Flight Computer Calculations

Flight Computers

- Flight computer have been used for decades in aviation to perform all sorts of calculations.
- It can be a great asset when you know how to use it properly.
- Examples of calculations are time/distance/speed, fuel burn, density altitude, conversions (NM/SM/km, gallon/liter/imp gallon, TAS/CAS), wind correction angle, ground speed, etc…

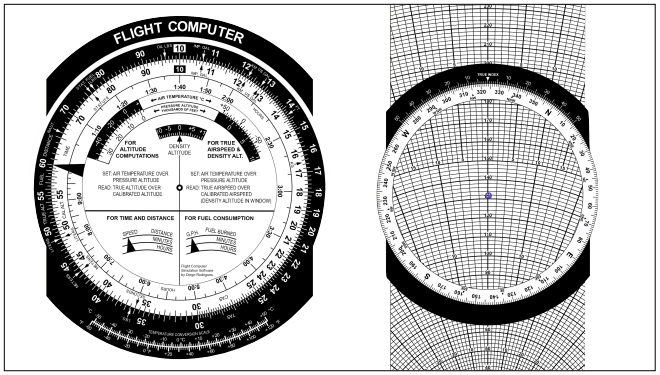
Digital vs Manual

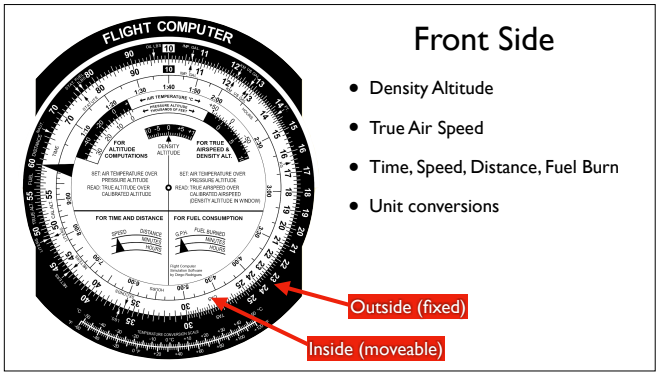
- You can purchase an E6B Flight Computer.
- You can download the Flight Computer Sim App for free.

Flight Computer Sim
Diego Rodrigues

☆☆☆☆☆ 4+
Not Enough Ratings Age

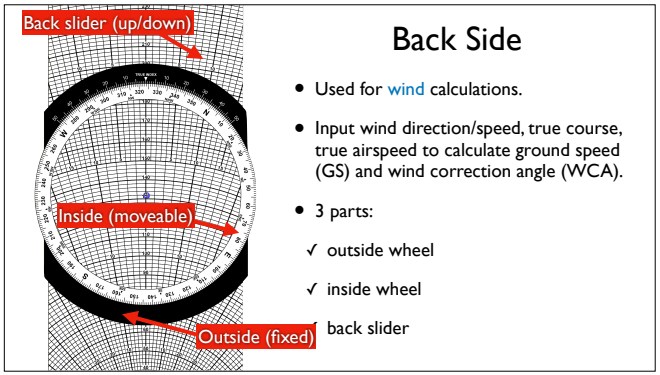
- You can use the UND online E6B website.
http://media.aero.und.edu/interactive-trainers/e6b/?q=wind





Front Side

- Density Altitude
- True Air Speed
- Time, Speed, Distance, Fuel Burn
- Unit conversions

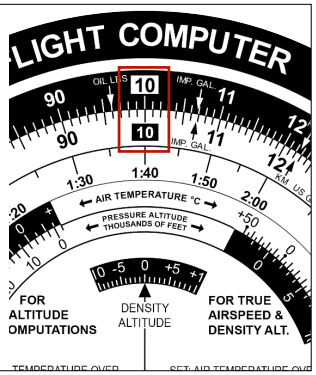


Back Side

- Used for wind calculations.
- Input wind direction/speed, true course, true airspeed to calculate ground speed (GS) and wind correction angle (WCA).
- 3 parts:
  - ✓ outside wheel
  - ✓ inside wheel
  - ✓ back slider

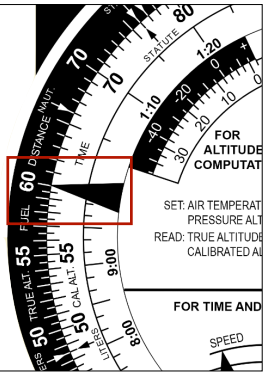
The 10 base

- Most calculations are made on a base of 10.
  - ✓ 1 x 10 = 10
  - ✓ 10 x 10 = 100
  - ✓ 100 x 10 = 1,000
- We use **10** for most base-10 calculations.



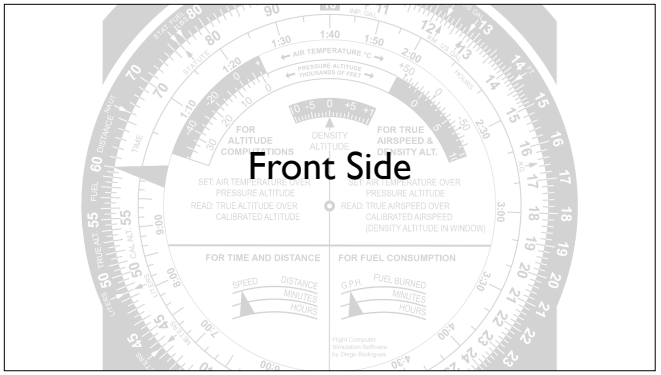
The 60-rate

- Most time-based calculations are on a base of 60.
  - ✓ 1 hour = 60 minutes.
  - ✓ 2 x 1h = 120 minutes.
- Hours can be expressed as a decimal (10-base) or with minutes (60-base)
  - ✓ 2:30 hours = 2.5 hours = 150 minutes.
- We use the 60-rate for 60-base calculations.



No Units

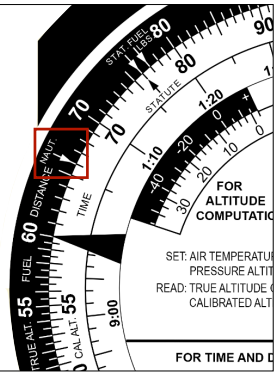
- The E6B wheel markings don't have units.
- The markings also don't have scales.
- **90** could be 90, but it can also be 9, .9, 900, 9000, .09, etc…
- **18** could be 18, or 1.8, .18, 180, 1800, etc…
- How do you know? It depends on the context.



Conversions

NM, SM, km

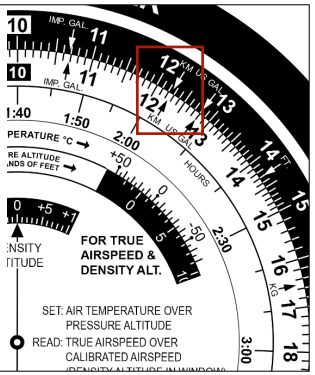
- Locate NM or NAUT on the outside.



Conversions

NM, SM, km

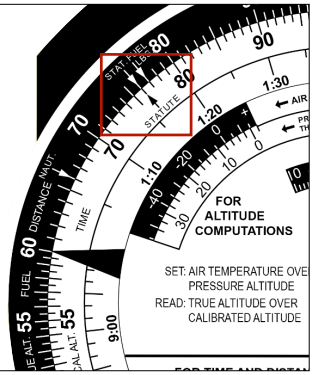
- Locate NM or NAUT on the outside.
- Locate KM on the inside AND outside.



Conversions

NM, SM, km

- Locate NM or NAUT on the outside.
- Locate KM on the inside AND outside.
- Locate STATUTE on the inside AND outside.



Convert 120 NM to SM.

Convert 236 km to SM.

Conversions

Knots to mph

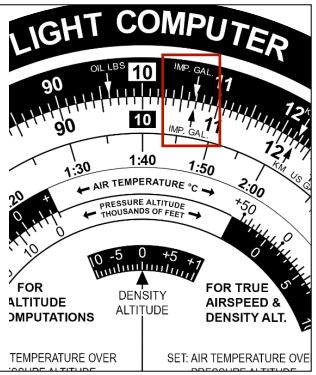
- 1 kt = 1 nautical mile per hour
- 1 mph = 1 mile per hour
- You simply need to convert nautical miles to statute miles (and vice versa).

Convert 522 mph to knots.

Conversions

US Gallon/Imp Gallon/lbs AvGas

- Locate IMP. GAL on the inside AND outside.



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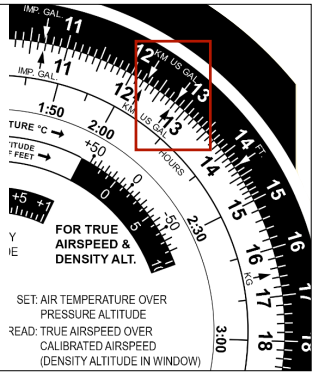
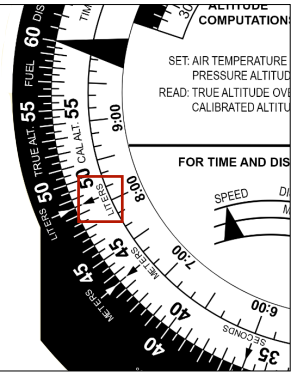
- Locate US. GAL on the inside AND outside.



Conversions

US Gallon/Imp Gallon/lbs AvGas

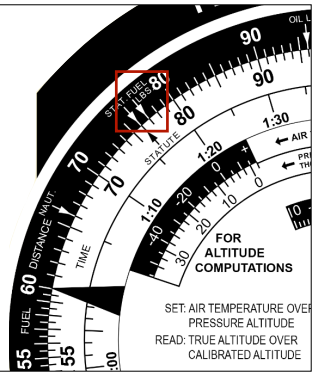
- Locate IMP. GAL on the inside AND outside.
- Locate US. GAL on the inside AND outside.
- Locate liters on the inside.



Conversions

US Gallon/Imp Gallon/lbs AvGas

- Locate IMP. GAL on the inside AND outside.
- Locate US. GAL on the inside AND outside.
- Locate liters on the inside.
- Locate FUEL LBS on the outside.



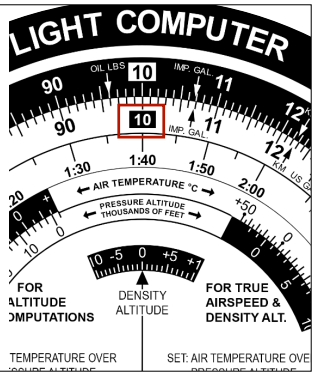
Convert 55 liters to US Gallons.

How much does 46 gallons on AvGas weigh?

Conversions

Minutes/Hours

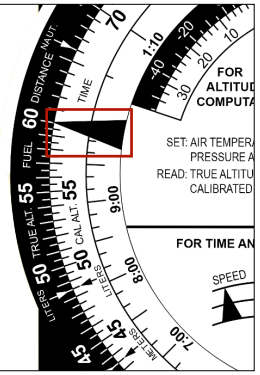
- Used to convert decimal hours (10-base) to minutes (60-base).
- Locate **10** on the inside.



Conversions

Minutes/Hours

- Used to convert decimal hours (10-base) to minutes (60-base).
- Locate **10** on the inside.
- Locate the 60-rate on the inside.

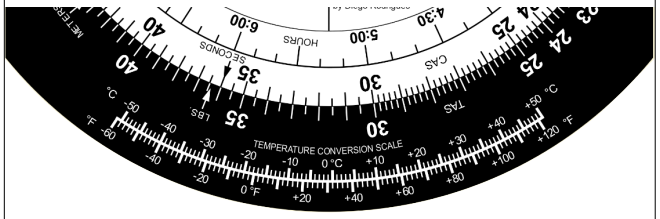


Convert 4.2 hours into minutes.

Convert 264 minutes into hours (10-base)

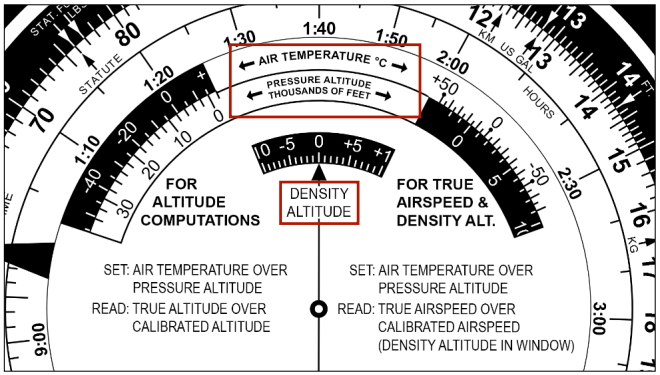
Conversions

Temperatures



Density Altitude Calculations

- Density altitude is the Pressure Altitude converted for non-standard temperature.
- If you know the Pressure Altitude and the outside temperature, you can calculate the Density Altitude.
- Remember: if the outside temperature is standard, Pressure Altitude equals Density Altitude.

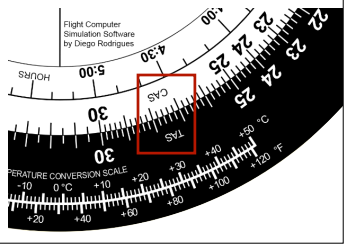


What is the standard temperature at 5000 feet?

If PA = 8000 feet and OAT = 15°C, what is Density Altitude?

True/Calibrated Airspeed (TAS/CAS)

- True Airspeed is the Calibrated Airspeed corrected for altitude and non-standard temperatures.
- At sea level on a standard day: CAS = TAS.
- Locate CAS (inside) and TAS (outside).



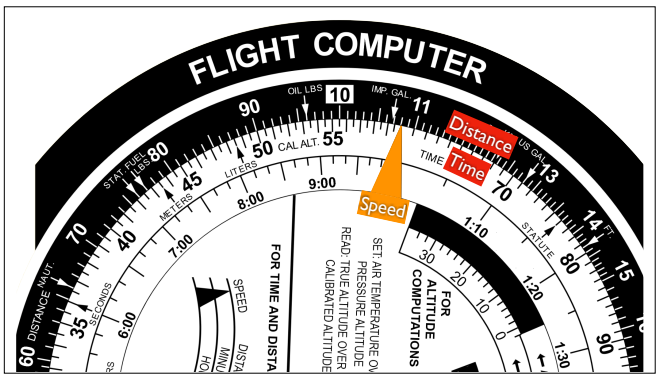
Flying at 11,000 feet, OAT is -15°C, what is TAS if CAS = 138 kt.

Speed/Distance/Time

- The E6B can solve speed/distance/time problems, assuming two of the three variables are available.

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{\text{miles}}{\text{hour}}$$

- Speed is expressed in distance per hour, we will therefore use the 60 rate to read speed.
- Pay attention to units!



If you traveled for 1h25min and covered 162 NM, what was your ground speed?

How long does it take to fly 70NM at 135 kt.

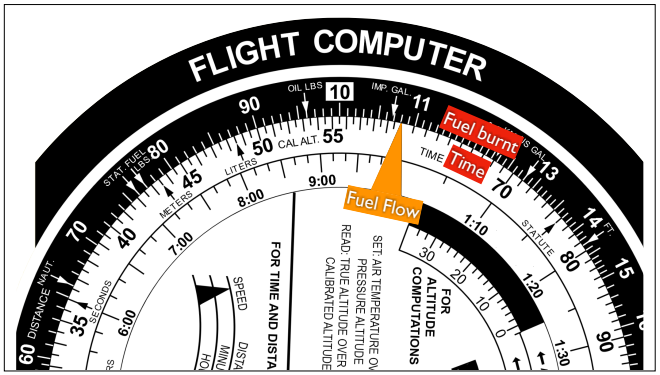
How far will the aircraft travel in 7.5 min with a GS of 114 kt?

Fuel Calculations

- The E6B can solve fuel consumption problems, similarly to speed/distance/time.

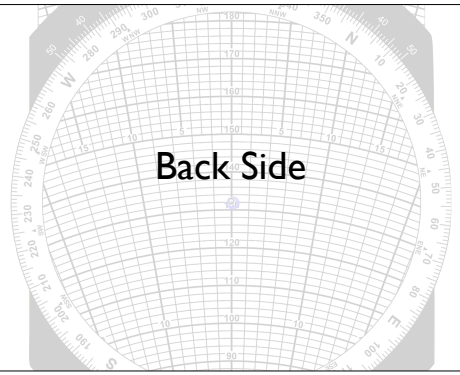
$$\text{Fuel Flow} = \frac{\text{fuel burnt}}{\text{time}} = \frac{\text{gallons}}{\text{hour}}$$

- Fuel Flow is expressed in fuel quantity per hour, we will therefore use the 60 rate to read Fuel Flow.
- Pay attention to units!



If you flew for 1h35min and burnt 19 gallons, what was your fuel flow?

If your fuel flow is 9 gph, how many gallons would you burn in 13min?



Effect of Wind

During cross-country flight, we must correct for the effect of wind.

- ✓ Ground speed is the True Airspeed (TAS) corrected for wind speed.
- ✓ The wind direction will affect the number of degrees of correction needed to get to destination: Wind Correction Angle (WCA).

$$TC \overset{-E}{\underset{+W}{}} VAR = MC \overset{-L}{\underset{+R}{}} WCA = MH \pm DEV = CH$$

Wind Calculations

The rear of the E6B is used to calculate True Heading and Ground Speed.

For Ground Speed and True Heading:

1. Set Wind Direction under True Index
2. Mark Wind Velocity up from center point
3. Set True Course under True Index
4. Slide Wind Velocity mark to True Air Speed
5. Ground Speed reads under center
6. Wind Correction Angle reads between center line and Wind Velocity mark

Wind Calculations

- You need the following to get started:
  - ✓ Wind Speed/Direction (from the Winds Aloft Forecast)
  - ✓ True Course (from your cross-country planner)
  - ✓ True Airspeed (from the POH/AFM)
- Follow the instructions in the back of the E6B.

Practice Exercise

- True Course = 090°
- True Airspeed = 128 kts
- Wind 210° @ 15 knots
- What is the Wind Correction Angle?
- What is the Ground Speed?

TC = 090° TAS = 128 kts Wind 210° @ 15 knots

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Next up...

Planning a Cross Country