Aircraft Performance

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Engine and Propeller

- Engine - It’s What Makes the Whirly Thing Turn!
- Propeller – It Actually Produces the Thrust

Engine Power

- Rated in Brake Horse Power (bhp)
- 1 bhp = 745.5 Watts
- E.g., Diamond Engine is 100 bhp
- Power is Under Ideal Conditions
- Best Engine Power is Obtained When Optimum Air to Fuel Ratio is Obtained

$$Air\ Fuel\ Ratio\ (AFR) = \frac{Mass\ Air}{Mass\ Gasoline}$$

Engine Power

- As We Increase in Altitude – Air Density (Mass) Decreases – Hence Power Decreases
- Look at Diamond Chart
- What is Difference in Power Between 2,000' to 8,000' at Standard Temperature (15 deg C)?
- Optimum Cruise Altitude (Minimized Fuel Burn at Reasonable KTAS) is About 8,000'

Press Alt ft	RPM	20° C Below Standard Temp			Standard Temperature			10° C Above Standard Temp		
		%bhp	KTAS	GPH	%bhp	KTAS	GPH	%bhp	KTAS	GPH
2,000	2800	87	128	8.8	83	129	8.7	80	130	8.6
	2700	78	123	7.7	74	124	6.8	72	125	6.6
	2600	69	118	6.4	66	119	6.2	64	120	6.1
	2500	61	113	5.9	59	113	5.7	57	114	5.6
	2400	54	107	5.3	52	108	5.2	50	109	5.1
4,000	2800	79	126	8.6	76	127	8.6	74	129	6.8
	2700	71	121	6.6	68	122	6.4	66	123	6.2
	2600	63	116	6	61	117	5.9	59	118	5.7
	2500	56	111	5.5	55	112	5.4	53	113	5.3
	2450	53	108	5.3	51	109	5.1	50	110	5.1
6,000	2800	73	125	6.7	70	126	6.5	69	128	6.4
	2700	66	120	6.2	64	121	6	62	123	5.9
	2600	59	115	5.7	57	116	5.6	56	117	5.5
	2500	53	110	5.2	51	111	5.1	50	112	5
8,000	2800	68	124	6.4	66	125	6.2	65	127	6.1
	2700	61	119	5.9	60	121	5.8	59	122	5.7
	2600	55	114	5.4	54	116	5.3	53	117	5.3
	2550	53	112	5.2	51	113	5.1	50	114	5.1

Propeller Efficiency

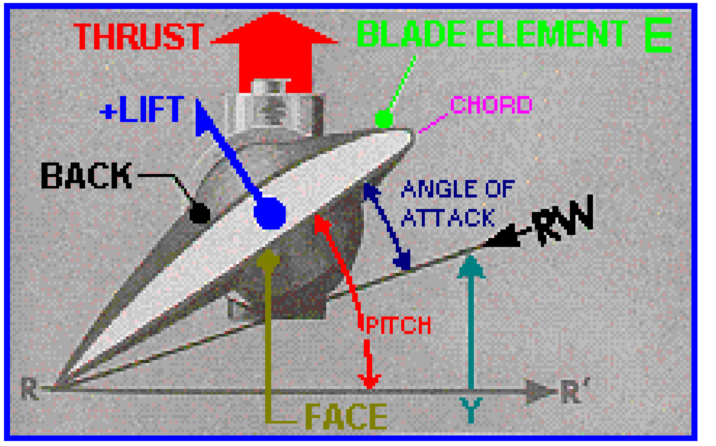
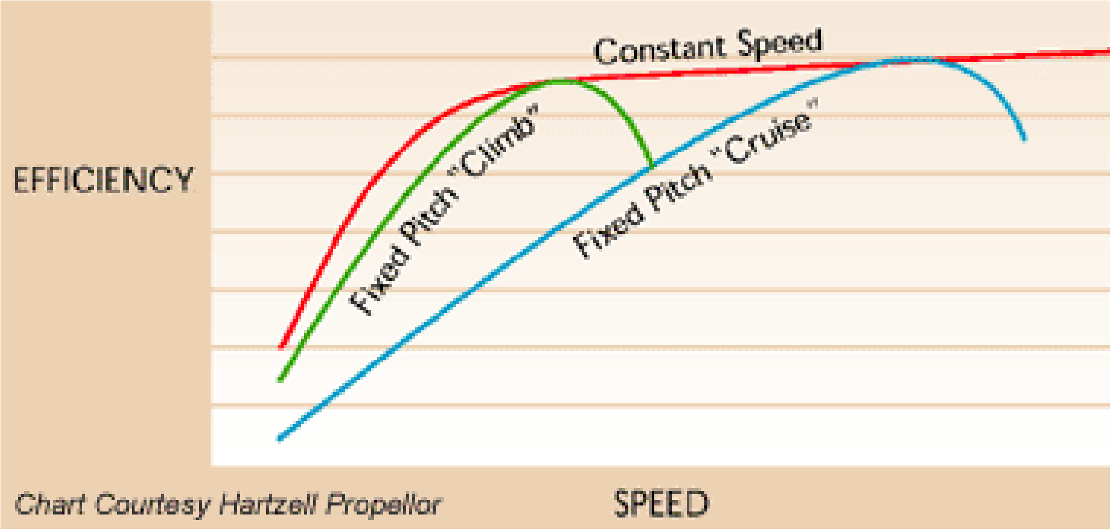


Figure 6-6 End view of propeller elements.

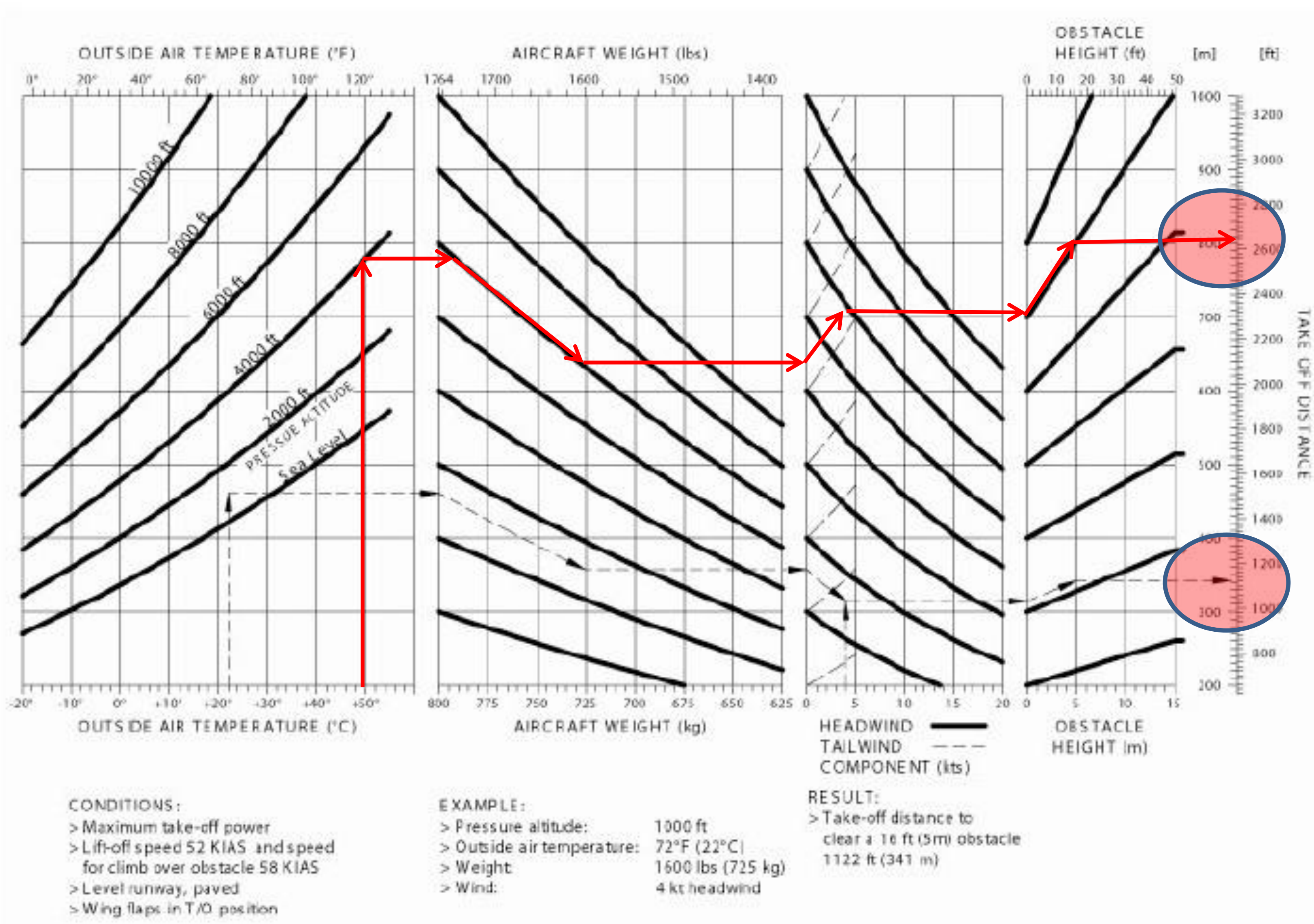
- Typically We Fly GA Airplanes That Have Fixed or Variable Pitch
- The Prop is an Airfoil
- Pitch (Angle of Attack) Determines Performance
- There are Climb and Cruise Props
- A Variable Pitch Let's Us Optimize Performance

Fixed vs Constant Speed

Overall Propeller Efficiency Is Perhaps 80-85% Maximum



Takeoff Performance



Landing and Roll Distance

- Landing Does Not Include Roll-Out
- Need to Consider Gradient of Runway
  – Every +/- 1% Gradient Impacts by +/- 10%
- Tables Include 50’

Table 4 - Landing and Rolling Distances for Heights Above MSL

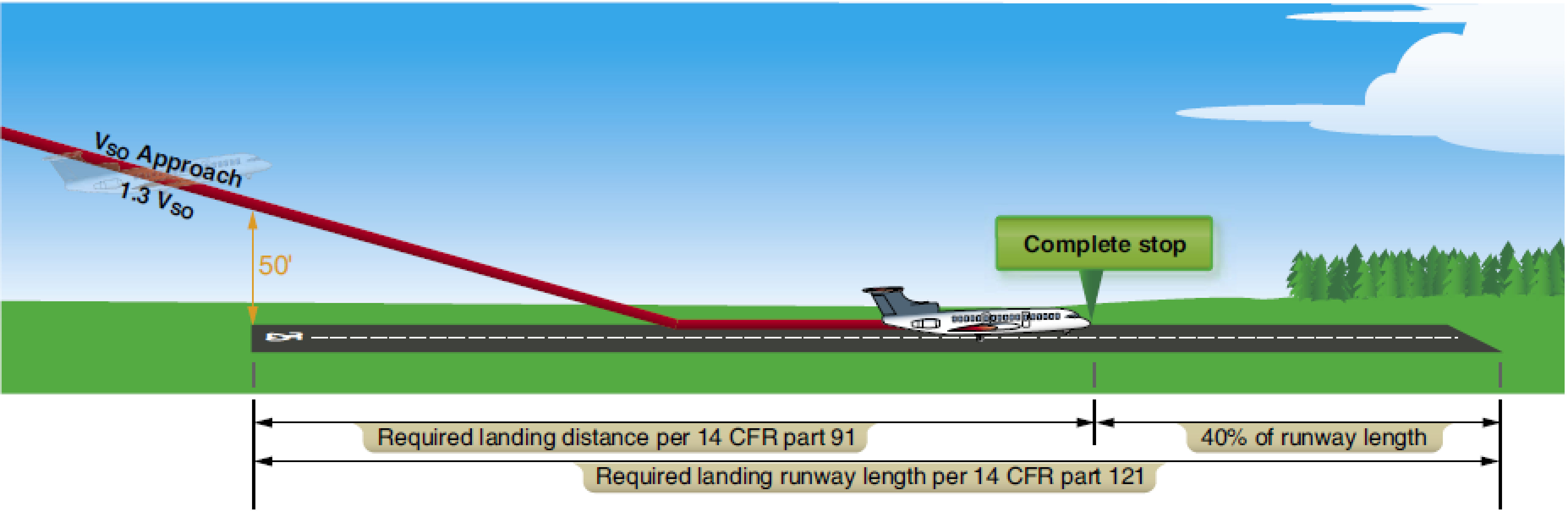
Height above MSL	ft.	0	1000	2000	3000	4000	5000	6000	7000
	(m)	(0)	(305)	(610)	(914)	(1219)	(1524)	(1829)	(2134)
Landing Distance	ft.	1360	1387	1417	1447	1478	1511	1545	1580
	(m)	(415)	(423)	(432)	(441)	(450)	(461)	(471)	(482)
Landing Roll Distance	ft.	661	680	701	722	744	767	791	815
	(m)	(201)	(207)	(214)	(220)	(227)	(234)	(241)	(248)

NOTE

Poor maintenance condition of the airplane, deviation from the given procedures as well as unfavorable outside conditions (i. e. high temperature, rain, unfavorable wind conditions, slippery runway) could increase the landing distance considerably.

Weight

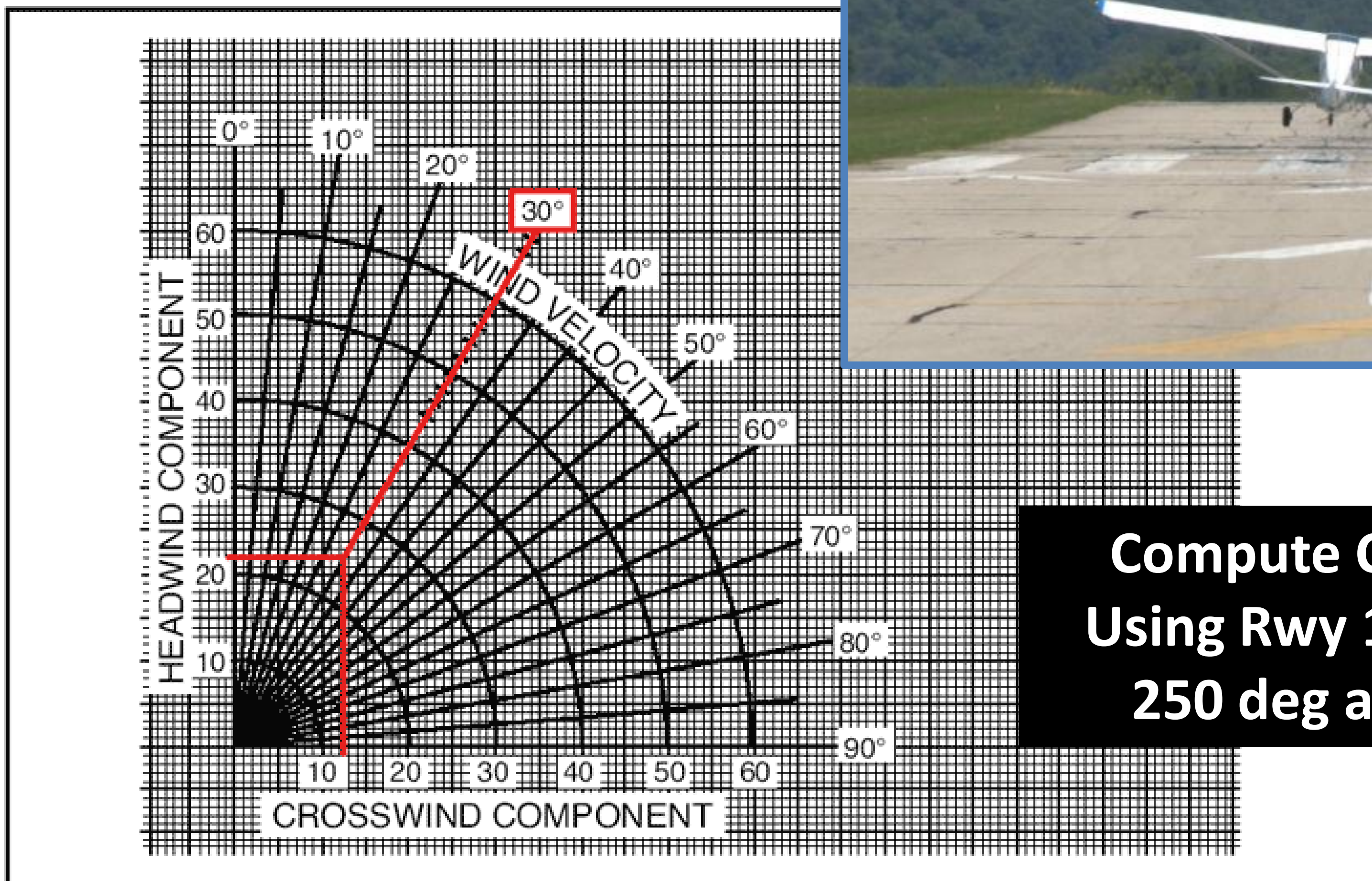
- Most Takeoff and Landing Charts are at Gross Weight
- Reduction of Weight (by 10%) will Improve Performance ~ 10%



Wind

- Headwind, Tailwind and Crosswind
- For Safety, Take Off Into the Wind
  - Only Excepting if Less Than 5 knots, **and** You Have Sufficient Runway
  - You, as PIC, have Right to Refuse Tailwind
  - **Always Refuse a Tailwind Landing**
  - **Tailwind (Every 2 knots Increases Ground Roll by 10%)**
- Crosswind
  - Airplane Has Maximum Demonstrated Crosswind
  - You, Depending on Experience, Might Not be Safe at This Maximum

Crosswind Component



Compute Crosswind Using Rwy 17, Wind is 250 deg at 30 Knts

Climb Performance

- Factors Influencing Are:
  - Weight and Balance
  - Density Altitude
  - Airplane Configuration (flaps, gear)

Climb Performance (cont.)

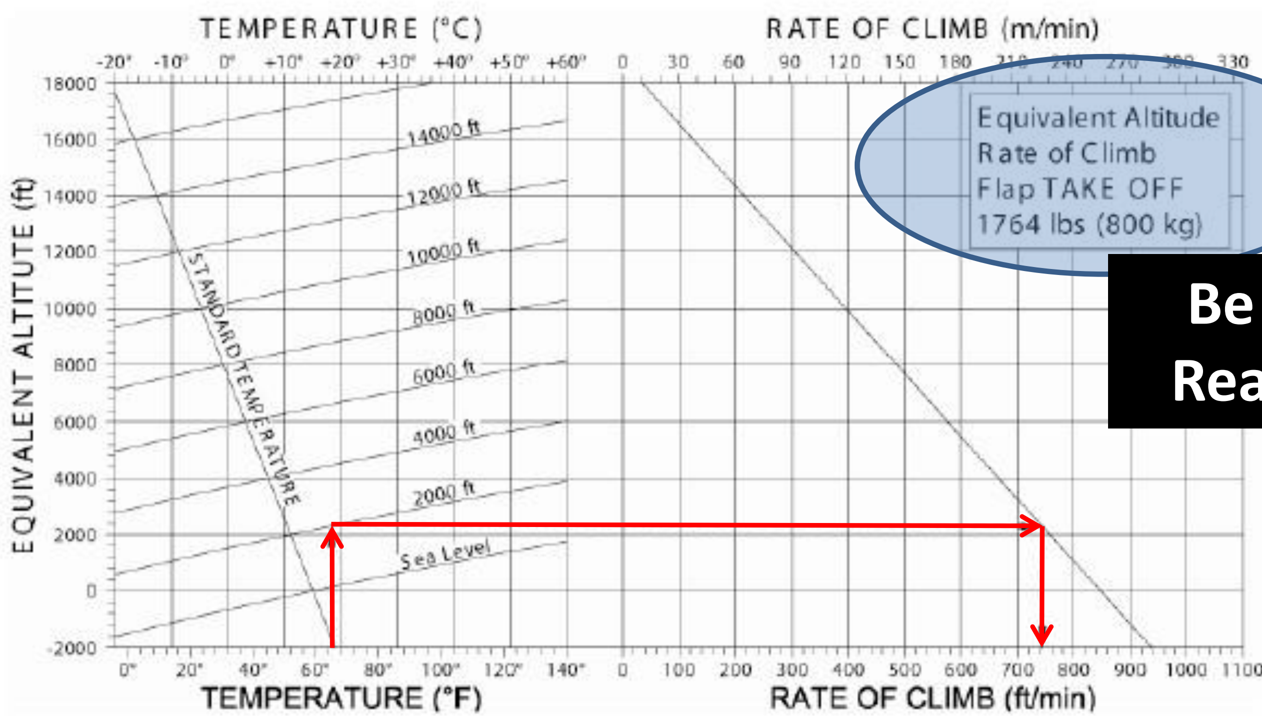
- Weight
  - Increased Weight Decreases Climb Performance
- Balance
  - Aft CG (Within Limits – Reduces Aircraft Effective Weight and Increases Climb Performance)
  - Forward CG (Within Limits – Increases Aircraft Effective Weight and Reduces Climb Performance)
  - Outside of CG Range – You Become a Test Pilot!

Climb Performance (cont.)

- Density Altitude
  - Built Into Climb Charts in POH
- Aircraft Configuration
  - Again – See Climb Charts
  - Pay Attention to Notes
- Don't Try to Be a Test Pilot

Climb Performance (cont.)

Best Rate-of-Climb Speed with Wing Flaps T/O: .... 68 KIAS



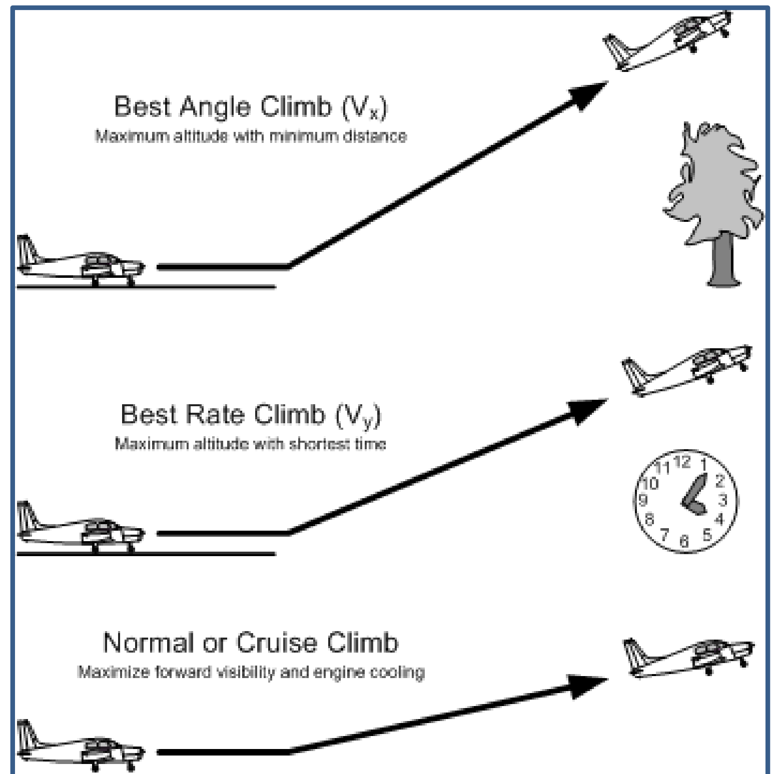
Be Sure to Read Notes

Example: Pressure Altitude: .... 2000 ft
OAT: .... 65° F
Weight : .... 1764 lbs

Result: Climb performance: .... 744 ft/min

Climb Objectives

- Clear Obstacles
- Get to Cruise Altitude in Shortest Time
- Reduce Wear or Load on Engine



Cruise Performance

- Factors
  - Density Altitude
  - Weight and Balance
  - Desired Speed
  - Desired Fuel Economy
- Fuel Reserve
  - FAA Says:
    - 30 Minutes Day VFR
    - 45 Minutes Night Vfr

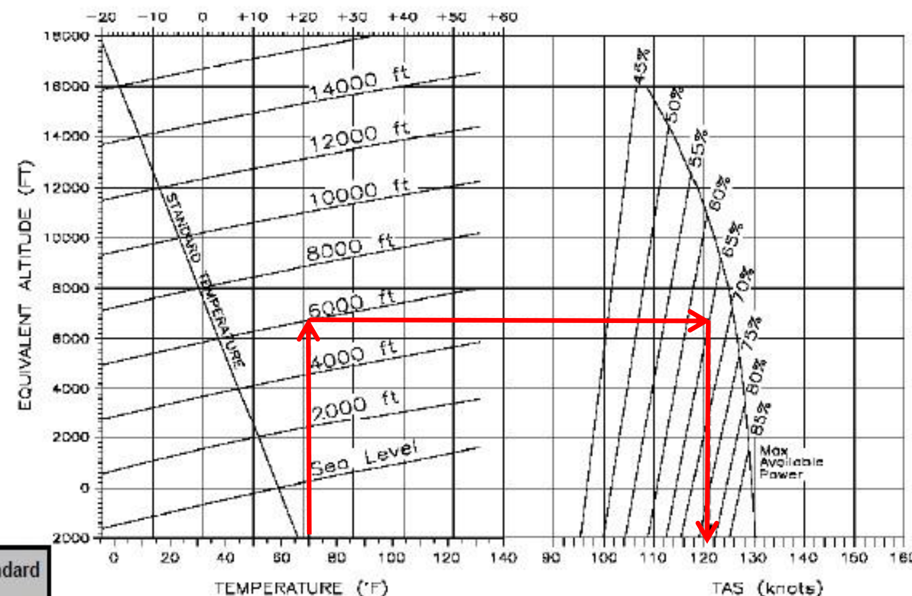
Cruise (cont.)

- May Need More Than One Chart
- Typically Cruise at ~65%
- From TAS (121 knts) Go to GPH Chart – Read 6 GPH

Diagram for true airspeed (TAS) calculation at selected power level.

CAUTION

IN AIRPLANE OPERATIONS WITHOUT THE OPTIONAL WHEEL FAIRINGS INSTALLED, THE MAXIMUM CRUISING SPEED IS REDUCED BY APPROXIMATELY 5%..



Example: Pressure Altitude: .... 6000 ft

OAT: .... 70° F

Power Setting: 65%

Result: True airspeed (TAS): 121kts

Press Alt ft	RPM	20° C Below Standard Temp			Standard Temperature			10° C Above Standard Temp		
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	2700	66	120	6.2	64	121	6	62	123	5.9
	2600	59	115	5.7	57	116	5.6	56	117	5.5
	2500	53	110	5.2	51	111	5.1	50	112	5

Fuel Consumption

- Fuel Gauges Are an Aid to Landing in New, Exciting, and Unexpected Places

Fuel Management

- Do’s
  - Keep a Log of Fuel Usage
  - Keep Track of Engine Run Times and Different Fuel Consumptions (Takeoff, Enroute, Runup, Taxi, Maneuvering, Alternate)
  - Know the POH
  - Fly at Specified Power Settings
  - Be Conservative
  - Drain and Take a Fuel Sample Before Each Flight
  - ‘Stick’ the Fuel Tanks
  - Be Conservative in Fuel Reserves

Fuel Management (cont.)

- Don’ts
  - Trust the Fuel Gauge
  - Push to the Limits on Range
  - Assume Line Staff Filled Your Plane with Proper Fuel

Weight and Balance

- Next Session
- Read Below
- http://www.faa.gov/library/manuals/aviation/pilot_handbook/media/PHAK%20-%20Chapter%2009.pdf
- Weight and Balance Example Using Diamond DA20-C1 (online)