BAA - BALTIC AVIATION ACADEMY
FLIGHT DISPATCHER COURSE

DAY 5 (1) - PERFORMANCE

Accelerate-Stop Distance Available (ASDA)
The length of the take-off run available plus the length of stopway, if such stopway is declared available by the appropriate authority and is capable of bearing the mass of the airplane under the prevailing operating conditions.

Landing Distance Available (LDA)
The length of the runway which is declared available by the appropriate authority and suitable for the ground run of an airplane landing

Take-off distance available (TODA)
The length of the take-off run available plus the length of the clearway available

Take-off run available (TORA)
The length of runway which is declared available by the appropriate authority

Contaminated Runway
A runway is considered to be contaminated when more then 25% of runway surface area within the required length and width being used is covered by the following:
Surface water more than 3mm deep, or by slush, or loose snow, equivalent to more than 3mm water

Wet Runway
A runway is considered wet when the runway surface is covered with water, or equivalent, less than contaminated runway or when there is sufficient moisture on the runway surface to cause it to appear reflective, but without significant areas of standing water

Damp Runway
A runway is considered damp when the surface is not dry, but when the moisture on it does not give it a shiny appearance

Dry runway
A dry runway is one which is neither wet nor contaminated

Applicability

OPS 1.470

An operator shall ensure that multi-engine airplanes powered by turbo propeller engines with a maximum approved passenger seating configuration of more than 9 or a maximum take-off mass exceeding 5700 kg, and a multi-engine turbojet powered airplanes are operated in accordance with Subpart G (Performance Class A)

An operator shall ensure that propeller driven airplanes with a maximum approved passenger seating configuration of 9 or less, and a maximum take-off mass of 5700 kg or less are operated in accordance with Subpart H (Performance Class B)

An operator shall ensure that airplanes powered by reciprocating engines with a maximum approved passenger seating configuration of more than 9 or a maximum take-off mass exceeding 5700 kg are operated in accordance with Subpart I (Performance Class C)

Where full compliance with the requirements of the appropriate Subpart cannot be shown due to specific design characteristics (example supersonic airplanes or seaplanes), the operator shall apply approved performance standards that ensure a level of safety equivalent to that of the appropriate Subpart.

Take-off

An operator shall ensure that the take-off mass does not exceed the maximum take-off mass specified in the AFM for the pressure altitude and the ambient temperature at the aerodrome at which the take-off is to be made

OPS 1.490 (b)

An operator must meet the following requirements when determining the maximum permitted take-off mass:

- **1.** The Accelerate Stop Distance must not exceed the ASDA
- **2.** The TOD must not exceed the TODA, with a clearway distance not exceeding half of the TORA
- **3.** The Take Off Run must not exceed the TORA
- **4.** Compliance with this paragraph must be shown using a single value of V1 for the rejected and continued take-off
- **5.** On a wet or contaminated runway, the take-off mass must not exceed

that permitted for take-off on a dry runway under the same conditions

When showing a compliance with subgraph (b) above, an operator must take account of the following:

- **1.** The pressure altitude at the airport
- **2.** The ambient temperature at the aerodrome
- **3.** The runway surface condition and the type of runway surface
- **4.** The runway slope In the direction Of take-off
- **5.** Not more than 50% of the reported head-wind component or not less than 150% of the reported tailwind component
- **6.** The loss, if any, of runway length due to alignment of the airplane prior to take-off

Take-off Obstacle Clearance

OPS 1.495 (a)

An operator shall ensure that the net take-off flight path clears:
All obstacles by a vertical distance of at least 35 ft or
By a horizontal distance of at least 90m plus 0,125 X D

Where D is the horizontal distance the airplane has travelled from the end of the take-off distance available or the end of the take-off distance if a turn is scheduled before the end of the TODA

For airplanes with a wingspan of less than 60m a horizontal obstacle clearance of half the airplane wingspan plus 60m, plus 0,125 X D may be used

OPS 1.490 (b)

When showing compliance with subparagraph (a), an operator must take account of the following:

- **1.** The mass of the airplane at the commencement of the Take-Off Run
- **2.** The pressure altitude at the aerodrome
- **3.** The ambient temperature at the aerodrome
- **4.** Not more than 50% of the reported head-wind component or not less than 150% of the reported tailwind component

OPS 1.495 (c)

When showing compliance with subparagraph (a) above:

- **1.** Track changes shall not be allowed up to the point at which the net take-off flight path has achieved a height equal to one half the wingspan but not less than 50 ft above the elevation of the end of the take-off run available. Thereafter up to the height of 400 ft it is assumed that the airplane is banked by no more than 15°. Above 400 ft height bank angles greater than 15°, but not more than 25° may be scheduled

- **2.** Any part of the net take-off flight path in which the airplane is banked more than 15° must clear all obstacles within the horizontal distances specified in the subparagraph (a), (d) and (e) of this paragraph by a vertical distance of at least 50 ft; and

- **3.** An operator must use special procedures, subject to the approval of the Authority, to apply increased bank angles of not more than 20° between 200 ft and 400 ft, or not more than 30° above 400 ft (See Appendix 1 to OPS1.495 (c)(3)).

- **4.** Adequate allowance must be made for the effect of bank angle on operating speeds and flight path including the distance increments resulting from increased operating speeds.

OPS 1495 (f)

An operator shall establish contingency procedures to satisfy the requirements of OPS 1.495 and to provide a safe route,
Avoiding obstacles, to enable the airplane to either comply with the en-route requirements of OPS 1.500, or land at
either the aerodrome of departure or at a take-off alternate aerodrome.

En-route - One Engine Inoperative

OPS 1.490 (b)

An operator shall ensure that the one engine inoperative en-route net flight path data shown in the AFM, appropriate to the meteorological conditions expected for the flight, complies with all points along the route

The net flight path must have a positive gradient at 1500 ft above the aerodrome where the landing is assumed to be made after engine failure

In meteorological conditions requiring the operation of ice protection systems, the effect of their use on the net flight path must be taken into account

Grid MORAs - grid Minimum Off-Route Altitude(s)

The International Standard Atmosphere (ISA)

Standard Atmosphere Modeling

The International reference is based on a sea level of 15 degrees Celsius at a pressure of 1013.25 hPa. The standard density of the air at level is 1.225

Operating Speeds

VMCG may not deviated more than 30 ft laterally from the centerline at any point

VMCA is the calibrated airspeed, at which, when the critical engine is suddenly made inoperative, it the possibility to maintain control of the airplane with that engine still inoperative, and maintain straight and level flight with an angle of bank of not more than 5 degrees

VMCA may not exceed 1.2 VS

During recovery, the airplane may not assume any dangerous attitude or require exceptional piloting skill, alertness, or strength to prevent a heading change of more than 20 degrees

Minimum Control Speed during approach and landing (VMCL)
It must be established with the worstest conditions

Seen on YouTube: Passenger airplane fails to take-off

Decision Speed: V1
VMCG<= VEF<=V1
Recognition Time = 1 sec

Rotation Speed
Vr>1.05Vmca

Lift-Off Speed V_{LOF}

Lift-off Speed (V_{LOF}) is the airspeed at which the airplane first becomes airborne.

Take-off Climb Speed V2

V2min means minimum take-off safety speed
Vs1g means the one-G stall speed at which the airplane can develop a lift force (normal to the flight path) equal to its weight

V2min may not be less than:
1.13VSR1 OR 1.2Vs

Take-Off

V2 > 1.1Vmc

Maximum Brake Energy Speed: Vmbe

V1 <= Vmbe

Maximum Tire Speed Vtire

The tire manufacturer specifies the maximum ground speed that can be reached, in order to limit the centrifugal forces and the heat elevation that may damage the tire structure
Vlof <= Vtire

Take-off Distances REQUIRED

Regulatory background

Amendment 25-42 required the ASD to include **2 seconds of continued acceleration beyond V1 speed**, before the pilot takes any action to stop the airplane. It also introduced the notion of Accelerate-Stop Distance all engines

This revision resulted in longer Accelerate-Stop Distances for airplanes whose application for a type certificate was made after amendment 25-42 became effective

Take-Off Distance (TOD)

TODdry = max of (TODn-1 dry, 1.15 TODn dry)
TODwet = max of (TODwet, TODn-1 wet)

Take-off Run (TOR)

Seen on YouTube: TakeOff Paris CDG - Cockpit View
Seen on YouTube: FAA TAPP Declared Distances
Landing performances are calculated from when we are 50 ft above the runway

Take-Off Run (TOR)

TOR < TORA

TOD < TODA

Climb and Obstacle Limitations

Take-off Flight Path begins 35 ft above the Take-off surface at the end of the Take-off distance

The Take-off path and the Take-off flight path regulatory definitions assumed that the aircraft is accelerated on the ground to Vet, at which point the critical engine is made inoperative and remains inoperative for the rest of the Take-off

Moreover, the V2 speed must be reached before the aircraft is 35 ft above the Take-off surface, and the aircraft must continue at a speed not less than V2, until at least 400 ft above the Take-off surface = (MINIMUM ACCELERATION HEIGHT) or in case obstacles with sufficient obstacle clearance. (Extended 2nd segment)

MAXIMUM ACCELERATION HEIGHT: The Maximum Takeoff Thrust (TOGA) is certified for a **maximum of 10 minutes in case of an engine failure at Take-off.**
5 minutes in case all normal operating cases

JAR/FAR 25.115(a)

Take-off Flight Path

After 35ft the Flight Path begin

Gross Flight Path

Gross performance is what has been observed and measured during flight testing/certification. Gross Performance is what is required for certification purposes.It is the average performance expected from a group/fleet of aircrafts.

Net Flight Path

'Net' performance is that 'gross' performance degraded by a small percentage, to take into account 'real-world' variables (handling skill, wear and tear of engine and airframe, accuracy of data, e.g. meteorolgical, runway).

Net Performance is the performance obtained by reducing the gross performance in specified manner to allow for degradation that cannot be accounted for,due to factors such as difference in operating techniques,due to age-ing of the acft and different climatic conditions at different places.

Net T/O flight path is obtained by reducing the gross climb gradient by:

- **1.** 0.8 percent for two-engine airplanes;
- **2.** 0.9 percent for three-engine airplanes; and
- **3.** 1.0 percent for four-engine airplanes.

The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the takeoff flight path at which the airplane is accelerated in level flight.

It is used for obstacle clearance purposes.

OBSTACLE CLEARANCE
Obstacle Clearance during Straight Take-off

An operator shall ensure that the net take-off flight path clears all the obstacle minimum for 35 ft

Obstacle clearance during a turn

If bank angle <= 15° Obstacle clearance margin 35ft
If bank angle > 15° Obstacle clearance margin 50ft

Meteo Monitor: www.windy.com
sat24.com

Regulatory Take-off Weight Chart (RTOW Charts)

Flexible and Derated Take-off

The aircraft actual Take-off weight is often lower than the maximum regulatory Take-off weight
Therefore, in certain cases, it is possible to Take-off at a thrust levels less than the Maximum Take-off Thrust.
It is advantageous to adjust the thrust to the actual weight, as it increases engine life and reliability, while reducing maintenance and operation costs.

The AFM states that (reduces thrust Take-offs) are not authorized on **contaminated** runways!
They are not authorized on wet runways, unless suitable performance accountability is made for the increased stopping distance on the wet surface.
For Airbus and Boeing aircraft is allowed according certification.

Vtire is that speed calculated considering the Tire Speed Limit

Optimum Altitude

The best aircraft cruise altitude for a given weight and corresponding air temperature. An increase in temperature will lower the level of altitude capability and the optimum altitude.

In technical terms, optimum altitude is defined as the altitude at which the equivalent airspeed for a thrust setting will equal the square root of the coefficient of lift over the coefficient of drag.

From an operational perspective, the optimum altitude **is the most economical altitude, which minimizes total costs related to the operation of the aircraft.**

Modern aircraft equipped with flight management computers (FMC's) have the capability due to display the optimum altitude.

Enroute Limitations

In case of an engine failure during flight, the remaining thrust is no longer sufficient to balance the drag force and to maintain an adeguate cruising speed

The thrust necessary to fly at the initial altitude suddenly becomes greater

Drift Down Procedure

This procedure is not dictated by a performance costraint, but the oxygen system constraint
As the necessary oxygen quantity must be quite significant to supply the entire passenger cabin masks, its flow rate is limited to a maximum duration.
So a new altitude is required.

Engine Failure at Cruise Level
The net flight path penalize

Seen on YouTube: Airbus A340 EMERGENCY - Engine Failure

Oxygen Systems
OPS 1.770

An operator shall not operate a pressurized airplane at pressure altitudes above 10,000 ft unless supplemental oxygen equipment is provided

After a cabin pressurization failure, oxygen is automatically supply to passengers through individual dispensing units, immediately available to each occupant

These units are automatically deployed in case of a cabin pressurization loss, but they only supply oxygen for a limited period of time

The duration of passenger oxygen supply varies, depending on the system

Route Study
Route Study should be based on the most penalizing profile

Vsl = 1.23 Vs1g
Vapp => Vls

For PRE-PLANNING the "Dispatch Landing Distance" is to use which is:
Actual Landing Distance X 1.67 = Safety Factor

Landing distance data must include correction factors for no more than 50% of the nominal wind components along the landing path opposite to the landing direction, and no less than 150% of the nominal wind components

Consider 50% of the Headwind Component, and 150% of the Tailwind component

GO AROUND PERFORMANCE REQUIREMENTS

1.23Vs1g <= V <= 1.41Vs1g and check that V=> Vmcl

Approach	Climb
Minimum climb gradient one engine out	Twin: 2.1% Quad: 2.7%

Equal Field Length

TORA = TODA

Balance Field Length

TODA = ASDA

JAR/FAR 25.111

*(a) The **takeoff path** extends from a standing start to a point at which the aeroplane is at a height:*

- *Of 1500 ft above the takeoff surface, or*

- *At which the transition from the takeoff to the en-route configuration[1] is completed and the final takeoff speed[2] is reached,*

whichever point is higher".

"JAR/FAR 25.115 (a)

*The **takeoff flight path** begins 35 ft above the takeoff surface at the end of the takeoff distance."*

From 35 ft above the surface starts the take-off performance

*From **Lift-Off** to **1500 ft** (referred to **airfield height**) there are the **4 segments of the take-off flight path***

The take-off starts as the throttles are advanced and ends as the aircraft passes through a defined height, called the screen height, at the end of the runway. Depending on the Performance Class and runway conditions the screen height can be either 1sft, 35ft or 50ft.