CS 25.1583 Operating limitations

ED Decision 2018/010/R

(See AMC 25.1583)

(a) *Airspeed limitations.* The following airspeed limitations and any other airspeed limitations necessary for safe operation must be furnished.

(1) The maximum operating limit speed V_{MO}/M_{MO} and a statement that this speed limit may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorised for flight test or pilot training.

(2) If an airspeed limitation is based upon compressibility effects, a statement to this effect and information as to any symptoms, the probable behaviour of the aeroplane, and the recommended recovery procedures.

(3) The manoeuvring speed established under CS 25.1507 and statements, as applicable to the particular design, explaining that:

(i) full application of pitch, roll, or yaw controls should be confined to speeds below the manoeuvring speed; and

(ii) rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw, and full control inputs in more than one axis at the same time, should be avoided as they may result in structural failures at any speed, including below the manoeuvring speed.

(4) The flap extended speeds V_{FE} and the pertinent wing-flap positions and engine powers.

(5) The landing gear operating speed or speeds, and a statement explaining the speeds as defined in CS 25.1515(a).

(6) The landing gear extended speed V_{LE}, if greater than V_{LO}, and a statement that this is the maximum speed at which the aeroplane can be safely flown with the landing gear extended.

(b) *Powerplant limitations*. The following information must be furnished:

(1) Limitations required by CS 25.1521.

(2) Explanation of the limitations, when appropriate.

(3) Information necessary for marking the instruments required by CS 25.1549 to 25.1553.

(c) *Weight and loading distribution.* The weight and centre of gravity limitations established under CS 25.1519 must be furnished in the aeroplane Flight Manual. All of the following information, including the weight distribution limitations established under CS 25.1519, must be presented either in the aeroplane Flight Manual or in a separate weight and balance control and loading document that is incorporated by reference in the aeroplane Flight Manual;

(1) The condition of the aeroplane and the items included in the empty weight as defined in accordance with CS 25.29.

(2) Loading instructions necessary to ensure loading of the aeroplane within the weight and centre of gravity limits, and to maintain the loading within these limits in flight.

(3) If certification for more than one centre of gravity range is requested, the appropriate limitations, with regard to weight and loading procedures, for each separate centre of gravity range.

(d) *Flight crew.* The number and functions of the minimum flight crew determined under CS 25.1523 must be furnished.

(e) *Kinds of operation.* The kinds of operation approved under CS 25.1525 must be furnished.

(f) *Ambient air temperatures and operating altitudes.* The extremes of the ambient air temperatures and operating altitudes established under CS 25.1527 must be furnished.

(g) Reserved.

(h) *Additional operating limitations.* The operating limitations established under CS 25.1533 must be furnished.

(i) *Manoeuvring flight load factors.* The positive manoeuvring limit load factors for which the structure is proven, described in terms of accelerations, must be furnished. (See AMC 25.1583(i))

(j) reserved

(k) A limitation on the maximum depth of runway contaminants for take-off operation must be furnished. (See AMC 25.1583(k).)

[Amdt No: 25/1]
[Amdt No: 25/18]
[Amdt No: 25/22]

AMC 25.1583(i) Manoeuvring Flight Load Factors

ED Decision 2003/2/RM

The flight manoeuvring limit load factors for which the structure is approved, expressed in terms of normal acceleration, or g, should be included. If more restrictive flight load factors are established for particular operations outside the normal operating envelope (e.g. landing flap position with maximum take-off weight) such factors should be presented and defined.

AMC 25.1583(k) Maximum Depth of Runway Contaminants for Take-off Operations

ED Decision 2006/005/R

Compliance with CS 25.1583(k) may be shown using either Method 1 or Method 2 –

a. *Method 1*. If information on the effect of runway contaminants on the expected take-off performance of the aeroplane is furnished in accordance with the provisions of CS 25.1591, take-off operation should be limited to the contamination depths for which take-off information is provided.

b. *Method 2*. If information on the effect of runway contaminants on the expected take-off performance of the aeroplane in accordance with the provisions of CS 25.1591 is not provided, take-off operation should be limited to runways where the degree of contamination does not exceed the equivalent of 3 mm (0·125 inch) of water, except in isolated areas not exceeding a total of 25% of the area within the required length and width being used.

NOTE 1 In establishing the maximum depth of runway contaminants it may be necessary to take account of the maximum depth for which the engine air intakes have been shown to be free of ingesting hazardous quantities of water or other contaminants in accordance with CS 25.1091(d)(2).
NOTE 2: Unless performance effects are based on tests in water depths exceeding 15 mm, or on other evidence equivalent in accuracy to the results of direct testing, it will not normally be acceptable to approve take-off operation in depths of contaminants exceeding the equivalent of 15 mm of water.

[Amdt 25/2]

CS 25.1585 Operating procedures

ED Decision 2003/2/RM

(a) Operating procedures must be furnished for –

(1) Normal procedures peculiar to the particular type or model encountered in connection with routine operations;

(2) Non-normal procedures for malfunction cases and failure conditions involving the use of special systems or the alternative use of regular systems; and

(3) Emergency procedures for foreseeable but unusual situations in which immediate and precise action by the crew may be expected to substantially reduce the risk of catastrophe.

(b) Information or procedures not directly related to airworthiness or not under the control of the crew, must not be included, nor must any procedure that is accepted as basic airmanship.

(c) Information identifying each operating condition in which the fuel system independence prescribed in CS 25.953 is necessary for safety must be furnished, together with instructions for placing the fuel system in a configuration used to show compliance with that section.

(d) The buffet onset envelopes determined under CS 25.251 must be furnished. The buffet onset envelopes presented may reflect the centre of gravity at which the aeroplane is normally loaded during cruise if corrections for the effect of different centre of gravity locations are furnished.

(e) Information must be furnished that indicates that when the fuel quantity indicator reads 'zero' in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

(f) Information on the total quantity of usable fuel for each fuel tank must be furnished.

CS 25.1587 Performance information

ED Decision 2018/005/R

(a) Each aeroplane Flight Manual must contain information to permit conversion of the indicated temperature to free air temperature if other than a free air temperature indicator is used to comply with the requirements of CS 25.1303(a)(1).

(b) Each aeroplane Flight Manual must contain the performance information computed under the applicable provisions of this CS-25 (including CS 25.115, 25.123 and 25.125 for the weights, altitudes, temperatures, wind components, and runway gradients, as applicable) within the operational limits of the aeroplane, and must contain the following:

(1) In each case, the conditions of power, configuration, and speeds, and the procedures for handling the aeroplane and any system having a significant effect on the performance information.

(2) V_{SR} determined in accordance with CS 25.103.

(3) The following performance information (determined by extrapolation and computed for the range of weights between the maximum landing weight and the maximum takeoff weight):

(i) Climb in the landing configuration.

(ii) Climb in the approach configuration.

(iii) Landing distance.

(4) Procedures established under CS 25.101(f) and (g) that are related to the limitations and information required by CS 25.1533 and by this paragraph in the form of guidance material including any relevant limitation or information.

(5) An explanation of significant or unusual flight or ground handling characteristics of the aeroplane.

(6) Corrections to indicated values of airspeed, altitude and outside air temperature.

(7) An explanation of operational landing runway length factors included in the presentation of the landing distance, if appropriate.

c) Each aeroplane flight manual (AFM) must contain the performance information associated with abnormal landing configurations (see AMC 25.1587(c)).

[Amdt 25/21]

AMC 25.1587(c) Landing distances in abnormal configurations

ED Decision 2018/005/R

1. Purpose

This AMC provides guidance and recommendations on how to determine and present in the aeroplane flight manual (AFM) landing distance information appropriate to abnormal configurations or following the loss of normal services, and guidelines on which failure cases should be considered.

2. Related certification specifications

CS 25.125 Landing

CS 25.1585 Operating procedures

CS 25.1587 Performance information

3. Background

When a failure occurs in flight, the flight crew has to analyse the consequences of this failure on the landing. Some failures cause an increase in the landing distance, which must be evaluated. A diversion may be necessary if the destination aerodrome runway is no longer appropriate due to the increased landing distance.

For the production of AFM data, the applicant considers all failures and assesses their probability of occurrence. In addition, the question of the best presentation of the relevant data should be addressed.

This AMC does not consider configuration deviation list (CDL) items or any unserviceabilities identified in the master minimum equipment list (MMEL) that are known prior to dispatch.

4. Performance information

The applicant should determine information on the landing distance that is likely to be needed for landings in abnormal configurations, and following the loss of normal services. This information should consist of the horizontal distance from the point at which the main gear of the aeroplane is 50 ft above the landing surface to the point where the aeroplane comes to a complete stop for standard temperatures at each weight, altitude and wind within the operational limits established by the applicant for landing on a dry runway. This information should be established in accordance with CS 25.125(b)(4) and (5), CS 25.125(c)(1) and (2), CS 25.125(f) and with the following conditions:

(a) The aeroplane is in the landing configuration appropriate to the failure case being considered;

(b) A steady approach is maintained down to the 50-ft height, at not less than the recommended approach speed, and using the recommended approach procedure, appropriate to the failure case being considered. (See paragraph 5 below);

(c) Changes to configuration, power or thrust, and speed are made in accordance with the recommended procedure appropriate to the failure case being considered; and

(d) All deceleration devices with which the aeroplane is fitted, including reverse thrust, may be used during the on-ground part of the landing, to an extent dependent both on the characteristics of the aeroplane and on the recommended use of deceleration devices, provided that:

(1) a practical procedure for their use has been established;

(2) the controllability of the aeroplane during their use has been shown to be satisfactory (see paragraph 8 below); and

(3) they would be available, and their use is recommended, for the failure case being considered.

5. Operating procedures

It is intended that in deriving the landing distance of paragraph 4 above, which is required by CS 25.1585(a) to be included in the AFM, the applicant should use procedures that are generally based on the application of conventional stall and controllability margins. However, it is acknowledged that for failure cases, this is not always practical. Where the procedure uses less than the normal margin, this should be based on flight evaluation and stated in the AFM, along with advice on how this might affect the way the approach is conducted (e.g. reduced pitch manoeuvre capability and the ability to counteract wind shear). Nevertheless, for some configurations that cannot be easily flight-tested, a combination of simulation and analysis may be acceptable.

6. Effect of failures on landing distance

The applicant should determine information on landing distances in abnormal configurations in accordance with the procedures appropriate to the abnormal configuration for single failures and combinations of failures provided in the AFM that:

(a) have a probability of occurrence greater than approximately 10^{-7}; and

(b) result in more than a 10 % increase in landing distance.

If a procedure is included in the AFM for a failure case that:

(a) has a probability of occurrence less than 10^{-7}; and

(b) results in an increase in the landing distance of more than 10 %,

then information about the increase in landing distance should also be included in the AFM.

7. Effect of overspeed and wet runway

The applicant should provide information on the separate effects of a 10-kt overspeed and of a wet runway.

Note: overspeed in the above context refers to speed in excess of the approach speed recommended for the abnormal condition, which itself may be greater than the normal approach speed.

8. Deceleration devices

The applicant may include the use of deceleration devices during the on-ground part of the landing to the extent that directional control can be readily maintained during their use on a wet runway, with a crosswind component of not less than 10 kt from the adverse side.

9. Data derivation and AFM presentation

The applicant may derive the performance information described in paragraph 4 from calculations that are conservatively based on the best available information, on simulation or flight test, or any combination of these. The recommended operating procedures discussed in paragraph 5 should be presented in a simple manner (e.g. as increments in the landing distance, or approach speeds). The effects of overspeed and a wet runway may be presented as generalised information that covers a variety of abnormal configurations.

[Amdt 25/21]

SUPPLEMENTARY INFORMATION

CS 25.1591 Take-off performance information for operations on slippery wet and contaminated runways

ED Decision 2021/015/R

(See AMC 25.1591)

(a) Supplementary take-off performance information applicable to aeroplanes operated on slippery wet runways and on runways contaminated with standing water, slush, snow, or ice may be furnished at the discretion of the applicant. If supplied, this information must include the expected performance of the aeroplane during take-off on hard-surfaced runways covered by these contaminants. If information on any one or more of the above surface conditions is not supplied, the AFM must contain a statement prohibiting take-off on surfaces that do not meet the minimum friction criteria, or contaminated surface(s) for which information is not supplied. Additional information covering operation on contaminated surfaces other than the above may be provided at the discretion of the applicant.

(b) Performance information furnished by the applicant must be contained in the AFM. The information may be used to assist operators in producing operational data and instructions for use by their flight crews when operating with contaminated runway surface conditions. The information may be established by calculation or by testing.

(c) The AFM must clearly indicate the conditions and the extent of applicability for each contaminant used in establishing the contaminated runway performance information. It must also state that actual conditions that are different from those used for establishing the contaminated runway performance information may lead to different performance.

[Amdt 25/2]
[Amdt 25/27]

AMC 25.1591 The derivation and methodology of performance information for use when taking-off from slippery wet and contaminated runways

ED Decision 2021/015/R

1.0 Purpose

This AMC provides information, guidelines, recommendations, and acceptable means of compliance for use by applicants in the production of performance information for aeroplanes when taking off from runways that are slippery wet or contaminated by standing water, slush, snow, and ice.

2.0 Technical Limitations of Data

The methodology specified in this AMC provides one acceptable means of compliance with the provisions of CS 25.1591. In general it does not require aeroplane testing on contaminated runway surfaces, although such testing if carried out at the discretion of the applicant may significantly improve the quality of the result or reduce the quantity of analytical work required.

Due to the nature of naturally occurring runway contaminants and difficulties associated with measuring aeroplane performance on such surfaces, any data that is either calculated or

measured is subject to limitations with regard to validity. Consequently the extent of applicability should be clearly stated.

The properties specified in this AMC for various contaminants are derived from a review of the available test and research data and are considered to be acceptable for use by applicants. This is not an implied prohibition of data for other conditions or that other conditions do not exist.

EASA acknowledges that the observing of and reporting on the type and depth of runway surface contaminants (water, slush, dry snow, wet snow) is limited. This information may not be accurately and timely relayed to the flight crew. Furthermore, shallow depths of contaminants do not generally reduce wheel braking friction below that of a wet runway, except in unfavourable circumstances where lower than expected runway condition codes (RWYCCs) are reported (see AMC 25.1592). In line with International Civil Aviation Organization (ICAO) and Federal Aviation Administration (FAA) standards, EASA considers a depth of more than 3 mm for loose contaminant accountability in take-off performance assessments a reasonable lower threshold. If the depth of such loose contaminant is lower than 3 mm, or if there is a thin layer of frost, the runway is considered wet, for which this AMC 25.1591 does not apply.

It is intended that the use of aeroplane performance data for contaminated runway conditions produced in accordance with CS 25.1591 should include recommendations associated with the operational use of the data. Where possible, this operational guidance should be provided by the applicant or its production co-ordinated with the applicant to ensure that its use remains valid.

Operators are expected to make careful and conservative judgments in selecting the appropriate performance data to use for operations on contaminated runways. Particular attention should be paid to the presence of any contaminant in the critical high speed portion of the runway. For takeoff, it may be appropriate to use different contaminant types or depths for the takeoff and the accelerate-stop portions. For example, it may be appropriate to use a greater contaminant depth or a contaminant type that has a more detrimental effect on acceleration for the takeoff portion than for the accelerate-stop portion of the takeoff analysis.

In considering the maximum depth of runway contaminants it may be necessary to take account of the maximum depth for which the engine air intakes have been shown to be free of ingesting hazardous quantities of water in accordance with CS 25.1091(d)(2).

3.0 Standard Assumptions

Due to the wide variation in possible conditions when operating on contaminated runways and the limitations inherent in representing the effects of these conditions analytically, it is not possible to produce performance data that will precisely correlate with each specific operation on a contaminated surface. Instead, the performance data should be determined for a standardised set of conditions that will generally and conservatively represent the variety of contaminated runway conditions occurring in service.

It should be assumed that:

— the contaminant is spread over the entire runway surface to an even depth (although rutting, for example, may have taken place).

— the contaminant is of a uniform specific gravity.

— where the contaminant has been sanded, graded (mechanically levelled) or otherwise treated before use, that it has been done in accordance with agreed national procedures.

4.0 Definitions

The following definitions are a subset of the runway surface condition descriptors for which a representative take-off performance model may be derived using the methods contained in this AMC.

4.1 Frost

Ice crystals formed from airborne moisture on a surface whose temperature is below freezing. Frost differs from ice in that frost crystals grow independently and, therefore, have a more granular texture.

Note 1: 'below freezing' refers to air temperature equal to or lower than the freezing point of water (0 C/32°F).

Note 2: under certain conditions, frost can render the runway surface very slippery, which should then be appropriately reported as 'reduced braking action'.

4.1.a Standing water

Water of a depth greater than 3mm.

Note: a surface condition where there is a layer of water of 3 mm or less is considered wet, for which this AMC 25.1591 is not applicable.

4.2 Slush

Snow that is so water-saturated that water will drain from it when a handful is picked up or will splatter if stepped on forcefully.

4.3 Wet snow

Snow that contains enough water to be able to make a well-compacted, solid snowball, without squeezing out water.

4.4 Dry snow

Snow from which a snowball cannot readily be made.

4.5 Compacted snow

Snow that has been compacted into a solid mass such that aeroplane tyres, at operating pressures and loadings, will run on the runway surface without significant further compaction or rutting of the runway surface.

4.6 Ice

Water that has frozen or compacted snow that has transitioned into ice, in cold and dry conditions.

Note: this definition excludes wet ice that has a film of water on top of it or contains melting ice, which provides minimal braking friction and uncertain lateral control.

4.7 Slippery wet runway

A wet runway where the surface friction characteristics on a significant portion of the runway have been determined to be degraded.

4.8 Specially prepared winter runway

A runway, with a dry frozen surface of compacted snow and/or ice which has been treated with sand or grit or has been mechanically or chemically treated to improve runway friction. The runway friction is monitored and reported on a regular basis in accordance with national procedures.

4.9 Specific gravity

The density of the contaminant divided by the density of the water.

5.0 Contaminant Properties to be Considered

5.1 Range of Contaminants

The following general range of conditions or properties may by used. The list given in Table 1 is not necessarily comprehensive and other contaminants may be considered, provided account is taken of their specific properties.

Data should assume the contaminant to be uniform in properties and uniformly spread over the complete runway.

Contaminants can be classified as being:-

(i) Drag producing, for example by contaminant displacement or impingement,

(ii) Braking friction reducing, or

(iii) A combination of (i) and (ii).

Data to be produced should use the classification and assumptions of Table 1 and then the appropriate sections of the AMC as indicated.

Contaminant Type	*Range of Depths to be Considered — mm*	*Specific Gravity Assumed for Calculation*	*Is Drag Increased?*	*Is Braking Friction Reduced below Dry Runway Value?*	*Analysis Paragraphs Relevant*
Standing water, Flooded runway	More than 3 up to 15 (see Note 1)	1.0	Yes	Yes	7.1, 7.3, 7.4
Slush	More than 3 up to 15 (see Note 1)	0.85	Yes	Yes	7.1, 7.3, 7.4
Wet snow (see Note 2)	More than 3 up to 5 (see Note 1)		No	Yes	7.3, 7.4
Wet snow (see Note 3)	More than 5 up to 30	0.5	Yes	Yes	7.1, 7.3, 7.4
Dry snow (see Note 2)	More than 3 up to 10 (see Note 1)		No	Yes	7.3, 7.4
Dry Snow	More than 10 up to 130	0.2	Yes	Yes	7.2, 7.3, 7.4
Compacted snow at or below outside air temperature (OAT) of -15 °C/5 °F	0 (see Note 4)		No	Yes	7.3, 7.4