

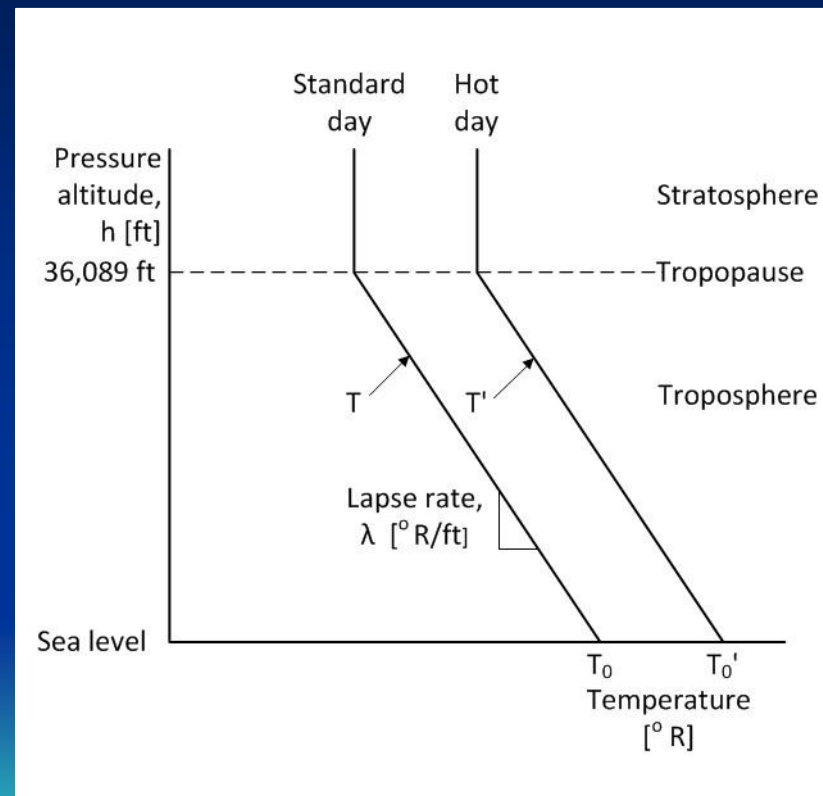
Appendix B

Characteristics of the Atmosphere

2016-04-25

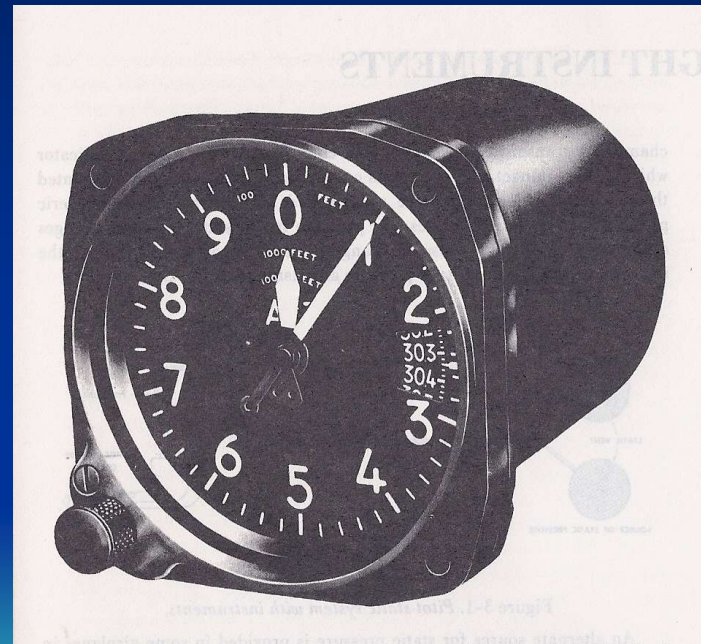
International Standard Atmosphere

- Constant lapse rate to tropopause (36,089 ft MSL)
- Constant temperature in stratosphere up to ~ 65,600 ft MSL)
- Altitude is pressure altitude unless stated otherwise
- In practice, lapse rate is not uniform

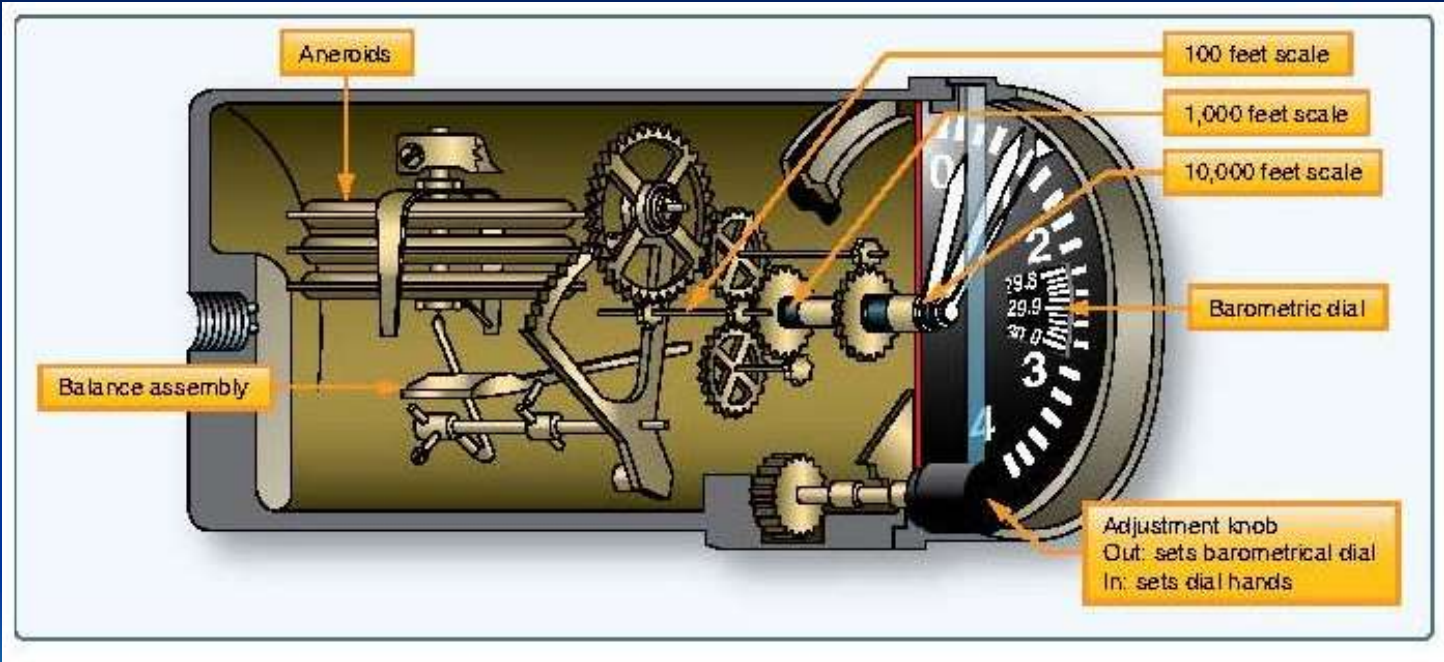


Altimeter

- Altimeter measures pressure, not altitude
- Pressure measured by an aneroid barometer, and converted to an altitude on display



Altimeter



Atmospheric Model Assumptions

Constant	Symbol	Value
Temperature lapse rate	λ	-0.003566 °R/ft
Gas constant	R	53.35 ft/°R
Sea level pressure	p_o	2116.2 lb/ft ²
Sea level temperature	T_o	518.7 °R
Sea level density	ρ_o	0.002377 slugs/ft ³
Gravitational constant	g	32.17 ft/sec ²
Specific heat ratio	γ	1.4

Standard Day Conditions

In Troposphere

$$T = T_0 + \lambda h$$

$$p = p_0 \left(1 + \frac{\lambda h}{T_0} \right)^{5.2561}$$

$$\rho = \frac{p}{gRT}$$

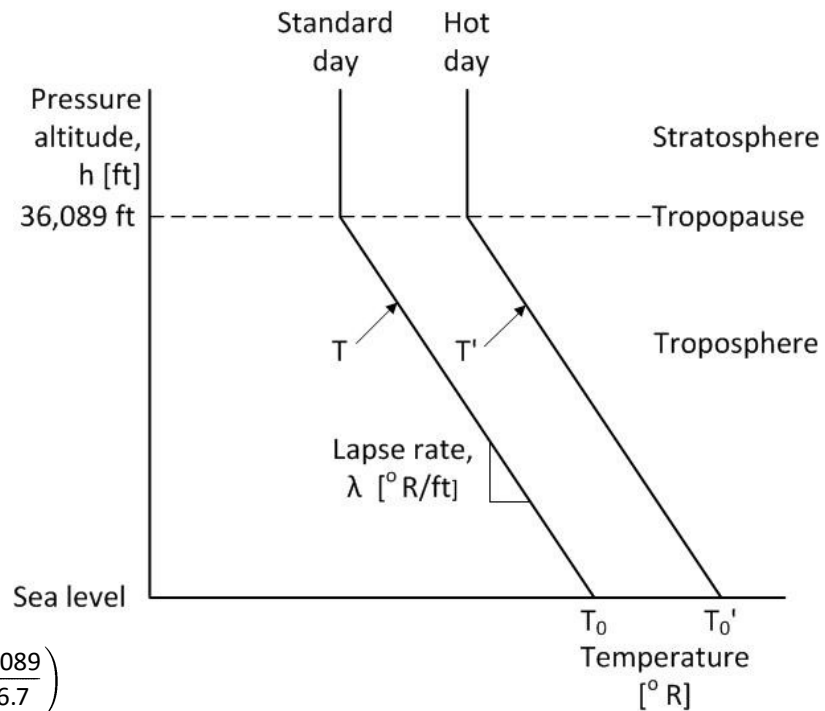
Speed of sound

$$a = \sqrt{\gamma gRT}$$

In Stratosphere

$$T = 390^\circ \text{ R}$$

$$p = p_0 0.2234 e^{-\left(\frac{h-36089}{20806.7}\right)}$$



Hot Day Conditions

In Troposphere

Temperature offset is

$$T' = T + \Delta T$$

Temperature at altitude h is

$$T' = T_0' + \lambda h$$

$$\rho' = \frac{\rho}{gRT'}$$

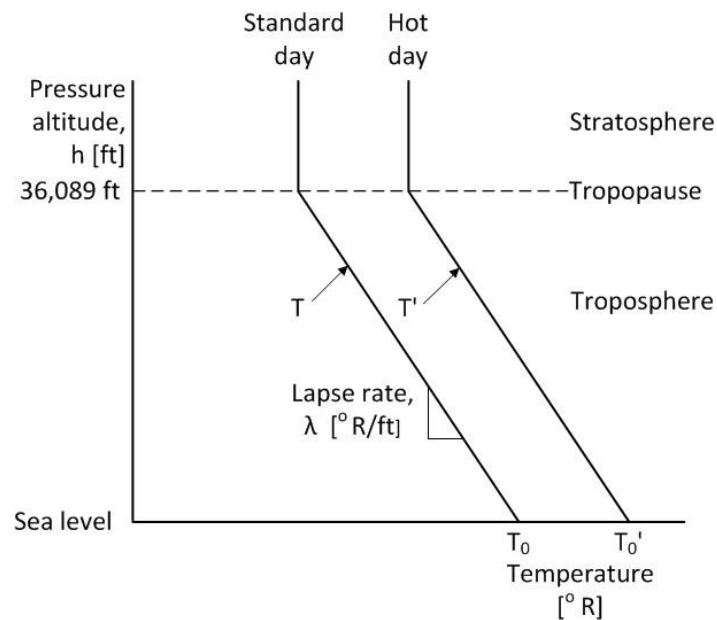
Speed of sound

$$a = \sqrt{\gamma gRT}$$

In Stratosphere

$$T = 390 + \Delta T^\circ R$$

$$p = p_0 0.2234 e^{-\left(\frac{h - 36089}{20806.7}\right)}$$



Hot Day Conditions

- On a hot day the atmosphere expands upward
- At a given geometric altitude, the altimeter will experience a higher pressure (and show a lower altitude), than for a standard day
- E.g., on an ISA +10 C (+18 F) day, an aircraft at a geometric altitude of 6,000 ft MSL will show a pressure altitude of 5,795 ft

