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Airspeed Definitions

AE460 Aircraft Design

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Background

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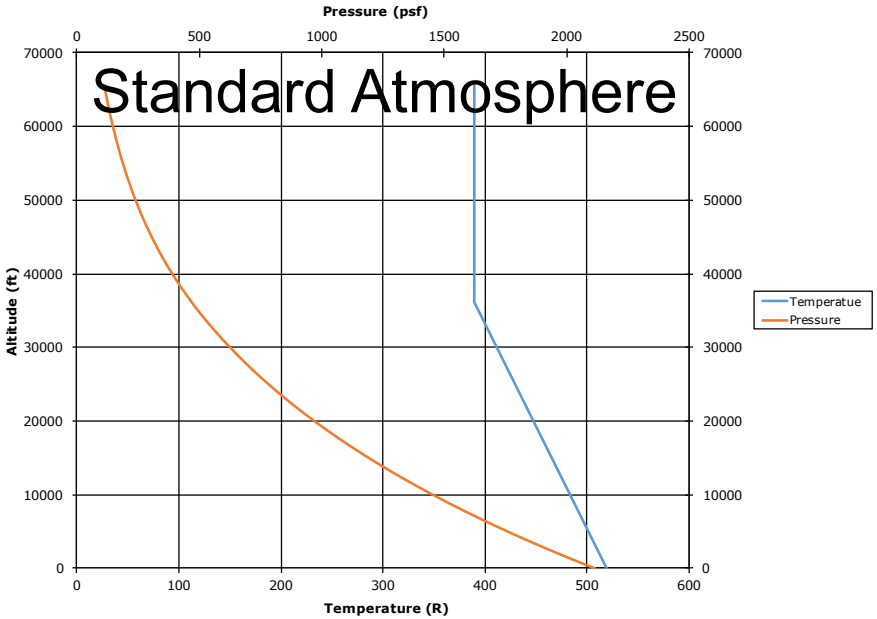
- Most aerospace classes use Mach (M) and/or True Airspeed (V_∞) for calculations, but there are other airspeeds to consider for other purposes.
- This lecture describes the various airspeeds and how to calculate them.
- Example: (my airspeed calculator that I use in many of my spreadsheets)
  - Altitude and M are the inputs

Use this website to check your calculator:
http://www.hochwarth.com/misc/AviationCalculator.html

Altitude (h)	20000	ft	
Mach (M)	0.8		
Temperature (T)	447.5	R	Standard Atmosphere
Pressure (P)	971.7	psf	Standard Atmosphere
Density (ρ)	0.001265	slug/ft^3	Standard Atmosphere
Speed of Sound (a)	1036.9	ft/s	
Dynamic Pressure (q_c)	509.49	psf	Raymer p781
Airspeed (V_∞)	491.5	KTAS	Raymer p781
Airspeed (V_∞)	829.5	ft/s	
Equivalent Air Speed	358.6	KEAS	Raymer p781
Corrected Airspeed	372.9	KCAS	Raymer p781



Airspeed Definitions (Raymer)

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- IAS – Indicated Airspeed. As read from the cockpit instruments
- CAS - Calibrated Air Speed. IAS corrected for airspeed and instrument error (every aircraft is different and is calibrated during flight test)
- EAS – Equivalent Airspeed. CAS corrected for compressibility effects.
- TAS – True Airspeed. EAS corrected for density (altitude)

Airspeed Calculations (Raymer[1])

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Assume CAS=IAS in preliminary design

$$EAS = \frac{CAS}{\sqrt{\frac{P}{P_0}}}\left[\frac{\left(\frac{q_c}{P}+1\right)^{.286}-1}{\left(\frac{q_c}{P_0}+1\right)^{.286}-1}\right]$$

$$TAS = \frac{EAS}{\sqrt{\frac{\rho}{\rho_0}}}$$

$$M = \frac{TAS}{a}$$

Where:

$q_c = P([1+.2M^2]^{3.5}-1)$

a = *speed of sound*

P_0 = *pressure at sea level*

ρ_0 = *density at sea level*

[1]Raymer, Dan. Aircraft Design: *A Conceptual Approach*. Reston, Virginia: AIAA, 2006.

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