

**Draft Certification Specifications and Guidance Material
for additional airworthiness specifications for operations (CS-26)**

related to

take-off performance parameters and position errors — large aeroplanes

(RMT.0741)

The same format as for the publication of notices of proposed amendments (NPAs) has been used to present the amendments:

- deleted text is ~~struck through~~;
- new text is highlighted;
- an ellipsis '...' indicates that the rest of the text is unchanged.

Disclaimer

This draft document has not been editorially reviewed and is provided for information purposes only.

Certification Specifications

and Guidance Material

for

Additional airworthiness specifications

for operations

(CS-26)

DRAFT — FOR INFORMATION ONLY

SUBPART B — AEROPLANES

[...]

CS 26.204 Take-off performance monitoring system

Compliance with point 26.204 of Part-26 is demonstrated by showing compliance with CS 25.704, or with the following.

(a) The TOPMS must reduce the risk of an unsafe take-off from the selected runway by providing alerts to the flight crew in a timely manner, considering the actual aeroplane configuration and the planned weight and centre of gravity (CG).

(1) Before and until the take-off initiation, this must include the conditions resulting from:

(i) Errors in the entry and selection of the take-off performance parameters in the aeroplane systems; and

(ii) Errors in the position of the aeroplane at take-off initiation.

(2) In addition, for the following aeroplanes, the system must monitor the take-off roll and alert the flight crew when conditions exist resulting from insufficient real-time aeroplane performance: aeroplanes with a maximum take-off mass (MTOM) of 35 000 kg (77 162 lb) or more and certified for:

(i) Transport of passengers with a maximum passenger seating configuration (MPSC) of more than 19, or

(ii) Transport of cargo only, or

(iii) Transport of passengers and cargo, with one of the following cargo compartments installed on the main deck(s) –

(A) a Class B compartment that exceeds the size permitted by CS 25.857(b) at Amendment 8 of CS-25, or

(B) a Class C compartment, or

(C) a Class F compartment.

(b) The system must consider normal take-off configurations and at least accommodate dry and wet runway conditions on smooth runways.

[Issue: 26/6]

GM1 26.204 Take-off performance monitoring system

The intention of CS 26.204 is to mitigate the risk of a take-off being performed with an aeroplane that is in an unsafe take-off condition in terms of performance and position, accommodating at least dry and wet runway conditions on smooth runways. An alert to the flight crew should be triggered early enough to allow a corrective action, ideally during the cockpit preparation phase but at the latest before the aeroplane reaches the V_1 speed.

(a) *Performance*. The intent is to mitigate the risk of incidents and accidents that can result from the use of incorrect take-off performance parameters due to either errors made during the performance parameter calculation, or errors made during the entry of correctly calculated performance parameters in the aeroplane system(s) (e.g. in the flight management system (FMS) or another system). The following errors could be encountered:

- incorrect weight values, including use of an incorrect zero fuel weight (ZFW) value for take-off weight (TOW) calculation, use of an incorrect TOW value (e.g. use of ZFW, empty weight or other value), use of a previous flight TOW, various errors made when using the electronic flight bags (EFBs), typing errors when entering weight values in the FMS and errors in the load sheet provided to the flight crew;
- incorrect available runway length, for example not taking into account a notice to airmen (NOTAM) (maintenance work), use of an incorrect runway chart, or an error made during re-calculation after a runway change;
- incorrect assumed temperature for thrust or power reduction calculation, or incorrect thrust or power selection in the FMS (e.g. fixed derate);
- incorrect or inconsistent take-off speeds in the FMS or no speeds entered;
- incorrect aeroplane configuration.

(b) *Position*. The intent is to mitigate the risk of incidents and accidents that can result from errors in the positioning of the aeroplane for initiation of the take-off, for instance take-off from a runway position providing a length shorter than that assumed for the take-off performance parameter calculation (e.g. incorrect runway intersection), take-off from a runway different from the one used for performance calculation and entered in the aeroplane systems (in the FMS or other system), take-off from a taxiway, or an error in the heading (e.g. take-off from opposite QFU).

(c) *Runway conditions*. In addition to the specifications in CS 26.204(b), at the discretion of the applicant, the system may also accommodate grooved or porous friction course wet runways, and other levels or type of contamination.

[Issue: 26/6]

GM2 26.204 Take-off performance monitoring system

(a) *Take-off performance monitoring system (TOPMS) design minimum features*

The system should be designed to timely alert the flight crew, as a minimum, to the following conditions.

- (1) *Before and until take-off initiation.*

(i) From cockpit preparation until take-off initiation, errors or inconsistencies exist in the following parameters that are expected to be available from the aeroplane systems (in the FMS or other system) or in the actual aeroplane configuration.

- (A) Weight values (e.g. out-of-range or inconsistent values) and CG (e.g. out-of-range or inconsistent values, also consistency with alternate CG limits if applicable).
- (B) Aeroplane configuration (e.g. inconsistent values of pitch trim, flap position, slat position). This should include configurations that would not trigger an alert as requested by CS 25.703 (if applicable) but are nevertheless unsafe for the specific aeroplane weight and CG. The applicant should account for the configurations that are not covered when demonstrating compliance with CS 25.107(e)(4).
- (C) The predicted take-off distance/run (calculated by the TOPMS in compliance with CS 25.113) is not compatible with the take-off distance/run available, or the predicted accelerate-stop distance (calculated by the TOPMS in compliance with CS 25.109) is not compatible with the accelerate-stop distance available. When the take-off is not initiated from the runway threshold, this should be taken into account (e.g. when using a runway intersection). The take-off distance available and the accelerate-stop distance available are defined in ICAO Annex 14 Vol. I (Aerodrome Design and Operations).
- (D) Thrust or power selection parameter(s) (e.g. out-of-range or inconsistent values).
- (E) Take-off speeds (e.g. out-of-range values, incoherent speeds, insufficient margins with minimum control or stall speeds).

(ii) *Take-off initiation position.*

Take-off is initiated:

- (A) from a position on the runway such that the remaining available take-off distance/run is not compatible with the predicted take-off distance/run (see paragraph (a)(1)(i)(C)) or the remaining available accelerate-stop distance is not compatible with the predicted accelerate-stop distance (see paragraph (a)(1)(i)(C)) (e.g. positioning on incorrect runway intersection);
- (B) from a runway different from the one entered in the aeroplane systems (in the FMS or other system). This includes heading errors such as opposite QFU errors;
- (C) outside a runway (e.g. from a taxiway).

(2) *Real-time aeroplane performance (for aeroplanes that must comply with CS 26.204(a)(2)).* During the take-off roll, the real-time aeroplane performance differs significantly from the reference take-off performance (please refer to note 2 below) such that an unsafe take-off may result. Real-time parameters should be monitored and evaluated to determine whether the take-off will be safe. These parameters may include but are not limited to:

- (i) aeroplane acceleration;
- (ii) aeroplane ground speed and airspeed;
- (iii) wheel speed.

The method used by the applicant to determine when the actual performance of the aeroplane is unsafe should be presented to and agreed by EASA. Some examples of methods that may be used are:

- (iv) real-time acceleration compared with a reference acceleration;
- (v) airspeed as a function of time, based on real-time acceleration, compared with a reference;
- (vi) distance travelled, based on real-time acceleration, compared with a reference.

Note 1. Regardless of the method of distance calculation selected by the applicant, the reference distance should take into account an engine failure at the speed V_{EF} allowing the flight crew to take initial action by the selected V_1 .

Note 2. When comparing real-time with reference acceleration, airspeed or distance parameters, the applicant may assume an appropriate (i.e. without errors) calculation of take-off and accelerate-stop distances prior to take-off initiation. This assumption allows the calculation of an expected acceleration at a given moment during the take-off roll. This expected acceleration can be compared with the actual measured acceleration and used to determine performance in real-time. Criteria for triggering an alert should be defined and described.

Other methods may be proposed by the applicant.

The alert should be triggered at a speed sufficiently low, and below any possible V_1 in order to ensure the possibility to perform a safe rejected take-off.

(b) System reliability, availability and integrity

- (1) The TOPMS alerts the flight crew when conditions are identified that pose a risk of an accident or major incident.
- (2) Failure cases may be design-dependent, and hence proposed failure condition classifications will need to be confirmed through a formal TOPMS safety analysis carried out in compliance with CS and AMC 25.1309.

The following basic failure conditions classifications may be considered.

- (i) Detected or undetected loss of the TOPMS function does not impact the aeroplane behaviour but is considered a reduction in the safety margin. Such a failure condition is considered as having no more than Minor effects.
- (ii) Undue (false or inadequate) alert of the TOPMS effect is design-dependent. Such a failure condition is considered as having no more than Major effects below V_1 . Beyond V_1 , the effects should be considered as at least Hazardous.

- (3) The safety analysis referred to in paragraph (b)(2) above should take into account the effect of database errors. Database integrity aspects are addressed in EUROCAE ED-76B/RTCA DO-200C 'Standards for Processing Aeronautical Data'.

(c) Design and test considerations

- (1) Unwanted alerts should be reduced by inhibiting the TOPMS where it is safer to do so, for example to prevent alerts being triggered after V_1 so that a hazardous rejected take-off is not attempted.
- (2) Nuisance alerts should be minimised by correctly setting the alerting threshold. The probability of a nuisance alert should be commensurate with a Major failure condition.
- (3) A TOPMS alert should be adequately prioritised and interference with other installed systems' alerts should be avoided (e.g. runway awareness and advisory system, windshear alerting system, etc).
- (4) An alert should be provided to the flight crew when a TOPMS function becomes unavailable, for example if an input from the navigation database is missing.
- (5) A means should be provided to the flight crew to inhibit the TOPMS (e.g. to address issues preventing its normal operation).
- (6) It should be shown by testing and/or analysis that, for all approved take-off configurations and operating conditions, the risk of nuisance alerts is minimised and alerts are triggered when necessary. The applicant should consider at least the following parameters: requested thrust or power settings, feasible weights and CGs, flight control surface positions (e.g. pitch trim, flaps, slats, etc), runway slopes, aeroplane positions on the runway, runway winds, runway conditions, temperatures and altitudes.

(d) Aeroplane Flight Manual

The applicant should provide the TOPMS operational domain, operational limitations, and procedures in compliance with CS 25.1581.

[Issue: 26/6]