AMC 25.113(a)(2), (b)(2) and (c)(2) Take-off distance and take-off run

ED Decision 2003/2/RM

In establishment of the take-off distance and take-off run, with all engines operating, in accordance with CS 25.113(a), (b) and (c), the flight technique should be such that –

a. A speed of not less than V_2 is achieved before reaching a height of 11 m (35 ft) above the take-off surface,

b. It is consistent with the achievement of a smooth transition to a steady initial climb speed of not less than V_2 + 19 km/h (10 kt) at a height of 122 m (400 ft) above the take-off surface.

CS 25.115 Take-off flight path

ED Decision 2003/2/RM

(a) The take-off flight path must be considered to begin 11 m (35 ft) above the take-off surface at the end of the take-off distance determined in accordance with CS 25.113(a) or (b) as appropriate for the runway surface condition.

(b) The net take-off flight path data must be determined so that they represent the actual take-off flight paths (determined in accordance with CS 25.111 and with sub-paragraph (a) of this paragraph) reduced at each point by a gradient of climb equal to –

 (1) 0·8% for two-engined aeroplanes;

 (2) 0·9% for three-engined aeroplanes; and

 (3) 1·0% for four-engined aeroplanes.

(c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the take-off flight path at which the aeroplane is accelerated in level flight.

CS 25.117 Climb: general

ED Decision 2003/2/RM

Compliance with the requirements of CS 25.119 and 25.121 must be shown at each weight, altitude, and ambient temperature within the operational limits established for the aeroplane and with the most unfavourable centre of gravity for each configuration.

CS 25.119 Landing climb: all engines operating

ED Decision 2016/010/R

(See AMC 25.119)

In the landing configuration, the steady gradient of climb may not be less than 3·2%, with the engines at the power or thrust that is available 8 seconds after initiation of movement of the power or thrust controls from the minimum flight idle to the go-around power or thrust setting; and

(a) In non-icing conditions, with a climb speed of VREF determined in accordance with CS 25.125(b)(2)(i); and

(b) In icing conditions with the most critical of the "Landing Ice" accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g), and with a climb speed of V_{REF} determined in accordance with CS 25.125(b)(2)(i).

[Amdt 25/3]
[Amdt 25/16]
[Amdt 25/18]

AMC 25.119 Landing climb: all-engines-operating

ED Decision 2020/024/R

In establishing the thrust specified in CS 25.119, either –

a. Engine acceleration tests should be conducted using the most critical combination of the following parameters:

i. Altitude;

ii. Airspeed;

iii. Engine bleed;

iv. Engine power off-take;

likely to be encountered during an approach to a landing airfield within the altitude range for which landing certification is sought; or

b. The thrust specified in CS 25.119 should be established as a function of these parameters.

For aeroplanes equipped with a reduced go-around (RGA) thrust or power function, the climb requirements specified in CS 25.119 are applicable with the RGA function active. During the determination of the maximum thrust or power specified in AMC 25.119 a. and b. the thrust or power controls should be moved to the RGA thrust or power setting. This is consistent with an AFM all-engines-operating go-around procedure which recommends the use of an RGA function (see AMC 25.143(b)(4)). In exceptional circumstances such as in the presence of wind shear or of unplanned obstacles, the flight crew may elect to use go-around thrust or power that exceeds the RGA setting. However, the applicant is not required to provide AFM climb gradient performance for this situation.

If an AFM go-around procedure is approved to use thrust or power above the RGA setting, then the climb requirements of CS 25.119 will apply at the higher thrust or power setting.

[Amdt 25/3]
[Amdt 25/26]

CS 25.121 Climb: one-engine-inoperative

ED Decision 2015/008/R

(See AMC 25.121)

(a) *Take-off; landing gear extended.* (See AMC 25.121(a).) In the critical take-off configuration existing along the flight path (between the points at which the aeroplane reaches V_{LOF} and at which the landing gear is fully retracted) and in the configuration used in CS 25.111 but without ground effect, the steady gradient of climb must be positive for two-engined aeroplanes, and not less than 0·3% for three-engined aeroplanes or 0·5% for fourengined aeroplanes, at V_{LOF} and with –

(1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with CS 25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted (see AMC 25.121(a)(1)); and

(2) The weight equal to the weight existing when retraction of the landing gear is begun determined under CS 25.111.

(b) *Take-off; landing gear retracted.* In the take-off configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in CS 25.111 but without ground effect,

(1) the steady gradient of climb may not be less than 2·4% for two-engined aeroplanes, 2·7% for three-engined aeroplanes and 3·0% for four-engined aeroplanes, at V_2 with –

(i) The critical engine inoperative, the remaining engines at the take-off power or thrust available at the time the landing gear is fully retracted, determined under CS 25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the aeroplane reaches a height of 122 m (400 ft) above the take-off surface (see AMC 25.121(b)(1)(i)) ; and

(ii) The weight equal to the weight existing when the aeroplane’s landing gear is fully retracted, determined under CS 25.111.

(2) The requirements of sub-paragraph (b)(1) of this paragraph must be met:

(i) In non-icing conditions; and

(ii) In icing conditions with the most critical of the “Take-off Ice” accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g), if in the configuration used to show compliance with CS 25.121(b) with this “Take-off Ice” accretion:

(A) The stall speed at maximum take-off weight exceeds that in non-icing conditions by more than the greater of 5.6 km/h (3 knots) CAS or 3% of VSR; or

(B) The degradation of the gradient of climb determined in accordance with CS 25.121(b) is greater than one-half of the applicable actual-to-net take-off flight path gradient reduction defined in CS 25.115(b).

(c) *Final take-off.* In the en-route configuration at the end of the take-off path determined in accordance with CS 25.111:

(1) the steady gradient of climb may not be less than 1·2% for two-engined aeroplanes, 1·5% for three-engined aeroplanes, and 1·7% for four-engined aeroplanes, at V_{FTO} and with –

(i) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

(ii) The weight equal to the weight existing at the end of the take-off path, determined under CS 25.111.

(2) The requirements of sub-paragraph (c)(1) of this paragraph must be met:

(i) In non-icing conditions; and

(ii) In icing conditions with themost critical of the “Final Take-off Ice” accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g), if in the configuration used to show compliance with CS 25.121(b) with this “Take-off Ice” accretion:

(A) The stall speed at maximum take-off weight exceeds that in non-icing conditions by more than the greater of 5.6 km/h (3 knots) CAS or 3% of VSR; or

(B) The degradation of the gradient of climb determined in accordance with CS 25.121(b) is greater than one-half of the applicable actual-to-net take-off flight path gradient reduction defined in CS 25.115(b).

(d) *Approach.* In a configuration corresponding to the normal all-engines-operating procedure in which V_{SR} for this configuration does not exceed 110% of the V_{SR} for the related all-engines-operating landing configuration:

(1) steady gradient of climb may not be less than 2·1% for two-engined aeroplanes, 2·4% for three-engined aeroplanes and 2·7% for four-engined aeroplanes, with –

(i) The critical engine inoperative, the remaining engines at the go-around power or thrust setting;

(ii) The maximum landing weight;

(iii) A climb speed established in connection with normal landing procedures, but not more than 1·4 V_{SR}; and

(iv) Landing gear retracted.

(2) The requirements of sub-paragraph (d)(1) of this paragraph must be met:

(i) In non-icing conditions; and

(ii) In icing conditions with the most critical of the Approach Ice accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g). The climb speed selected for non-icing conditions may be used if the climb speed for icing conditions, computed in accordance with sub-paragraph (d)(1)(iii) of this paragraph, does not exceed that for non-icing conditions by more than the greater of 5.6 km/h (3 knots) CAS or 3%.

[Amdt 25/3]
[Amdt 25/16]

AMC 25.121 Climb: One-engine-inoperative

ED Decision 2003/2/RM

1 In showing compliance with CS 25.121 it is accepted that bank angles of up to 2° to 3° toward the operating engine(s) may be used.

2 The height references in CS 25.121 should be interpreted as geometrical heights.

AMC 25.121(a) Climb: One-engine-inoperative

ED Decision 2003/2/RM

The configuration of the landing gear used in showing compliance with the climb requirements of CS 25.121(a) may be that finally achieved following ‘gear down’ selection.

AMC 25.121(a)(1) Climb: One-engine-inoperative

ED Decision 2003/2/RM

A 'power operating condition' more critical than that existing at the time when retraction of the landing gear is begun would occur, for example, if water injection were discontinued prior to reaching the point at which the landing gear is fully retracted.

AMC 25.121(b)(1)(i) Climb: One-engine-inoperative

ED Decision 2007/010/R

A 'power operating condition' more critical than that existing at the time the landing gear is fully retracted would occur, for example, if water injection were discontinued prior to reaching a gross height of 122 m (400 ft).

[Amdt 25/3]

CS 25.123 En-route flight paths

ED Decision 2015/008/R

(See AMC 25.123)

(a) For the en-route configuration, the flight paths prescribed in sub-paragraphs (b) and (c) of this paragraph must be determined at each weight, altitude, and ambient temperature, within the operating limits established for the aeroplane. The variation of weight along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, may be included in the computation. The flight paths must be determined at a selected speed not less than V_{FTO}, with –

(1) The most unfavourable centre of gravity;

(2) The critical engines inoperative;

(3) The remaining engines at the available maximum continuous power or thrust; and

(4) The means for controlling the engine-cooling air supply in the position that provides adequate cooling in the hot-day condition.

(b) The one-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1·1% for two-engined aeroplanes, 1·4% for three-engined aeroplanes, and 1·6% for four-engined aeroplanes.

(1) In non-icing conditions; and

(2) In icing conditions with the "En-route Ice" accretion defined in Appendices C and O, as applicable, in accordance with CS 25.21(g), if:

(i) A speed of $1.18V_{SR}$ with the most critical of the "En-route Ice " accretion(s) exceeds the en-route speed selected in non-icing conditions by more than the greater of 5.6 km/h (3 knots) CAS or 3% of V_{SR}, or

(ii) The degradation of the gradient of climb is greater than one-half of the applicable actual-to-net flight path reduction defined in sub-paragraph (b) of this paragraph.

(c) For three- or four-engined aeroplanes, the two-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient climb of 0·3% for three-engined aeroplanes and 0·5% for four-engined aeroplanes.

[Amdt 25/3]
[Amdt 25/16]

AMC 25.123 En-route flight paths

ED Decision 2003/2/RM

If, in showing compliance with CS 25.123, any credit is to be taken for the progressive use of fuel by the operating engines, the fuel flow rate should be assumed to be 80% of the engine specification flow rate at maximum continuous power, unless a more appropriate figure has been substantiated by flight tests.

CS 25.125 Landing

ED Decision 2016/010/R

(a) The horizontal distance necessary to land and to come to a complete stop from a point 15 m (50 ft) above the landing surface must be determined (for standard temperatures, at each weight, altitude and wind within the operational limits established by the applicant for the aeroplane):

(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, 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 9.3 km/h (5 knots) CAS at the maximum landing weight

(b) In determining the distance in (a):

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

(2) A stabilised approach, with a calibrated airspeed of not less than V_{REF}, must be maintained down to the 15 m (50 ft) height.

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

(A) 1.23 V_{SR0};

(B) V_{MCL} established under CS25.149(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 sub-paragraph (b)(2)(i) of this paragraph;

(B) 1.23 V_{SR0} with the most critical of the "Landing Ice" accretion(s) defined in Appendices C and O, as applicable, in accordance with CS 25.21(g), if that speed exceeds V_{REF} for non-icing conditions by more than 9.3 km/h (5 knots) CAS; and

(C) A speed that provides the manoeuvring capability specified in CS 25.143(h) with the most critical of the " Landing ice accretion(s) defined in appendices C and O, as applicable, in accordance with CS 25.21(g).

(3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for service operation. (See AMC 25.125(b)(3).)

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

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

(c) The landing distance must be determined on a level, smooth, dry, hard-surfaced runway. (See AMC 25.125(c).) In addition –

(1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer;

(2) The brakes may not be used so as to cause excessive wear of brakes or tyres (see AMC 25.125(c)(2)); and

(3) Means other than wheel brakes may be used if that means –

(i) Is safe and reliable;

(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 aeroplane.

(d) Reserved.

(e) Reserved.

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

(g) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

[Amdt 25/3]
[Amdt 25/16]
[Amdt 25/18]

AMC 25.125(b)(3) Change of Configuration

ED Decision 2007/010/R

No changes in configuration, addition of thrust, or nose depression should be made after reaching 15 m (50 ft) height.

[Amdt 25/3]

AMC 25.125(c) Landing

ED Decision 2007/010/R

1 During measured landings, if the brakes can be consistently applied in a manner permitting the nose gear to touch down safely, the brakes may be applied with only the main wheels firmly on the ground. Otherwise, the brakes should not be applied until all wheels are firmly on the ground.

2 This is not intended to prevent operation in the normal way of automatic braking systems which, for instance, permit brakes to be selected on before touchdown.

[Amdt 25/3]

AMC 25.125(c)(2) Landing

ED Decision 2007/010/R

To ensure compliance with CS 25.125(c)(2), a series of six measured landings should be conducted on the same set of wheel brakes and tyres.

[Amdt 25/3]

CONTROLLABILITY AND MANOEUVRABILITY

CS 25.143 General

ED Decision 2020/024/R

(a) (See AMC 25.143(a) and (b)) The aeroplane must be safely controllable and manoeuvrable during:

(1) take-off;

(2) climb;

(3) level flight;

(4) descent;

(5) approach and go-around; and

(6) approach and landing.

(b) (See AMC 25.143(a) and (b)) It must be possible to make a smooth transition from one flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the aeroplane limit-load factor under any probable operating conditions, including:

(1) The sudden failure of the critical engine; (See AMC 25.143(b)(1).)

(2) For aeroplanes with three or more engines, the sudden failure of the second critical engine when the aeroplane is in the en-route, approach, or landing configuration and is trimmed with the critical engine inoperative; and

(3) Configuration changes, including deployment or retraction of deceleration devices; and

(4) Go-around manoeuvres with all engines operating. The assessment must include, in addition to controllability and manoeuvrability aspects, the flight crew workload and the risk of a somatogravic illusion. (See AMC 25.143(b)(4))

(c) The aeroplane must be shown to be safely controllable and manoeuvrable with the most critical ice accretion(s) appropriate to the phase of flight as defined in appendices C and O, as applicable, in accordance with CS 25.21(g), and with the critical engine inoperative and its propeller (if applicable) in the minimum drag position:

(1) At the minimum V_2 for take-off;

(2) During an approach and go-around; and

(3) During an approach and landing.

(d) The following table prescribes, for conventional wheel type controls, the maximum control forces permitted during the testing required by sub-paragraphs (a) through (c) of this paragraph. (See AMC 25.143(d)):

Force, in newton (pounds), applied to the control wheel or rudder pedals	Pitch	Roll	Yaw
For short term application for pitch and roll control – two hands available for control	334 (75)	222 (50)	–
For short term application for pitch and roll control – one hand available for control	222 (50)	111 (25)	–
For short term application for yaw control	–	–	667 (150)
For long term application	44,5 (10)	22 (5)	89 (20)

(e) Approved operating procedures or conventional operating practices must be followed when demonstrating compliance with the control force limitations for short term application that are prescribed in sub-paragraph (d) of this paragraph. The aeroplane must be in trim, or as near to being in trim as practical, in the immediately preceding steady flight condition. For the take-off condition, the aeroplane must be trimmed according to the approved operating procedures.

(f) When demonstrating compliance with the control force limitations for long term application that are prescribed in sub-paragraph (d) of this paragraph, the aeroplane must be in trim, or as near to being in trim as practical.

(g) When manoeuvring at a constant airspeed or Mach number (up to V_{FC}/M_{FC}), the stick forces and the gradient of the stick force versus manoeuvring load factor must lie within satisfactory limits. The stick forces must not be so great as to make excessive demands on the pilot's strength when manoeuvring the aeroplane (see AMC No. 1 to CS 25.143(g)), and must not be so low that the aeroplane can easily be overstressed inadvertently. Changes of gradient that occur with changes of load factor must not cause undue difficulty in maintaining control of the aeroplane, and local gradients must not be so low as to result in a danger of over-controlling. (See AMC No. 2 to CS 25.143(g)).

(h) (See AMC 25.143(h)). The manoeuvring capabilities in a constant speed coordinated turn at forward centre of gravity, as specified in the following table, must be free of stall warning or other characteristics that might interfere with normal manoeuvring.

CONFIGURATION	SPEED	MANOEUVRING BANK ANGLE IN A COORDINATED TURN	THRUST/POWER SETTING
TAKE-OFF	V_2	30°	ASYMMETRIC WAT-LIMITED (1)
TAKE-OFF	V_2 + xx (2)	40°	ALL ENGINES OPERATING CLIMB (3)
EN-ROUTE	V_{FTO}	40°	ASYMMETRIC WAT-LIMITED (1)
LANDING	V_{REF}	40°	SYMMETRIC FOR –3° FLIGHT PATH ANGLE

(1) A combination of weight, altitude and temperature (WAT) such that the thrust or power setting produces the minimum climb gradient specified in CS 25.121 for the flight condition.

(2) Airspeed approved for all-engines-operating initial climb.

(3) That thrust or power setting which, in the event of failure of the critical engine and without any crew action to adjust the thrust or power of the remaining engines, would result in the thrust or power specified for the take-off condition at V_2, or any lesser thrust or power setting that is used for all-engines-operating initial climb procedures.

(i) When demonstrating compliance with CS 25.143 in icing conditions -