Aircraft Range and Endurance (Breguet Equations): Jet and Propeller

Cruise range and endurance of a jet or propeller aircraft from the fuel burned, lift-to-drag ratio, speed and specific fuel consumption, by the Breguet equations.

Method: Breguet range and endurance equations

Input parameters

Unit system: SI

Parameter	Value	Unit
Aircraft type	Jet (thrust-specific fuel consumption)	
Weight at the start of cruise	600.00	kN
Fuel burned in cruise (weight)	120.00	kN
Lift-to-drag ratio in cruise	16.000	
Cruise true airspeed	828.00	km/h
Thrust-specific fuel consumption (jet)	0.060000	kg/(N·h)
Brake-specific fuel consumption (propeller)	230.00	g/kWh
Propeller efficiency	82.000	%

Calculated results

Parameter	Value	Unit
Range	5,024.2	km
Endurance at that speed	6.0678	h
Cruise fuel fraction	20.000	%
Logarithmic weight ratio	0.22314	

Notes for this case

- Breguet equations for cruise at constant L/D, specific fuel consumption and (jet) speed or (propeller) efficiency. Climb, descent, reserves and wind are not included.

Formula and method

$$\text{jet}: \quad R = \frac{V}{g c_T}\frac{L}{D}\ln\frac{W_0}{W_1}, \quad E = \frac{1}{g c_T}\frac{L}{D}\ln\frac{W_0}{W_1}$$

$$\text{propeller}: \quad R = \frac{\eta_p}{g c_P}\frac{L}{D}\ln\frac{W_0}{W_1}$$

Variables

type	Aircraft type	-
W_0	Weight at the start of cruise	N
W_f	Fuel burned in cruise (weight)	N
L/D	Lift-to-drag ratio in cruise	-
V	Cruise true airspeed	m/s
c_T	Thrust-specific fuel consumption (jet)	kg/(N·s)
c_P	Brake-specific fuel consumption (propeller)	kg/J

η_p	Propeller efficiency	-
R	Range	m
E	Endurance at that speed	s
W_f/W_0	Cruise fuel fraction	-
$\ln(W_0/W_1)$	Logarithmic weight ratio	-

Method and standards

Breguet cruise equations.

Assumptions and limits

- Constant L/D and specific fuel consumption; steady cruise.

References

Breguet range and endurance equations

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/breguet-range-endurance

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Reopens the calculator with the inputs of this report.