Aircraft Take-Off Ground Roll Distance

Ground roll to lift-off from weight, wing area, maximum lift coefficient, thrust, rolling friction and drag, with forces taken at 0.7 of lift-off speed.

Method: Take-off ground roll with forces averaged at 0.7 V_LO

Input parameters

Unit system: SI

Parameter	Value	Unit
Take-off weight	12,000	N
Wing area	16.200	m²
Maximum lift coefficient (take-off flaps)	1.8000	
Average thrust during the roll	2,600.0	N
Rolling friction coefficient (0.02 paved, 0.05–0.1 grass)	0.020000	
Lift coefficient during the ground roll	0.50000	
Zero-lift drag coefficient (gear and flaps down)	0.045000	
Induced drag factor 1/(πeAR), with ground effect	0.040000	
Altitude (ISA, geopotential)	500.00	m

Calculated results

Parameter	Value	Unit
Stall speed (take-off configuration)	95.594	km/h
Lift-off speed 1.2 V_s	114.71	km/h
Net accelerating force at 0.7 V_LO	2,148.3	N
Ground roll	289.17	m
Ground roll, thrust only (1.44W²/(gρSC_L,max T))	238.93	m

Notes for this case

• Ground roll s = V_LO²/(2ā) with the forces averaged at 0.7 V_LO; V_LO = 1.2 V_s. The airborne distance to clear a 15 m (50 ft) obstacle is extra, often 30–60 % more.

Formula and method

$$s_{LO} = \frac{1.44W^2}{g\rho S C_{L,max}\left\{T - [D + \mu_r(W - L)]_{0.7V_{LO}}\right\}}, \quad V_{LO} = 1.2V_s$$

Variables

W	Take-off weight	N
S	Wing area	m²
$C_{L,max}$	Maximum lift coefficient (take-off flaps)	-
T	Average thrust during the roll	N
μ_r	Rolling friction coefficient (0.02 paved, 0.05–0.1 grass)	-
$C_{L,g}$	Lift coefficient during the ground roll	-
C_{D0}	Zero-lift drag coefficient (gear and flaps down)	-
k	Induced drag factor 1/(πeAR), with ground effect	-
h	Altitude (ISA, geopotential)	m

V_s	Stall speed (take-off configuration)	m/s
V_{LO}	Lift-off speed 1.2 V_s	m/s
$F_{0.7}$	Net accelerating force at 0.7 V_LO	N
s_{LO}	Ground roll	m
s_{simple}	Ground roll, thrust only (1.44W²/(gρSC_L,max T))	m

Method and standards

Approximate take-off ground roll.

Assumptions and limits

- Level runway, no wind, constant thrust, ISA.

References

Take-off ground roll with forces averaged at 0.7 V_LO

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/aerospace/takeoff-ground-roll

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Reopens the calculator with the inputs of this report.