Aircraft Lift, Drag and Lift-to-Drag Ratio from the Drag Polar

Lift coefficient, induced and total drag, power required and L/D of an aircraft in level flight, with the speed for best L/D, from a parabolic drag polar.

Method: Parabolic drag polar with induced drag

Input parameters

Unit system: SI

Parameter	Value	Unit
Aircraft weight	12,000	N
Wing area	16.200	m²
True airspeed	216.00	km/h
Altitude (ISA, geopotential)	1,500.0	m
Zero-lift drag coefficient	0.027000	
Aspect ratio b²/S	7.4000	
Oswald efficiency factor	0.80000	

Calculated results

Parameter	Value	Unit
Air density (ISA)	1.0581	kg/m³
Lift coefficient W/(qS)	0.38894	
Drag coefficient	0.035134	
Drag (= thrust required)	1,084.0	N
Lift-to-drag ratio	11.070	
Power required DV	65.039	kW
Maximum lift-to-drag ratio	13.123	
Speed for maximum L/D (minimum drag)	160.02	km/h

Notes for this case

- Parabolic drag polar C_D = C_D0 + C_L²/(πeAR) in steady level flight (L = W). Above about Mach 0.6 compressibility drag adds to C_D0.

Formula and method

$$C_L = \frac{W}{\frac{1}{2}\rho V^2 S}, \quad C_D = C_{D0} + \frac{C_L^2}{\pi e AR}, \quad D = \frac{1}{2}\rho V^2 S C_D$$

$$\left(\frac{L}{D}\right)_{max} = \frac{1}{2\sqrt{k C_{D0}}}, \quad V_{md} = \sqrt{\frac{2W}{\rho S}}\left(\frac{k}{C_{D0}}\right)^{1/4}, \quad k = \frac{1}{\pi e AR}$$

Variables

W	Aircraft weight	N
S	Wing area	m²
V	True airspeed	m/s
h	Altitude (ISA, geopotential)	m
C_{D0}	Zero-lift drag coefficient	-

AR	Aspect ratio b²/S	-
e	Oswald efficiency factor	-
ρ	Air density (ISA)	kg/m³
C_L	Lift coefficient W/(qS)	-
C_D	Drag coefficient	-
D	Drag (= thrust required)	N
L/D	Lift-to-drag ratio	-
P_R	Power required DV	W
$(L/D)_{max}$	Maximum lift-to-drag ratio	-
V_{md}	Speed for maximum L/D (minimum drag)	m/s

Method and standards

Steady level flight with a parabolic drag polar.

Assumptions and limits

- Steady level flight, parabolic polar, ISA.

References

Parabolic drag polar with induced drag

Report details

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This calculator online

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