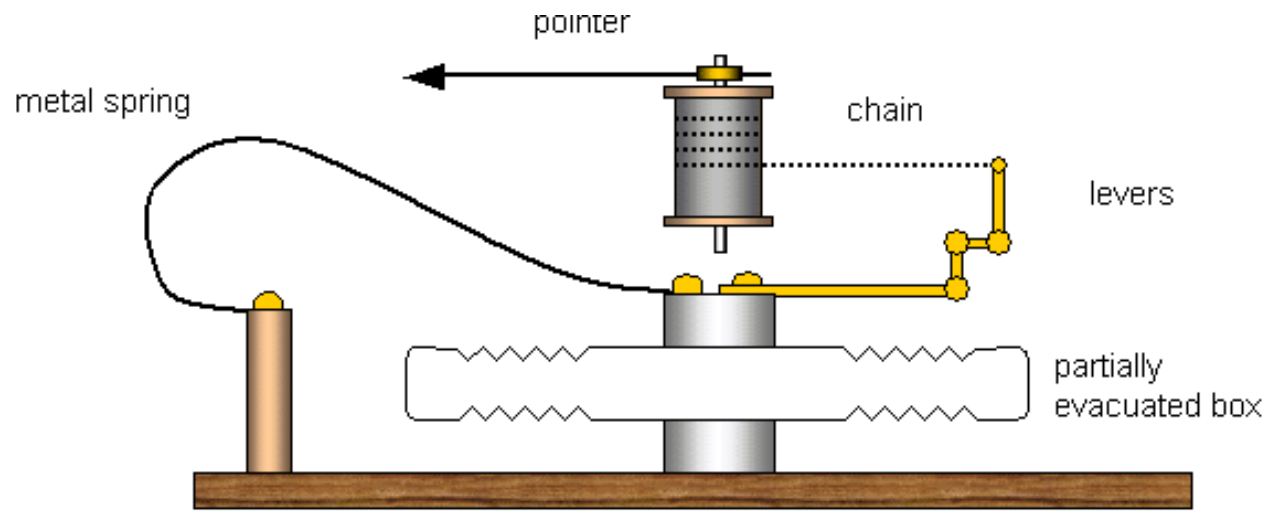




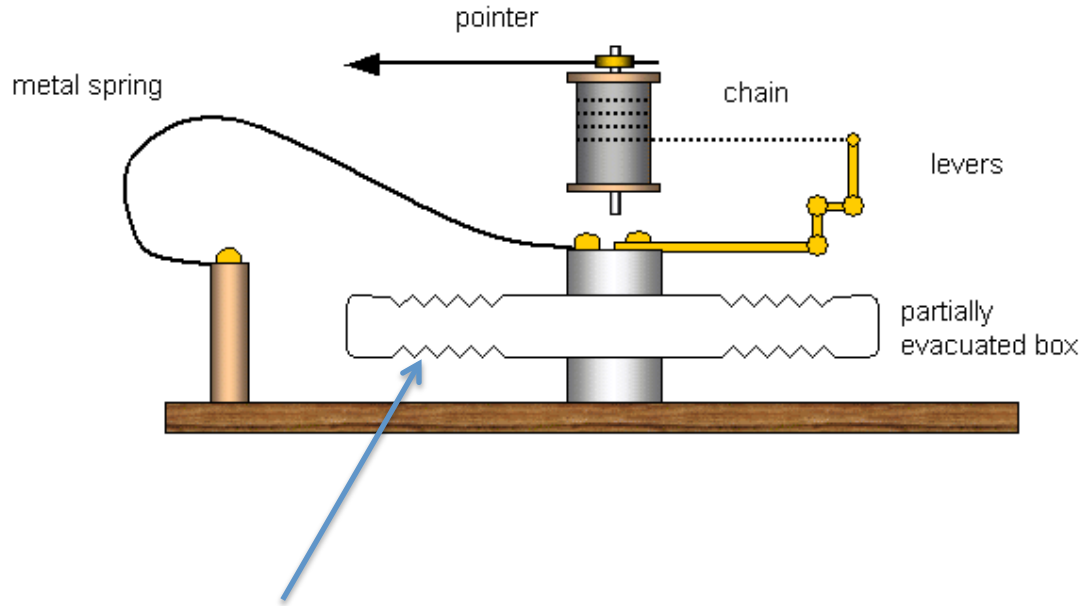
# **De-Mystify Aviation Altimetry**

**What an Aircraft Altimeter Really  
Tells You, And What It Doesn't!**

# Basic Altimeter is Just a Modified Barometer

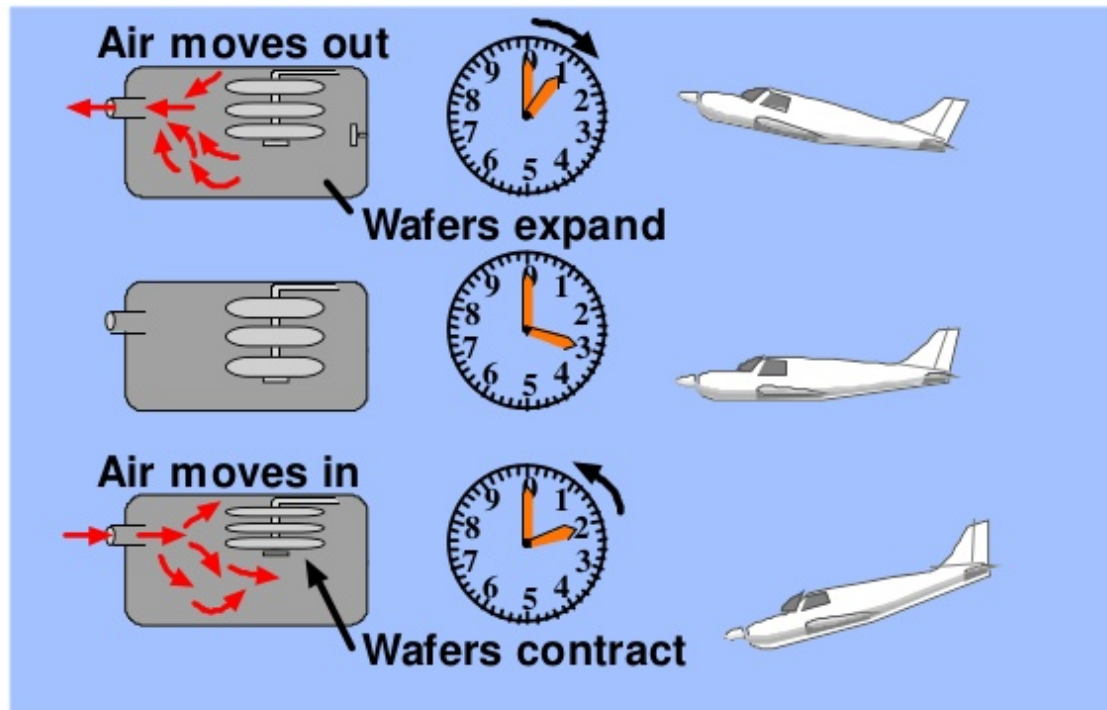


# Basic Aneroid Barometer



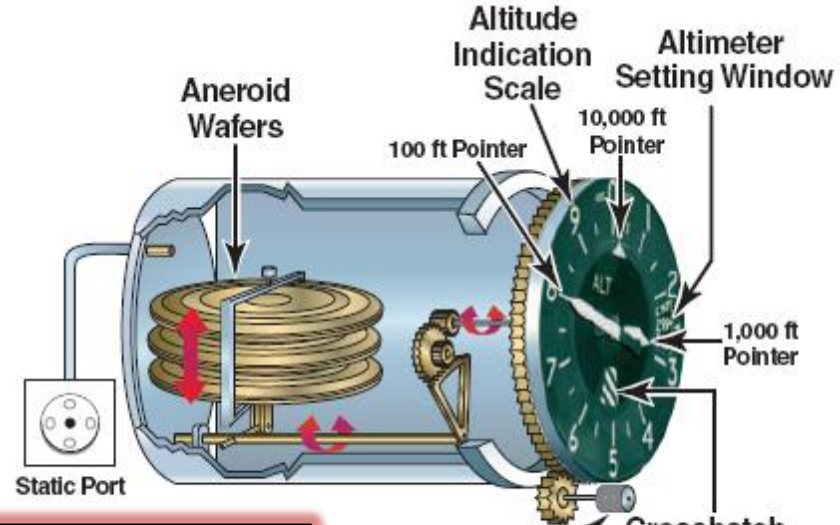
- Changes in Atmospheric Air Pressure Cause Diaphragm to Expand or Contract
- Results in Mechanical Motion to Change Pointer
- Temperature Compensation, If Any, Uses a Calibration Table

# Altimeter Operation



# Aircraft Altimeter

There is No  
Temperature  
Compensation  
In An  
Aircraft  
Altimeter!!!

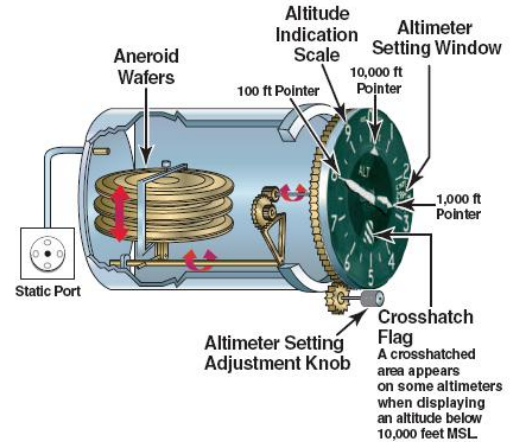


This Provides  
Pressure  
Compensation

A crosshatched area appears on some altimeters when displaying an altitude below 10,000 feet MSL.

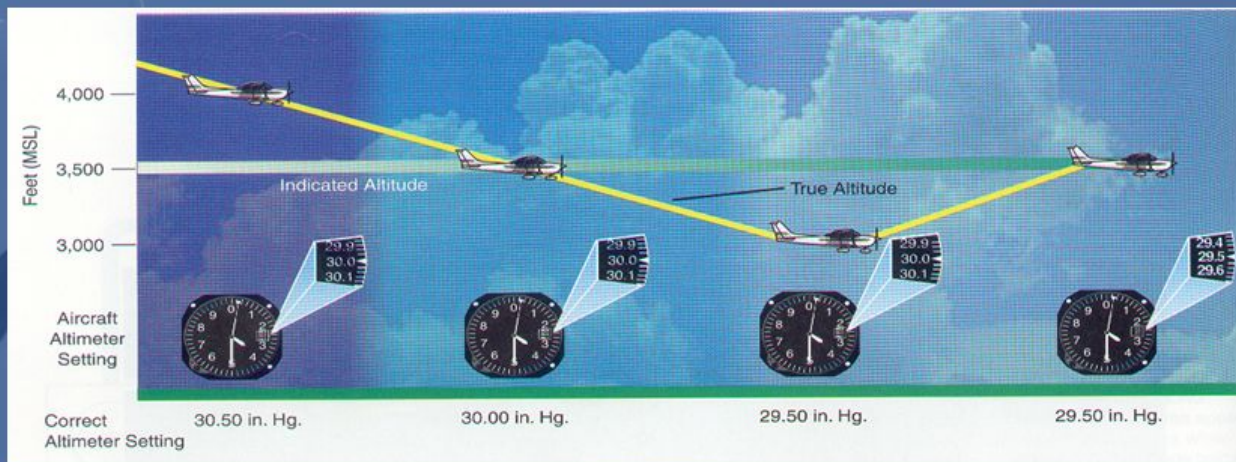
# Pressure Error Compensation

- ISA = 29.92" Hg at Mean Sea Level
- As Local Pressure Changes Altimeter Changes
- 1" Hg Decrease in Pressure Results In ~1,000' Increase in Altitude



# Don't Set Pressure as You Fly?

- Pressure Error
  - High to Low-Look out below, low to high plenty of sky
  - Need to set in current altimeter setting



# MSL Altitude

- Altitude Referenced to Mean Sea Level
  - What We See When We Set Altimeter to Local Barometric Pressure
  - Not An Exact Measure
  - Contains A Temperature Error

Recall,  
There is No  
Temperature  
Compensation  
In An  
Aircraft  
Altimeter!!!

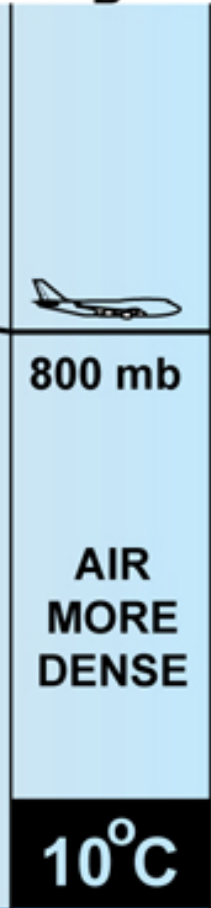
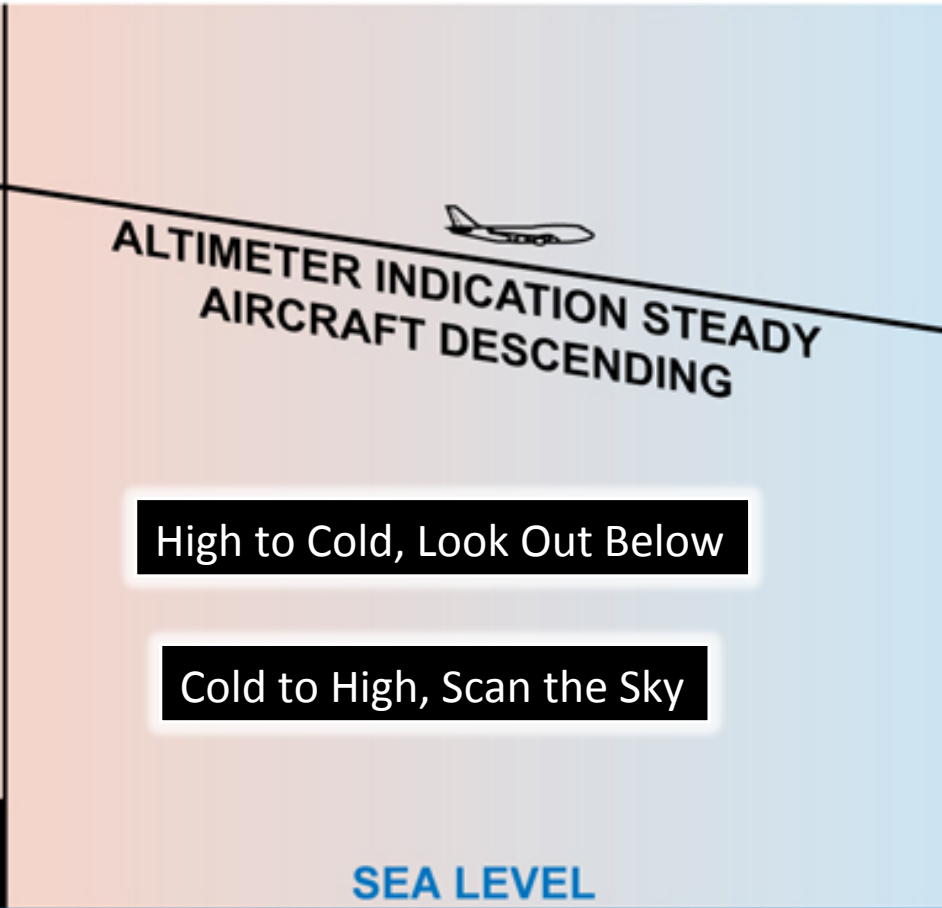


COLUMN

A

COLUMN

B



AIRCRAFT AT X ft ALTITUDE

AIRCRAFT AT LESS THAN X ft ALTITUDE

1000 mb

1000 mb

High to Cold, Look Out Below

Cold to High, Scan the Sky

AIR MORE DENSE

SEA LEVEL

# Example

What is Estimate of True Altitude With Altimeter Reading 10,000', Baro 29.92" Hg, and Field Elevation 5,000' Reporting -30 deg C?

Hints: Use E6B and Recognize Our MSL Altimeter Reading is Also the Same as Pressure Altitude; Estimate OAT Based on ISA Lapse Rate From Field Temperature

Recall, True Altitude is Height Above MSL

Answer: True Altitude ~ 9,000'

# Temperature Error (cont.)

TBL 7-2-3  
ICAO Cold Temperature Error Table

- E6B Gives Approximate Answer
- Can Use Table 7-2-3 From AIM
- Subtract 950'

		Height Above Airport in Feet													
		200	300	400	500	600	700	800	900	1000	1500	2000	3000	4000	5000
Reported Temp °C	+10	10	10	10	10	20	20	20	20	20	30	40	60	80	90
	0	20	20	30	30	40	40	50	50	60	90	120	170	230	280
	-10	20	30	40	50	60	70	80	90	100	150	200	290	390	490
	-20	30	50	60	70	90	100	120	130	140	210	280	420	570	710
	-30	40	60	80	100	120	140	150	170	190	280	380	570	760	950
	-40	50	80	100	120	150	170	190	220	240	360	480	720	970	1210
	-50	60	90	120	150	180	210	240	270	300	450	590	890	1190	1500

True Alt = Altimeter (10,000') - 950'

True Alt = 9,050'

# Operational Implications

- Mountain Flying
- FAA Has List of Cold Weather Restricted Airports
  - [https://www.faa.gov/other\\_visit/aviation\\_industry/airline\\_operators/airline\\_safety/info/all\\_infos/media/2015/info15002.pdf](https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/info/all_infos/media/2015/info15002.pdf)

# Terms

- MSL Altitude – Altitude Corrected for Local Pressure Referenced to Mean Sea Level
- Pressure Altitude – Altitude Referenced to Standard Pressure
- True Altitude – Height Above Mean Sea Level Elevation
- Absolute Altitude or AGL – Height Above Ground

# Summary So Far

- We Only 'See' MSL Altitude When Local Barometer is Set In Kollsman Window
  - MSL Altitude Has a Temperature Error
- Above 17,999' We Fly a 'Pressure Altitude'
  - We Set 29.92" Hg in Kollsman Window
  - Pressure Altitude Has Both a Pressure Error and Temperature Error

# But Wait – There's More

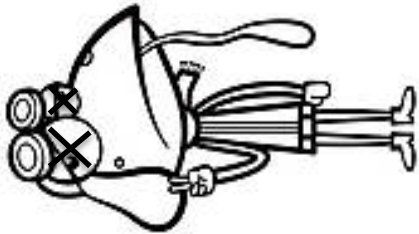


Travis, the  
'Do-Little'  
Frog Sez

**'Oh Man, My Flight Instructor  
Said I Need to Know Density  
Altitude is Pressure Altitude  
Corrected For Non Standard  
Temperature – Why Should I  
Care? I'll Save That for My  
Commercial Rating'**

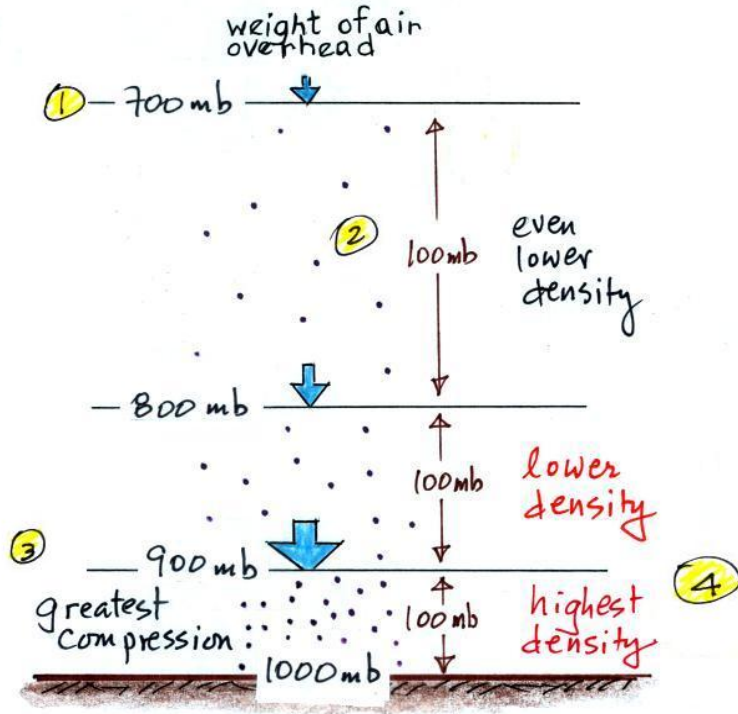
# Density Altitude

- Failure to Account For Density Altitude May Result In:





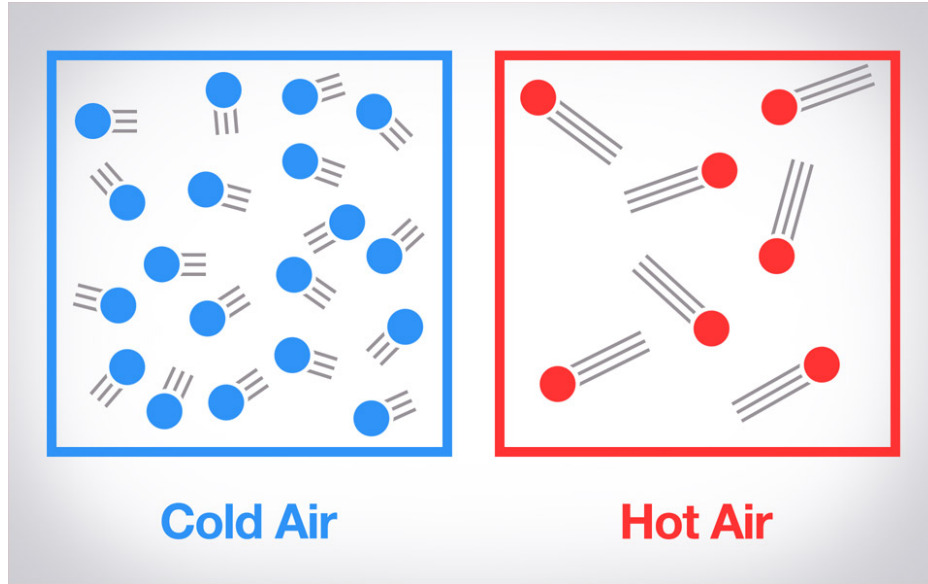
# Density Altitude Depends on Air Density



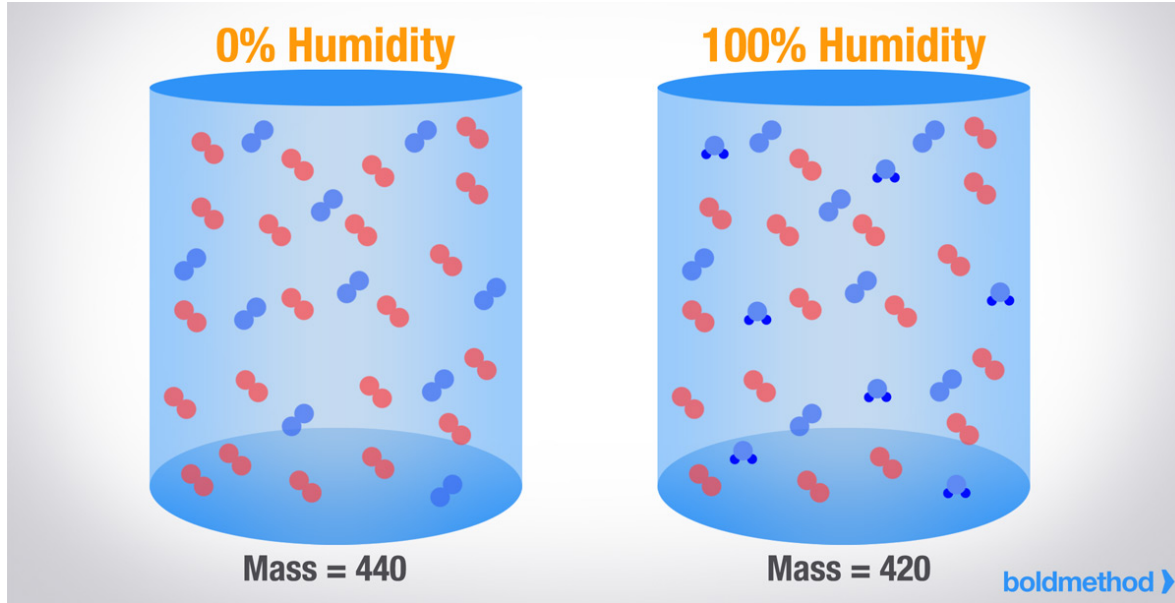
Air Density Changes Due to:

- Pressure
  - Temperature
  - Humidity
- If Pressure Increases, Air Density Increases
  - The Higher We Fly, The Air Becomes Less Dense
  - E.g., at 18,000' the Air Pressure is About 14.95" Hg

# Temperature Effect on Air Density



# Humidity Effect on Air Density



Note: We Normally  
Neglect Humidity in Our  
Computations of Density  
Altitude

# Computation of Density Altitude

- Equation (approximate – only works for feet)

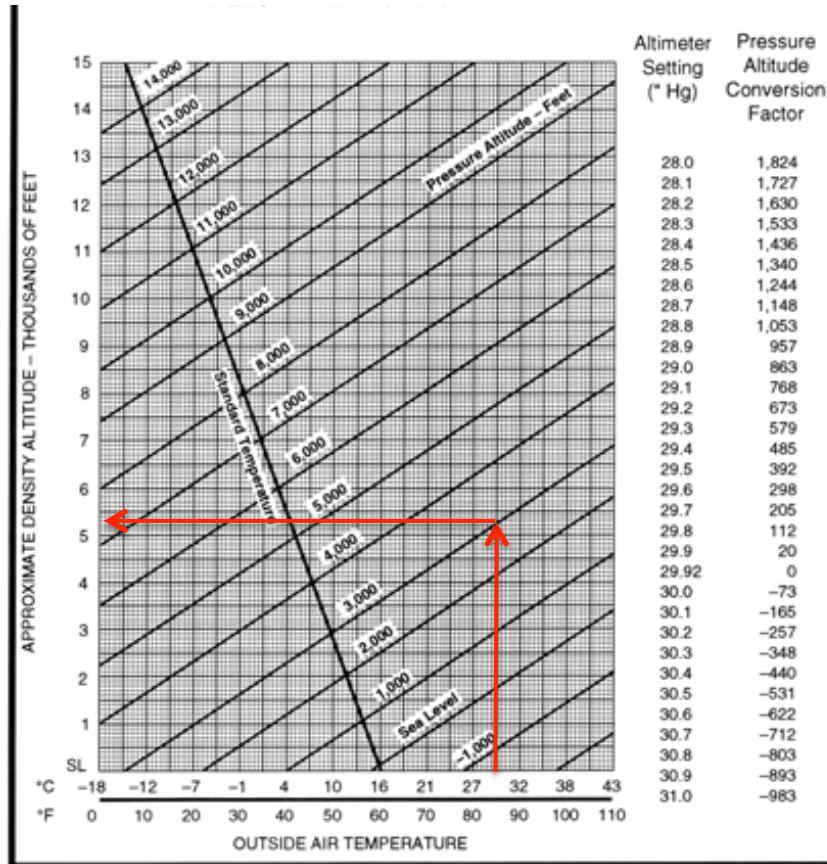
Density Altitude = Pressure Altitude + (120 x (OAT - ISA temperature))

e.g., PA=3,000', OAT=30 degC – what is DA?

DA ~ 5,520'

- Table or Graph (next page, also approximate)
- E6B

# Density Altitude Table



Same as Previous Example  
Result: DA About 5,350'

- E6B Results Depends on User Skill and Accuracy of Individual E6B
- Typically Good Enough for Practical Applications
- Electronic E6Bs More Accurate Than Mechanical E6B, Table, or Equation

# Effects of Density Altitude Are Built Into POH Performance Tables

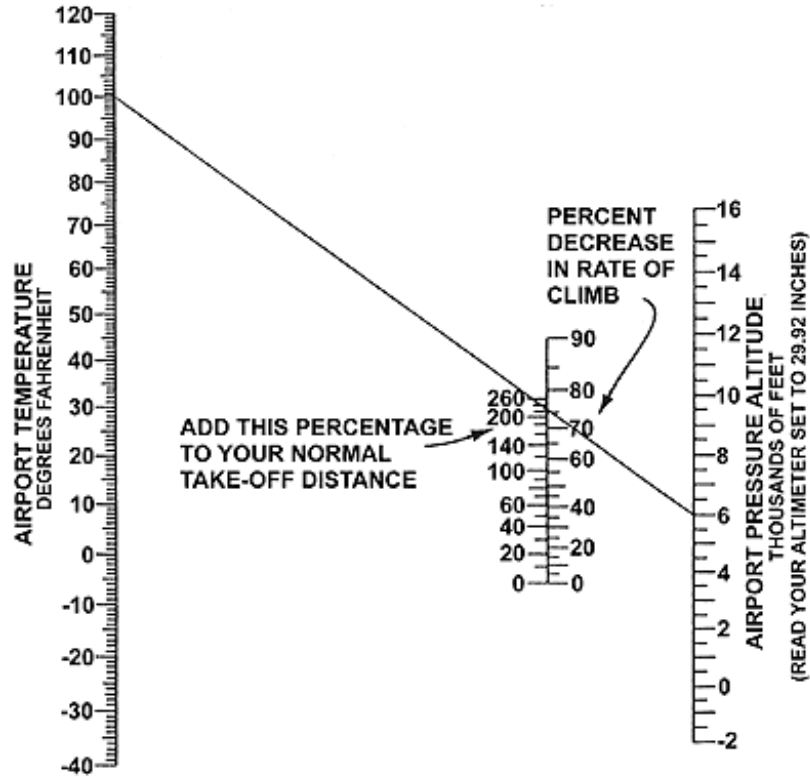
Press Alt In Feet	0°C		10°C		20°C		30°C		40°C	
	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst	Grnd Roll Ft	Total Ft To Clear 50 Ft Obst
S. L.	745	1275	800	1370	860	1470	925	1570	995	1685
1000	810	1390	875	1495	940	1605	1010	1720	1085	1845
2000	885	1520	955	1635	1030	1760	1110	1890	1190	2030
3000	970	1665	1050	1795	1130	1930	1215	2080	1305	2230
4000	1065	1830	1150	1975	1240	2130	1335	2295	1430	2455
5000	1170	2015	1265	2180	1360	2355	1465	2530	1570	2715
6000	1285	2230	1390	2410	1500	2610	1610	2805	1725	3015
7000	1415	2470	1530	2685	1650	2900	1770	3125	1900	3370
8000	1560	2755	1690	3000	1815	3240	1950	3500	2095	3790

Yikes Bubba!  
Maybe Flying  
Into a 2,500' Dirt  
Strip at 6,000' is  
Not Such a Good  
Idea



# Koch Chart

Suggest You Get A Koch Chart, Laminate it, and Put in Your Flight Bag



# Density Altitude Summary

- Definition: Pressure Altitude Corrected for Non-Standard Temperature
- **Operational Implication: What Airplane Thinks Its Altitude Is**
- **Failing To Comprehend Density Altitude**



Actual Screen Shot of Aircraft Accident Due to High Density Altitude, Graphic Aftermath Pictures Omitted