DOCUMENT
GSM-G-CPL.022

DOCUMENT TITLE

GENERAL OPERATIONS, FLIGHT PLANNING AND PERFORMANCE

CHAPTER 11 – RUNWAYS

Version 1.0
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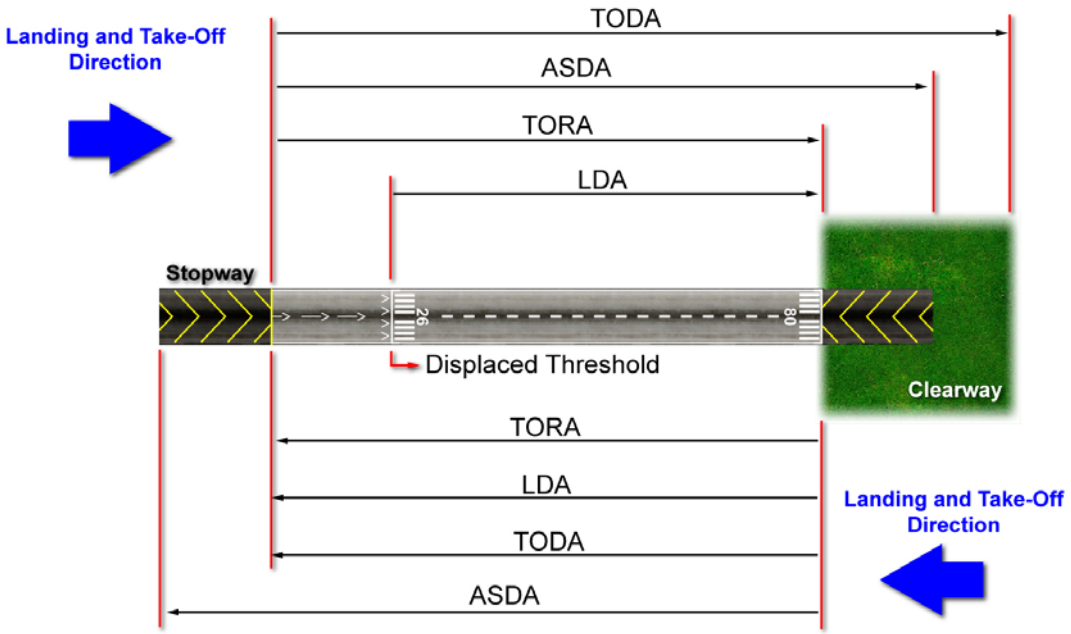
RUNWAYS

Certified and registered airfield have facilities that adhere to the rules and regulations of CASA.

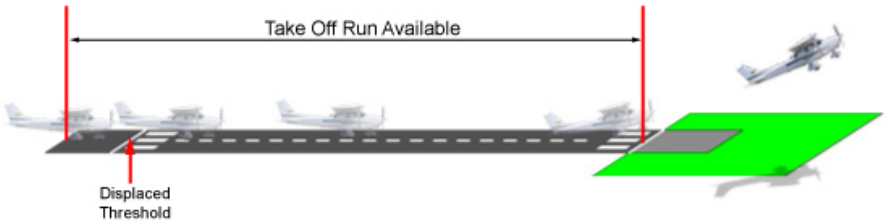
TERMS AND DEFINITIONS

It is important that the following runway terms and definitions are fully understood as they play an integral part of flight planning and aircraft performance:



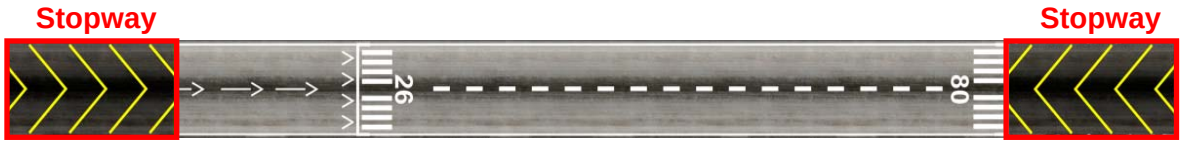
TAKE-OFF RUN AVAILABLE (TORA)

TORA is the length of runway declared available and suitable for the ground run of an aircraft taking off.



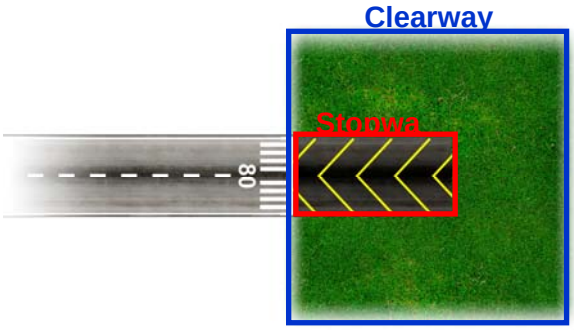
STOPWAY

Stopway is a prepared area at the end of the TORA on which an aircraft can be stopped in the event of an interrupted take-off. A pilot is not permitted to use its length to plan the take-off distance as it may only be used for emergencies.



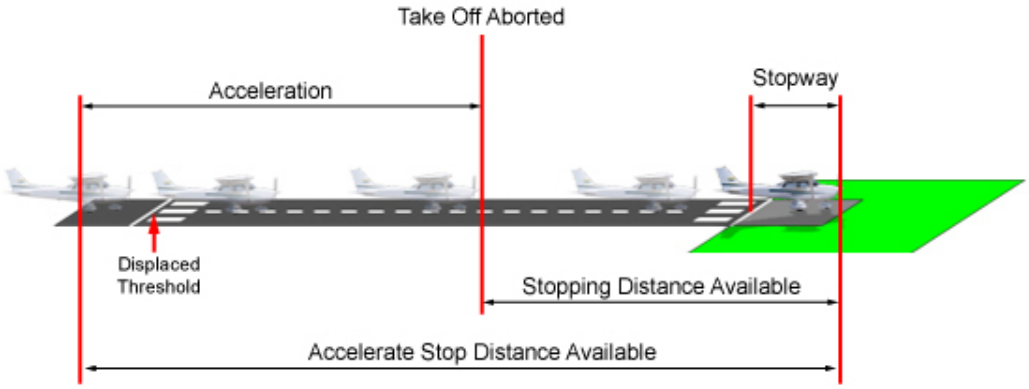
CLEARWAY

Clearway is an area clear of obstacles at the end of the TORA, over which the aircraft may make its lift off to 50 ft at Take-Off Safety Speed. If there is a Stopway it will be included in the clearway.



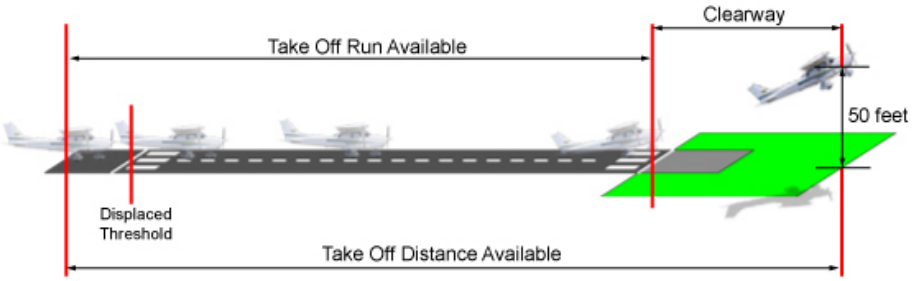
ACCELERATED STOP DISTANCE AVAILABLE (ASDA)

ASDA is the length of the take-off run available plus the length of stopway available (if stopway is provided) – TORA + Stopway



TAKE-OFF DISTANCE AVAILABLE (TODA)

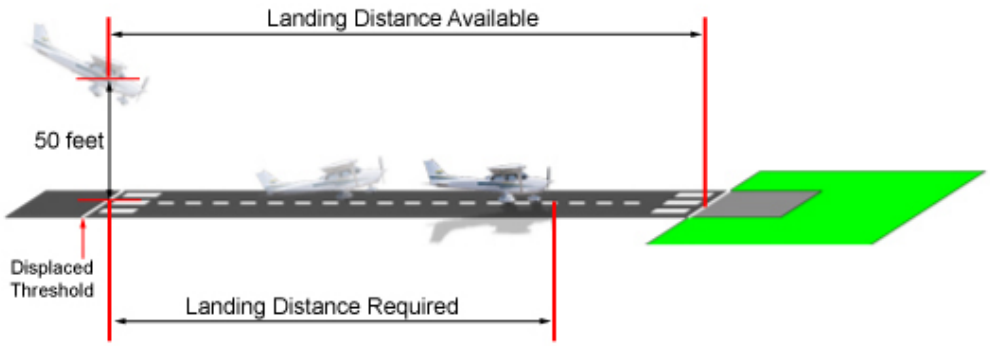
TODA is the length of the take-off run available plus the length of clearway available (if clearway is provided) – TORA + Clearway



The Obstacle Clear **Climb Path** Gradient is surveyed from the end of the TODA to determine an obstacle-clear climb gradient within a defined area beyond the runway. The percentage gradient may be shown in the "Runway distances supplement" section of the ERSA in brackets immediately following the TODA information

LANDING DISTANCE AVAILABLE (LDA)

LDA is described as the length of runway which is declared available and suitable for the ground run of an aircraft landing; it normally extends from threshold to threshold. Take note that a displaced threshold is not included in the calculation of the LDA.



LDA may also be described as the measured landing distance from 50 ft over the threshold at a speed not less than 1.3 times the stall speed, (V_{AT}), to the point where the aircraft comes to a full stop.

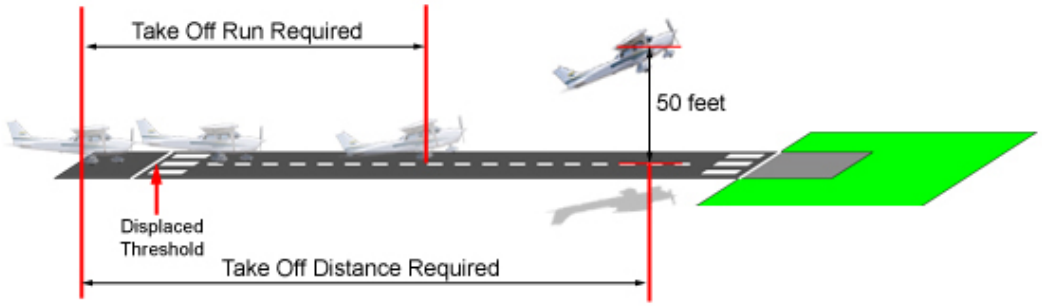
Important ! Landing performance charts and tables are based on a specified approach IAS. Approaching at a higher speed will lengthen the landing distance predicted by the chart or table.

DISTANCE REQUIREMENTS

The **distances required** to take-off and land as determined by the weight of the aircraft in the prevailing conditions must not exceed the **distances available** at the airfield in use. These required distances are abbreviated as TODR, TORR and LDR.

TAKE-OFF DISTANCE REQUIRED (TODR)

TODR is the distance required for an aircraft to get airborne under specified conditions, such as weight, temperature, (density) altitude and climb to 50 ft.

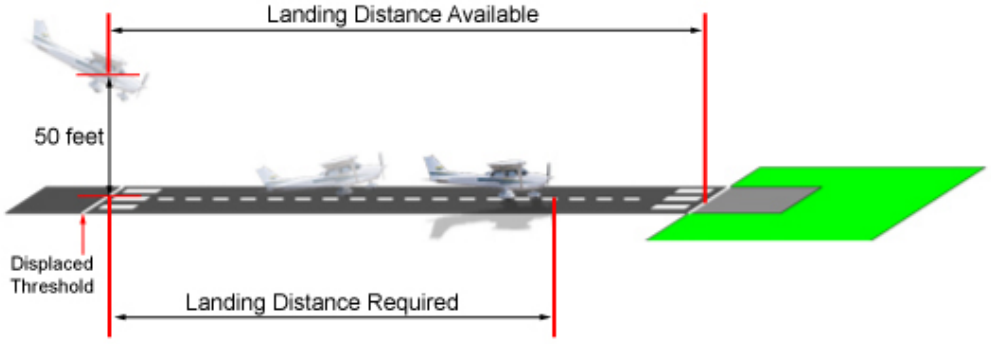


TAKE-OFF RUN REQUIRED (TORR)

TORR is the run required for the aircraft from brake release to get airborne.

LANDING DISTANCE REQUIRED (LDR)

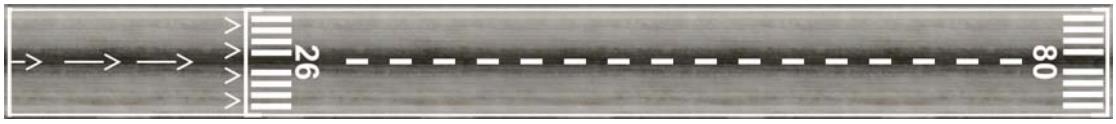
LDR is the horizontal distance between the point on the landing surface at which the aircraft is brought to a full stop and the point on the landing surface which the aircraft crossed at 50 ft at V_{REF}.



RUNWAYS AND RUNWAY MARKINGS

RUNWAY

Runway is a prepared surface for the take-off and landing of aircraft.

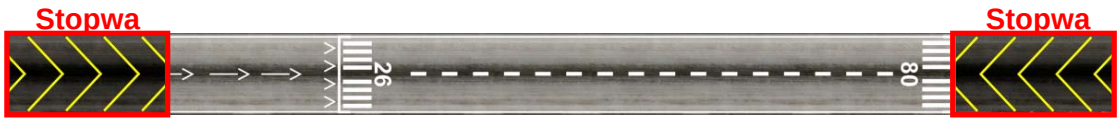


The **Runway** is the entire paved surface, which typically features threshold markings, numbers, centrelines, and overrun areas at both ends.

Note that **Runway Direction and Aircraft Heading** are given as the direction you are facing **relative to Magnetic North**. For convenience, runway direction is declared to the nearest 10^{o}. This designator is an approximation but is also practical, given constant changes in the Earth's Magnetic Field and delays in up-dating publications for specified airfields.

RUNWAY STRIP

Runway Strip is an area which includes Runway and Stopway. The intent is to reduce the risk of damage to an aircraft as it leaves the runway and to protect it when overflying during take-off, landing and missed approach. It is not intended for taxiing or take-off and landing runs.



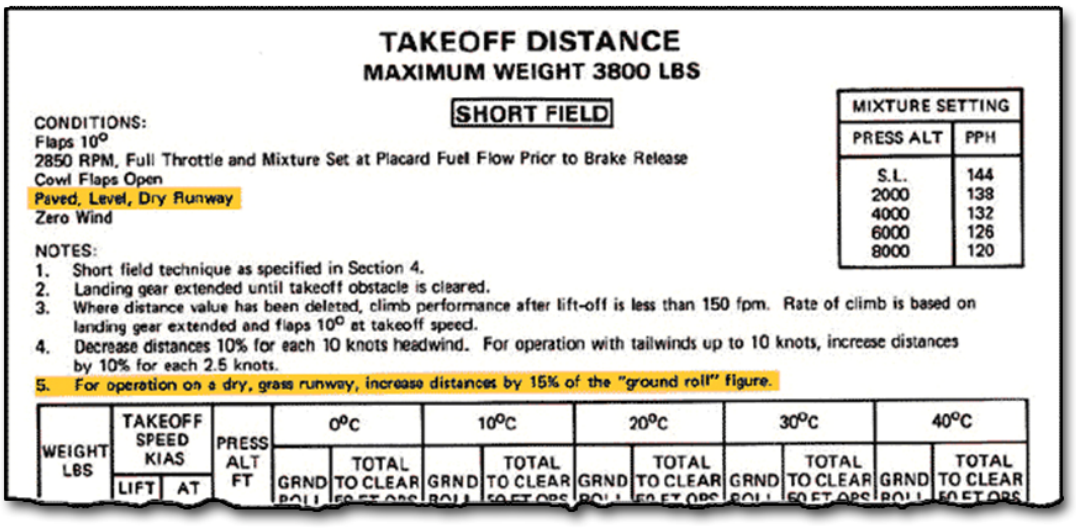
DISPLACE THRESHOLD

A displaced threshold is a threshold located at a point on the runway other than the designated beginning of the runway. White arrows are painted across the width of the runway prior to the threshold bar.

Displaced thresholds may be used for taxiing, take-off, and landing rollout, but not for touchdown. A displaced threshold often exists because obstacles just before the runway, runway strength, or noise restrictions may make the beginning section of runway unsuitable for landings. It is marked with white painted arrows that lead up to the beginning of the landing portion of the runway.

RUNWAY SURFACE CONDITIONS

If the runway surface is contaminated by, for example, water or snow, the aircraft will require more runway length to reach take-off speed. If this extra runway length is not available, the aircraft's take-off weight will have to be reduced. Gravel, grass, snow and rain degrade the performance of the take-off roll. The Aircraft Performance Manual bases take-off run figures on a level paved surface.



TAKEOFF DISTANCE
MAXIMUM WEIGHT 3800 LBS

SHORT FIELD

CONDITIONS:
Flaps 10°
2850 RPM, Full Throttle and Mixture Set at Placard Fuel Flow Prior to Brake Release
Cowl Flaps Open
Paved, Level, Dry Runway
Zero Wind

MIXTURE SETTING	
PRESS ALT	PPH
S.L.	144
2000	138
4000	132
6000	126
8000	120

NOTES:
1. Short field technique as specified in Section 4.
2. Landing gear extended until takeoff obstacle is cleared.
3. Where distance value has been deleted, climb performance after lift-off is less than 150 fpm. Rate of climb is based on landing gear extended and flaps 10° at takeoff speed.
4. Decrease distances 10% for each 10 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2.5 knots.
5. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT	AT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS

Effects of Aquaplaning

This happens when the aircraft tyres are not in direct contact with the runway surface because of a thin film of water between them. This will make the wheels skate along the surface instead of turning over it. Because of this, wheel braking has no effect and directional control can easily be lost. Aquaplaning most likely occurs at high groundspeeds when landing on a very wet runway.

When attempting to land, it is best to have the wheels make a firm contact with the runway in order to break through the film of water. It is recommended to brake intermittently whilst keeping good directional control.

RUNWAY CALCULATIONS

RUNWAY SLOPE OR GRADIENT

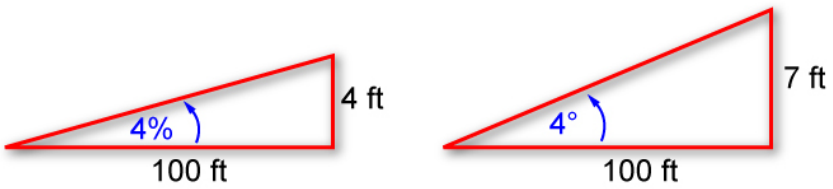
It is clearly more efficient to take-off with a runway that slopes downhill. This can give you a performance increment. In the same way, an uphill runway will give a performance decrement. An uphill slope requires a longer take-off run, and therefore, a possible reduction of the take-off weight. A runway with a downhill slope would have the opposite effect.

A gradient may be expressed in one of the following forms:

- In degrees, e.g. 2° slope
- As a ratio, e.g. 1:100 slope
- As a percentage, e.g. 3% slope.

Note the difference between percentage and degrees.

The left-hand figure represents a slope of 4% while the right-hand slope represents a gradient of 4°. These two gradients are not the same.



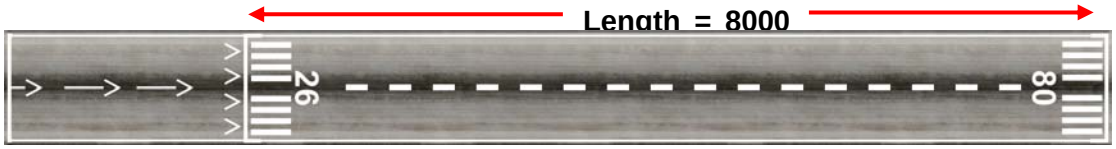
The runway gradient is normally determined by expressing the difference in threshold elevations as a percentage of the length (Rise divided by Run).

$$\text{Slope \%} = \frac{\text{Difference in Threshold Elevations}}{\text{Length (in ft)}} \times 100$$

By convention the slope is expressed as a % correct to 0.1% and is given as down towards the appropriate direction.

Example 1:

Runway 26 threshold elevation is 2 300 ft, runway 08 threshold elevation is 2 402 ft. The runway is 8 000 ft long.



2300 **2402**

The height difference between the thresholds is 102 ft, therefore runway slope is :

$$\frac{102}{8000} \times 100 = 1.28\%$$

Note: Be careful that you use similar units - runway lengths are often given in metres.

The slope information for a particular runway can be obtained by referring to the appropriate aerodrome in the ERSA's Runway Distance Supplement.

Example 2:

ARARAT

RWY	(CN)	TORA	TODA	ASDA	LDA
04	(1)	660 (2165)	720 (2362) (2.37%)	660 (2165)	660 (2165)
22	(1)	660 (2165)	720 (2362) (2.4%)	660 (2165)	660 (2165)
	Slope 0.4% down to NE. RWY WID 30 RWS WID 90				
12	(1)	1240 (4068)	1300 (4265) (1.92%)	1240 (4068)	1240 (4068)
30	(1)	1240 (4068)	1300 (4265) (1.2%)	1240 (4068)	1240 (4068)
	Slope 0.2% down to NW. RWY WID 18 RWS WID 90				

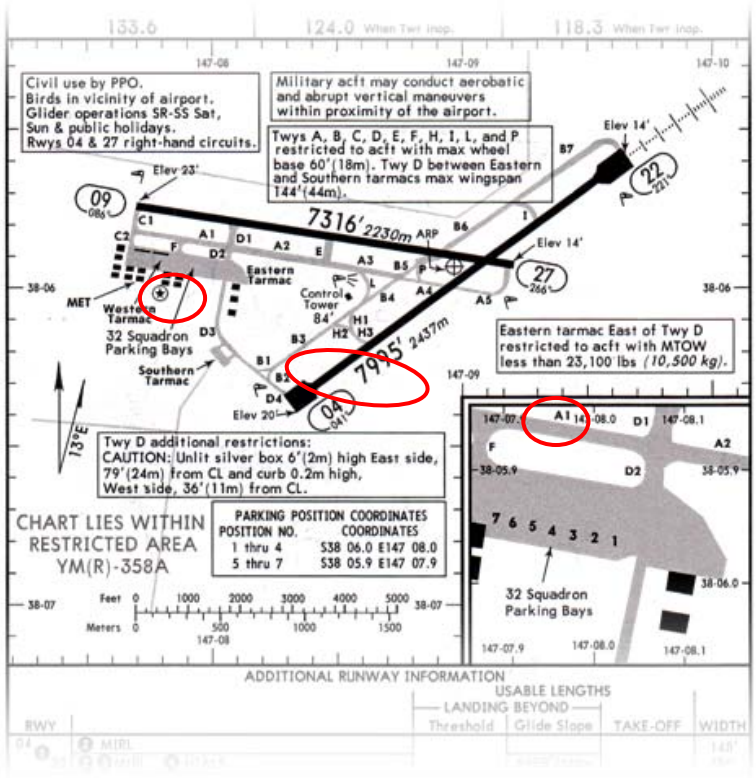
SUPPLEMENTARY TAKEOFF DISTANCES

RWY12 - 1070(3510)(1.6) 1295(4249)(1.9)

Sample from the ERSA

Another method to determine the slope for a particular runway is to use information regarding the airfield as published in Jeppesen or similar publications.

Example 3:



Runway 09/27 - 7316ft

09 Threshold Elevation 23ft

27 Threshold Elevation 14ft

$$\text{Slope \%} = \frac{\text{Difference in Threshold Elevations}}{\text{Length (in ft)}} \times 100$$

$$= \frac{23 - 14}{7316} \times 100$$

1m = 3.28 ft (approximate)

RWY 09/27 Slope = 0.12% - downhill to the East