EASA European Union Aviation Safety Agency	**Special Condition**	Doc. No.: Issue : 1 Date : 17 May 2019 Proposed ☒ Final ☐ Deadline for comments: 07 Jun 2019

SUBJECT	:	**Shorter landing distances on eligible wet Grooved or Porous Friction Course runways**
REQUIREMENTS incl. Amdt.	:	**CS 25.125, CS 25.109, CS 25.1587 at Amdt 13 [CAT.POL.A.230, CAT.POL.A.235 acc. to Commission Regulation (EU) 965/2012]**
ASSOCIATED IM/AMC[1]	:	**Yes☒ / No ☐**
ADVISORY MATERIAL	:	**FAA Aviation Rulemaking Advisory Committee FTHWG Task 9 Wet Runway Stopping Performance Final Report, Recommendation Report March 16, 2018**

INTRODUCTORY NOTE:

The following Special Condition has been classified as important and as such shall be subject to public consultation in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

IDENTIFICATION OF ISSUE:

Grooved runways or Porous Friction Course (PFC) overlaid runways are designed to provide, when wet, a higher effective friction than conventional (smooth) runways.

CS 25.109(d)(2) defines a reference wet friction for PFC/Grooved runway and allows reduced Accelerate-Stop Distances when operating on wet PFC/Grooved runways. CS 25.125 for landing does however not address landing on eligible wet grooved or PFC runways.

CAT.POL.A.235 Landing - wet and contaminated runways allows also reduced Landing Distances at Dispatch for landing on wet PFC/Grooved runways (but never shorter than Dispatch DRY):

(a) When the appropriate weather reports and/or forecasts indicate that the runway at the estimated time of arrival may be wet, the LDA (Landing Distance Available) shall be at least 115 % of the required landing distance determined in accordance with CAT.POL.A.230.

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[1] In case of SC, the associated Interpretative Material and/or Acceptable Means of Compliance is published for awareness only and it is not subject to public consultation.

(c) A landing distance on a wet runway shorter than that required by (a), but not less than that required by CAT.POL.A.230(a), may be used if the AFM includes additional information about landing distances on wet runways.

Historically this additional AFM information has been defined without harmonization for landing:

- on FAA side through AC121-195(d)-1, then -1A in 1990 (Brazilian Authority defined an equivalent),
- on JAA/EASA side through a CRI, for Airbus SA aircraft family CRI F-12 in Feb. 2002.

TALPA ARC recommendations have defined physics-based Time-Of-Arrival (TOA) landing distance assessment for all runway conditions, leading to FAA AC 25-32 and EASA NPA 2016-11.

In FTHWG Topic 9 Wet Runway Stopping Performance Final Report March 2018, a FTHWG with EASA participation has defined harmonized physics based Dispatch Landing Distances for Wet standard and PFC/Grooved runways. These dispatch distances address the risk of a degraded Wet friction, and define restrictive operational eligibility conditions for Wet Grooved or PFC runways.

The EASA NPA 2016/11 and Opinion 02/2019 are published for the determination of the Landing Distances at Dispatch and at Time-Of-Arrival (TOA) on wet grooved or PFC runways with specific friction improving characteristics.

The objective of this Special Condition and Interpretative Material is to ensure that critical variables associated with actual in-service wet runway performance on improved friction surfaces (PFC/Grooved) are considered to the degree that any approval in accordance with this Special Condition/Interpretative Material is appropriately conservative.

EASA proposes:

- to use the definition of “Landing distance for Dispatch to Wet PFC/Grooved runways” from FTHWG Topic 9 Wet Runway Stopping Performance, Final Report, March 2018 considering the friction already defined in CS 25.109(d)(2). This is assumed conservative on appropriately built and maintained PFC/Grooved runways, and
- to introduce a definition of “Landing Distances at Time-Of-Arrival (TOA) on Wet PFC/Grooved runways” considering same friction as above. It will support operators in landing performance assessment in flight, and
- to introduce an AFM or AFM supplement content to take credit of the PFC/Grooved runway shorter landing distance relative to aerodrome and operational restrictions of FTHWG Topic 9 Wet Runway Stopping Performance, Final Report, March 2018 (subject to specific approval from relevant Operational Authority)

according to the following Special Conditions and associated Interpretative Material.

Considering all the above, the following Special Condition is proposed:

Special Condition

Shorter landing distances on eligible Wet Grooved or PFC runways

1. Landing distance determination

1.1 Landing distance at dispatch determination based on friction according to CS 25.109(d)(2)

Landing distance at Dispatch to Wet Grooved/PFC runway is derived from FTHWG Task 9 Wet Runway Stopping Performance Final Report, based on CS 25.109(d)(2) friction, as described below.

a) The horizontal distance necessary to land and to come to a complete stop from a point 50 feet above the landing surface must be determined (for ambient temperatures, at each weight, altitude, and wind within the operational limits established by the applicant for the airplane):

(1) In non-icing conditions; and

(2) In icing conditions with the most critical of the landing ice accretion(s) defined in Appendices C and O of this part, as applicable, in accordance with CS 25.21(g), if V_{REF} for icing conditions exceeds V_{REF} for non-icing conditions by more than 5 knots CAS at the maximum landing weight.

b) The distance determined in paragraph (a) shall be the longest of:

(1) 110% of the horizontal distance necessary to land and to come to a complete stop from a point 50 feet above the landing surface with all engines operating.

(2) The horizontal distance necessary to land and to come to a complete stop from a point 50 feet above the landing surface assuming an inoperative engine.

c) In determining the distance in paragraph (a) of this section:

(1) The airplane must be in the landing configuration.

(2) A stabilized approach, with a calibrated airspeed of not less than V_{REF}, must be maintained down to the 50-foot height.

(i) In non-icing conditions, V_{REF} may not be less than:

(A) 1.23 VSR0;

(B) VMCL established under CS 25.149(f); and

(C) A speed that provides the manoeuvring capability specified in CS 25.143(h).

(ii) In icing conditions, V_{REF} may not be less than:

(A) The speed determined in paragraph (c)(2)(i) of this section;

(B) A speed that provides the maneuvering capability specified in CS-25.143(h) with the landing ice accretion defined in appendix C.
Note: *CS 25.125(b)(2)(ii)(B) deleted and replaced by SC B-09 25.125(b)(2)(ii)(C) applicable for A350 (quoted as change 7 of the A350 Special Condition B-09).*

(3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for in-service operation.

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, or porpoise.

(5) The landings may not require exceptional piloting skill or alertness.

d) The wet runway landing distance must be determined from the V_{REF} defined to meet the requirements of above §(c) up to and including a minimum of 10 knots above the V_{REF} speed, V_{REF} +10.

e) The landing distance should be determined on a level wet hard-surfaced runway:
(1) Without exceeding the wheel brake ratings and limits as specified by the brake manufacturer.
(2) Without causing excessive wear of brakes or tires; and
(3) Optionally with other means than wheel brakes, including the effects of reverse thrust, if that means
i. is safe and reliable, and
ii. is used so that consistent results can be expected in service; and
iii. is such that exceptional skill is not required to control the airplane.

f) The stopping force attributed to the wheel brakes used for a wet grooved or PFC runway surface may not exceed:

(1) the force resulting from the dry runway braking in meeting the requirements of CS 25.125; and

(2) the force resulting from the wet runway braking coefficient of friction defined by CS 25.109(d)(2). This tyre-to-ground wet runway braking coefficient of friction must be adjusted to take into account the efficiency of the anti-skid system on a wet grooved or PFC runway. The anti-skid efficiency value may be the same as for the accelerate-stop distance determination on a smooth wet runway.

The force resulting from the wet runway braking coefficient of friction determined in accordance with paragraph (f) shall take into account the distribution of the normal load between braked and un-braked wheels at the most adverse center-of-gravity position approved for landing.

g) The landing distance data must include correction factors for not more than 50 percent of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150 percent of the nominal wind components along the landing path in the direction of landing.

1.2 Time Of Arrival (TOA) landing distance assessment:

FAA AC 25-32 / EASA NPA 2016-11 do not define TOA assessment prior to landing on a wet runway with shorter landing distance at dispatch per this Special Condition. A valid TOA assessment can be performed in accordance with NPA 2016-11, but with the improved friction of CS 25.109(d)(2) used in the AFM:

i. A minimum 15% margin should be added to the distance defined in chapter 3 for the TOA landing distance assessment in the absence of in-flight failure affecting landing performance.

ii. Performance information for landing distance at the Time Of Arrival should be developed in accordance with the definitions provided in the associated Interpretative Material and included in the operational documentation.

2 Airplane Flight Manual (Supplement) Content

a) The AFM shall contain a statement to the effect that: "For landing on grooved/PFC runways, the operator must comply with all eligibility criteria, weather and runway conditions". Those conditions should be specified in the AFM.

In addition, the AFM should also contain a note to the effect that: "Meeting those criteria and conditions does not constitute operational approval to base the landing performance requirements at dispatch, or to base the TOA landing performance assessments on these distances.

b) The distance established must not be less than the factored dry runway distances required by CAT.POL.A.230 (a)(1).

c) The AFM shall contain the performance information computed under the applicable provisions of chapter 1.1 above for landing distance at dispatch with an additional 15% margin.

Associated Interpretative Material

Shorter landing distances on eligible Wet Grooved or Porous Friction Course (PFC) Runways

The associated Interpretative Material is published for awareness only and is not subject to public consultation.

1. Minimum Operational conditions for credit of shorter landing distances on Wet Grooved or PFC runways

1.1 Runway Eligibility Conditions for shorter landing distances on wet grooved or PFC runways determined under the Special Conditions in chapter 1:

1.1.1 An eligible runway for a shorter landing distance under the Special Condition chapter 1 should:

a) be described as having PFC/Grooved improved friction surfaces, on all declared length and width in the Aeronautical Information Publication (AIP) Aerodrome (AD) section issued by or under the responsibility of the relevant State.

b) be of crown transverse slope with minimum 1% value, with deviations allowed locally at intersections (with other runways or taxiways).

c) be maintained under an National Aviation Authority approved maintenance program, equivalent to the criteria in FAA AC 150/5320-12 at the latest issue. For runways not managed under the FAA AC 150/5320-12, an agreement should be obtained between the aircraft Operator and the aerodrome Operator specifying the equivalent minimum level of runway surface maintenance to be accomplished. These agreements should specify the runway inspection and maintenance frequencies, and promulgation of SLIPPERY WET information through an adequate text in NOTAM (Notice to Airmen) if the required friction levels might not be maintained, in which case shorter landing performance when wet is no longer applicable (e.g. drainage or surface texture deficiencies, groove wear or filling, or shorter performance when wet no longer applicable or equivalent wording to satisfy the objective of safe information to Operators/ Dispatchers / Crews).

d) be equipped with runway and touchdown markings and serviceable runway lighting systems. A Visual Approach Slope Indicator System (as e.g. a Precision Approach Path Indicator), which provides an acceptable threshold crossing height for the aircraft, should be provided and serviceable, to serve the approach to the runway. Such Visual Approach Slope Indicator System should be provided whether or not the runway is served by other visual approach aids or by non-visual aids (e.g. an electronic glide path).

e) be fitted with standard RSA as defined in FAA Part 139.309 or RESA as recommended by ICAO Annex 14, 3.5.4 for Code 3 and 4 Precision Instrumented runway (i.e. 1000 ft/300 m) or alternatively an arresting system meeting the specifications of FAA AC 150-5220-22B.

1.1.2 An aerodrome should be equipped with the effective capability to know precipitation intensity falling on the aerodrome:

- in order to identify when reaching or overshooting heavy rain threshold,
- with ATC actually reporting when heavy rain is present to aircraft in approach.

1.1.3 A compliance dossier should be established and maintained to demonstrate to the competent authority that all above-mentioned eligibility criteria are met.

1.2 Weather Conditions

The shorter landing performance when wet on eligible runway should not be used unless the following specific weather requirements are met:

a) Wind-shear: There should be no significant wind-shear reported:
   (i) By Aerodrome Low Level Wind-shear Alert System
   (ii) By Pilot Reports.

b) Rain intensity: There should be no report of heavy rain.

c) Visibility / RVR: The reported visibility / Runway Visual Range (RVR) should not be less than 1 statute mile (5000 ft / 1600 m).

1.3 Runway Conditions

The shorter landing performance when wet on an eligible runway should not be used unless the following specific requirements are met:

a) Contamination: There should be no frost, snow, standing water, slush, ice (other than isolated patches which do not impact braking action) observed or reported over full runway length within the width necessary for safe operations.

b) Pilot Reports and Operator aircraft performance monitoring: There should be no current Pilot Report of Braking Action less than "good" and no current Pilot Report of hydroplaning or slippery runway surface. There should be no alert in Operator FOM saying that aircraft Performance monitoring has detected an abnormal runway friction when wet.

1.4 Aircraft Operator Responsibilities

a) The aircraft operator approved training program and operating manual should specify the requirements necessary to assure that flight crews and dispatchers are cognizant of the runway eligibility, weather and runway condition requirements (or more restrictive per aircraft operator choice or operational authority choice) for shorter dispatch computation and TOA assessment when wet.

b) The aircraft operator should define and keep current in its Operating Manual a list of specific aerodromes/runways eligible for shorter landing performance when wet satisfying the requirements and conditions of this chapter 2, and inform dispatchers / crews when shorter dispatch computation and TOA assessment when wet are no longer applicable.

c) The aircraft operator should define, as part of a necessary Safety Management System for shorter landing performance on eligible runways, an aircraft braking performance monitoring program allowing to monitor if the aircraft Braking Action falls below the level of FAA AC 25-32 or EASA NPA 2016-11 associated with GOOD TO MEDIUM over partial or full landing roll. If such condition occurs, the aircraft operator should:
   - Inform the aerodrome operator.

- Subject to confirmed analysis, remove the runway from the "operator manual list of runways" eligible for shorter landing performance when wet used in AFM, until corrective actions are performed by the aerodrome operator.
- In absence of corrective action plan communicated by the aerodrome operator, inform its competent authority and manufacturer.

1.5 Deviations from Runway Eligibility Criteria:

a) If an aircraft operator seeks operational credit for shorter landing distances when wet that deviates from the runway eligibility criteria above, it should be demonstrated to the competent authority that an acceptable level of safety to the Special Condition is maintained. These deviations may be general or specific to a certain runway. The demonstration may require manufacturer involvement because of the complexity of the testing and/or analysis. The performance for such operations is typically included as an AFM supplement for Operation on Shorter Landing Distances When Wet on Eligible Runways, and is included as part of Operator Flight Operating Manual. Approval for deviations specific to a certain runway may not be applied as general eligibility on other runways.

The above provisions of this Interpretative Material in chapter 1 do not constitute operational approval to base the landing performance requirements at dispatch, or to base the TOA landing performance assessments on these distances.

2. Definitions and other Interpretative Material

This Interpretative Material derived from proposed FAR 25/CS 25 for Landing - Wet Runway in FTHWG Task 9 Wet Runway Stopping Performance Final Report applies to the shorter landing distances on eligible wet PFC/Grooved Runway subject in the Special Condition, for:

- The landing distance at dispatch determination (section 1.1)
- The time of arrival landing distance assessment (section 1.2).

Landing distance definition:

The landing distance is the horizontal distance from the point at which the main gear of the airplane is 50ft above the landing surface (treated as a horizontal plane through the touchdown point) to the position of the nose gear when the airplane is brought to a stop. This definition is the existing one specified in FAA AC 25-7C (2012) and in the Advisory Material of future harmonized CS 25.126.

Air distance definition for Time Of Arrival landing distance:

The air-distance should be the one associated to operational landing distance defined in EASA NPA 2016-11 and FAA AC 25-32 for Time Of Arrival Landing Distance assessment:

NPA 2016-11:

Unless the air distance used for compliance with CS 25.125 is representative of an average pilot flying in normal operations (see flight test demonstration below), the air distance used for time-of-

arrival landing performance assessments should be determined analytically as the distance traversed over a time period of 7 sec at a speed of 98 % of the recommended speed over the landing threshold, also referred to as the final-approach speed (VAPP). This represents a flare time of 7 sec and a touchdown speed (VTD) of 96 % of the VAPP. The VAPP should be consistent with the procedures recommended by the applicant, including any speed additives, such as those that may be used for winds or icing. The effect of higher speeds, to account for variations that occur in operations or are caused by the operating procedures of individual operators, should also be provided.
If the air distance is determined directly from flight test data instead of using the analytical method provided above, the flight test data should meet the following criteria:

— procedures should be used that are consistent with the applicant's recommended procedures for operations in service; these procedures should address the recommended final-approach airspeed, flare initiation height, thrust/power reduction height and technique, and target pitch attitudes;

— at a height of 50 ft above the runway surface, the aeroplane should be at an airspeed not slower than the recommended final-approach airspeed; and

— the touchdown rate of descent should be in the range of 1–4 ft per sec.
If the air distance is based on a time of 7 sec at a speed of 98 % of the recommended speed over the runway threshold, this air distance is considered valid for downhill runway slopes up to 2 % in magnitude (no credit should be taken for an uphill runway slope).

AC 25-32:

8.2.1 As shown in figure 1 of this AC, the air distance is the distance from a height of 50 feet above the landing surface to the point of main gear touchdown. This definition of the air distance is unchanged from that used for compliance with § 25.125. However, the air distance determined under § 25.125 may not be appropriate for use in making time-of-arrival landing performance assessments. Especially for airplanes for which the parametric method of determining the air distance was used as described in AC 25-7C, the air distances determined under § 25.125 may be shorter than the distance that the average pilot is likely to achieve in normal operations. ***Note:*** *AC 25-7C states the air distance computed using the parametric method should only be used in conjunction with the factor as described in § 121.195(b) or (c); § 135.385(b), (c), or (f); or equivalent.*

8.2.2 There are reasons why the air distance determined under § 25.125 might be shorter than the distance the average pilot is likely to achieve in normal operations. First, the parametric method of determining the air distance presented in AC 25-7C, used by some manufacturers to provide landing distance in their AFMs allows the air distance to be based on a steeper-than-normal approach angle of -3.5°, followed by a flare in which the touchdown rate of descent can be as high as 8 feet per second. Second, the § 25.125 air distance is based on beginning at a speed of VREF, whereas the operating procedures may recommend a higher speed, particularly when headwinds are present. Third, the philosophy followed by some manufacturers during the certification process is to determine the maximum capability of the airplane.

8.2.3 The air distance used for any individual landing at any specific runway is a function of the runway approach guidance, runway slope, use of any airplane features or equipment (for example, heads-up guidance, autoflight systems, etc.), pilot technique, and the inherent flare characteristics

of the specific airplane.

8.2.4 Unless the air distance used for compliance with § 25.125 is representative of an average pilot who is flying in normal operations (see paragraph 8.2.5 below), the air distance used for time-of-arrival landing performance assessments should be determined analytically as the distance traversed over a time period of 7 seconds at a speed of 98 percent of the recommended speed over the landing threshold, also referred to as the final approach speed (VAPP). This represents a flare time of 7 seconds and a touchdown speed (VTD) of 96 percent of VAPP. VAPP should be consistent with the TC holder's recommended procedures and training material, including any speed additives, such as may be used for winds or icing. The effect of higher speeds, to account for variations that occur in operations or through the operating procedures of individual operators, should also be provided.

8.2.5 If the air distance is determined directly from flight test data instead of the analytical method provided in paragraph 8.2.4 above, the flight test data should meet the following criteria:

8.2.5.1 Procedures should be used that are consistent with the TC holder's recommended procedures and training for operations in service. These procedures should address the recommended final approach airspeed, flare initiation height, thrust/power reduction height and technique, and target pitch attitudes.

8.2.5.2 At a height of 50 feet above the runway surface, the airplane should be at an airspeed no slower than the recommended final approach airspeed.

8.2.5.3 The touchdown rate of descent should be in the range of 1 to 4 feet per second.
***Note:** The criterion of paragraph 8.2.5.3 above should not be construed to mean that all of the landing data used to determine the air distance may have a touchdown rate of descent of 4 feet per second. The flight test data should contain a range of touchdown rates ranging from 1 to 4 feet per second.*

<u>Air distance definition for more recent landing distance at dispatch:</u>

FTHWG Task 9 Wet Runway Stopping Performance Final Report, has introduced complementary Advisory Material, from Manufacturers experience on introduction of Time Of Arrival in their operational documentation. The intent is to have normally a common operational air-distance for Time Of Arrival and for Dispatch.

Three acceptable means of compliance are described in paragraphs (1), (2), and (3) below.

(1) An accepted method for establishing an air distance reasonable for operating following operational procedures has been to use the following:
Air Distance (feet) = 0.5 * (V50 +VTD) *7*1.6878
Where V50 is the speed at 50 feet at the threshold, VTD is assumed touchdown speed, both in kts
7 = 7 seconds assumed from threshold to touchdown
1.6878 is the conversion from knots to ft/sec

This method is one method recognized in historical AC 121.195(d)-1A, Operational Landing Distances

for Wet Runways; Transport Category Airplanes, and in AC 25-32, Landing Performance Data for Time-of-Arrival Landing Performance Assessments, with VTD = 0.96*V50 (4% speed decay in flare).

An applicant may choose to use these relationships to establish landing distance in lieu of measuring airborne distance and speed loss. If an applicant chooses to use these relationships, with VTD = 0.96 V50 or higher, the applicant should show by test or analysis that they do not result in non-conservative air distances or touchdown speeds.

(2) If an applicant chooses to measure airborne distance or time, at least six tests covering the landing weight and speed range are required for each airplane configuration for which certification is desired. These tests should meet the following criteria

a) A stabilized approach, targeting a glideslope of -3 degrees and an indicated airspeed of VREF, should be maintained for a sufficient time prior to reaching a height of 50 feet above the landing surface to simulate a continuous approach at this speed. During this time, there should be no appreciable change in the power or thrust setting, pitch attitude, or rate of descent. The average glideslope of all landings used to show compliance should not be steeper than -3 degrees.

b) Below 50 feet, there should be no nose depression by use of the longitudinal control and no change in configuration that requires action by the pilot, except for reduction in power or thrust.

c) The average touchdown rate of sink at TD shall not exceed 3 feet per second and the maximum rate of sink at TD not to exceed 6 ft/s.

(3) If the applicant conducts enough tests to allow a parametric analysis (or equivalent method) that establishes, with sufficient confidence, the relationship between airborne distance (or time) as a function of the rates of descent at 50 feet and touchdown, the part 25 airborne distances may be based on an approach angle of -3.0 degrees, and a touchdown sink rate of 3 ft/s (See paragraph 19.1h for an example of this analysis method).

Note: The same methods and data used to determine the coefficients for the air time in 19.1(g) may be used to compute the air time as long as the determination of those coefficients included speeds consistent with 19.2(a)(4) and an adequate number of landings at touchdown rates of sink from 1 to 4 ft/sec.

Speed:

The airspeed, for shorter landing distance computation at Dispatch and Time Of Arrival associated with Wet PFC/Grooved runway operations, should be based on the final approach speed flown, in accordance with operators recommended Standard Operating Procedure, as those landing distance computations are physics based.

Runway friction cap:

The coefficient of friction used for a wet runway surface may not exceed 90% of the dry runway coefficient of friction, when friction limited, used for CS 25.125 (except if determined from flight tests on rubber-contaminated portion of runway).