **Credit for reverse thrust may be included**
 - **Presentation of the information in the AFM**



CS-25 Performance Data Requirements

- **Subpart G – Operating limitations and information – Supplementary information**
 - ★ **AMC 25.1591 provides guidelines on how to produce the performance data on contaminated surfaces**
 - **Note: the use of ground friction measurement devices is not considered practical and it falls under the operator responsibility to relate braking performance to any friction index**



Ways of improvements

- **How can we mitigate the runway excursion risk?**
- **Key factors for successful landing:**
 - ✦ **Stabilised approach (trajectory, stable attitude, airspeed, flare)**
 - ✦ **Decision making if un-stabilised approach or poor weather => go around**
 - ✦ **Accurate and on time reporting of runway conditions and weather information to permit accurate landing performance data**
 - ✦ **Pilots skills to cope with unexpected adverse conditions like wind gust/shear, system failure (e.g. asymmetric braking or reverse thrust)**



Ways of improvements

- **Key factors for successful takeoff:**
 - ★ **Accurate runway conditions and weather information to permit accurate takeoff performance data – aborted takeoff distance is key**
 - ★ **Decision making if takeoff run doesn't meet expected performance => aborted takeoff on time**
 - ★ **Pilots skills to cope with unexpected adverse conditions like wind gust/shear, system failure (e.g. loss of engine power, asymmetric thrust, tire failure)**



Ways of improvements

- **Need to consider an international and harmonised system in which runway conditions are monitored and reported on time and in a format consistent with AFM data**
- **However, providing the best runway condition and weather data is not sufficient**
 - ★ **The effort to improve pilots training to operation on contaminated runways/inclement weather is crucial**



Ways of improvements

- **CS-25 was upgraded at amendment 2 (Oct 2006)**
 - ★ **Requires for new Types either to establish AFM performance data on contaminated runways, or to prohibit operation**
- **CS-25 could be consistently upgraded to match a new harmonised reporting system semantic**
- **CS-25 upgrade will not address in service aeroplanes**
 - ★ **Need to consider a plan for in service aeroplanes performance data upgrade**



European Aviation Safety Agency

Ways of improvements

➤ Thank you for your attention