AIR CLASSICS™

E6-B
Flight Computer

Instructions

This instruction booklet can be used with the three different E6-B models available from ASA. If you have a different model than the one depicted, some parts of your computer may appear slightly different from the computers pictured in this booklet. However, the calculations are accomplished with the same method and produce the same answers.

© 1992 – 2000 ASA

Aviation Supplies & Academics, Inc.
7005 132nd Place SE
Newcastle, WA 98059-3153

All rights reserved. Reproduction in whole or in part of this text is strictly prohibited and unlawful without the written permission of Aviation Supplies & Academics, Inc.

ISBN 1-56027-421-2
ASA-E6B

Contents

Page

Instructions for Using ASA Flight Computer **4**

The Slide Rule Side **5**

Time, Speed, and Distance Problems **8**

Fuel Consumption Problems **11**

Conversions **13**

Nautical to Statute Miles **13**

U.S. Gallons to Imperial Gallons **15**

Quantity/Weight Conversions **16**

Using the Altitude and Speed Correction Windows **18**

True Airspeed and Density Altitude **18**

Converting Mach Number to True Airspeed.... **20**

True Altitude **21**

Feet Per Mile vs. Feet Per Minute **22**

Off-Course Problems **24**

The Crosswind Table **27**

The Wind Side of the Slide **28**

Determining Winds in Flight **32**

Answers to Sample Problems **37**

Instructions for Using ASA Flight Computer

Your ASA E6-B Flight Computer has two main parts: a circular slide rule side for making quick calculations, and a wind side for computing ground speed and wind correction angle. The slide portion of the circular slide rule side also includes quick-reference material.

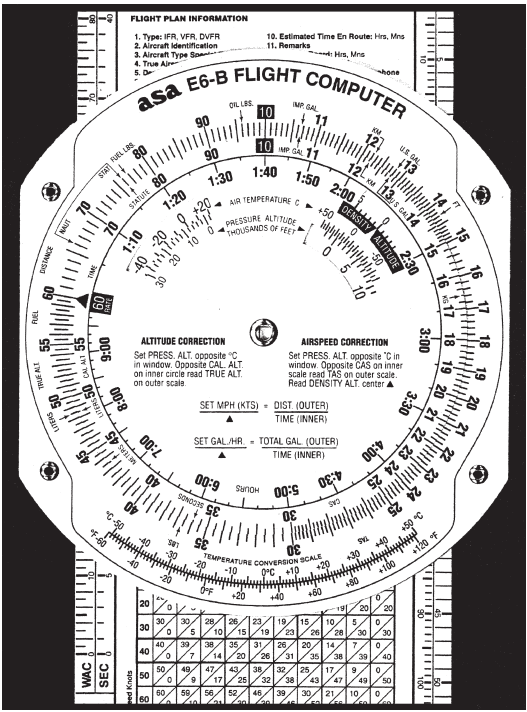

Figure 1

The Slide Rule Side

The term “circular slide rule” shouldn’t be intimidating. This side of your computer simply consists of a rotating disk with numbers on the *middle* scale, which when set against similar numbers on the fixed portion (*outer* scale), allows you to solve problems of **time**, **speed**, and **distance**, calculate **fuel consumption**, and make **conversions between measurements** such as statute and nautical miles. The *inner* scale on the rotating disk is graduated in hours. The slide rule side also has “windows” that you will use to solve airspeed and altitude problems.

You can see that the number **60** on the rotating disk is marked differently than the other numbers. That is because most of your problems will be concerned with time—“something” per hour, either miles or gallons. Before you get to that, you should learn how to read and interpret the numbers on both portions of the slide rule side.

Rotate the disk until all of the numbers on the middle scale match up with the numbers on the outer scale—10 will be at the top. However, that number “10” may be read as “.1,” “1,” “100,” or “1,000” *depending upon the context of the problem*. For now, read it as 10. The next number to the right is 11, so each life (or mark) of calibration between the two numbers is equal to .1, and you would read them as 10.1, 10.2, 10.3, etc. If you were solving a problem involving 1,000 pounds of fuel, the number 10 would be read as 1,000, and each calibration would be equal to 10 pounds, and the 11 would be read as 1,100 pounds. *See* Figure 1.

Now look at the number 15 on the disk. Between 15 and 16 each calibration mark is equal to .2 and would be read as 15.2, 15.4, etc. If you were solving a problem with an airspeed of 150 knots, the first calibration past 15 (150 in this case) would be 152. The spacing changes again at the number 30, where each calibration becomes .5, and at 60, where each calibration equals 1. Before you read a value from the disks, be sure you understand what each line of calibration is equal to.

You will use the slide rule side to establish **ratios**. With the numbers matched, the ratio is 1 to 1. Now set the number 60 (the rate arrow) directly opposite to (or, "lined-up" with) 12 on the outer disk (*see* Figure 2). Notice that all of the numbers on the outer disk are exactly twice the value of the numbers on the inner disk: 90 is opposite of 180, 15 is opposite of 30, 3.5 is opposite of 7.0. You will use these ratios in solving time-speed-distance and fuel consumption problems.

Look at the inside scale on the disk, where the lines of calibration look like clock times: 9:00, 6:00, etc.—these express hours. The inner scale is in hours and the middle scale is in minutes. 1:10 is directly below 70; one hour and ten minutes is the same as seventy minutes. 5:00 is printed below 300 minutes, and five hours is the same as 300 minutes. To convert minutes to seconds, place the rate arrow opposite to the minutes on the **outer** scale and read seconds opposite to the "seconds" arrow, just to the right of 35 on the inner scale.

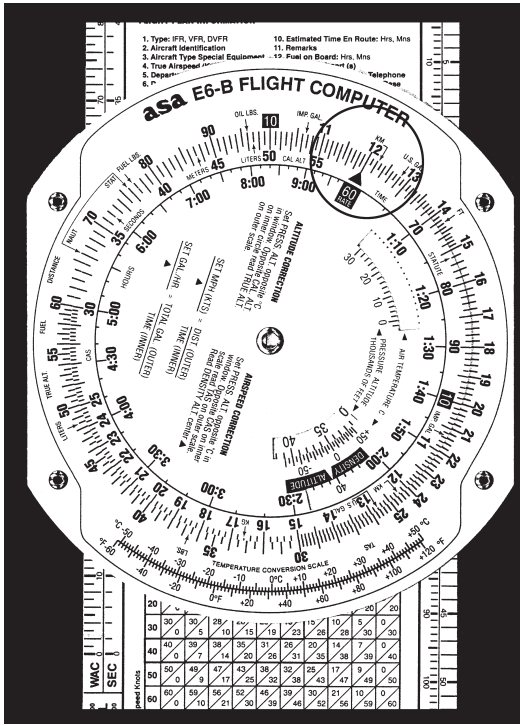

Figure 2. Line up the number 60 (the rate arrow) with the number 12 on the outer disk (or, scale).

Time, Speed, and Distance Problems

The rate arrow on the disk is always set to indicate a value per hour on the outer scale. There are three basic time-speed-distance problems. In two of these problems you know the rate, while in the third problem, the rate is part of the answer you are looking for.

To find the **Time En Route**, let's assume you know your airspeed is 150 knots (nautical miles per hour).

1. Set the rate arrow to 150. *See* Figure 3.
2. You have determined the distance to your destination to be 245 nautical miles. Speed and distance are always on the outer scale; 245 is halfway between 24 and 25.
3. Look directly opposite to that value on the inner scale to find the Time En Route. It is between 1:35 and 1:40. There are five calibration marks on the middle scale between 1:35 and 1:40, and 245 NM on the outer scale is closest to the third calibration, or one hour and 38 minutes.

To find out how far you can go if your **fuel endurance** is 4.5 hours and your ground speed is known to be 125 knots:

1. Set the rate arrow at 125 on the outer scale. *See* Figure 4.
2. Find 4:30 on the inner scale.
3. The value on the outer scale is slightly more than 55. You know that 4 hours at 125 knots should cover 500 miles, so the outer scale is read as 500, not 50 or 5,000, which makes each large calibration mark worth 10 nautical miles. The answer is 564 nautical miles.

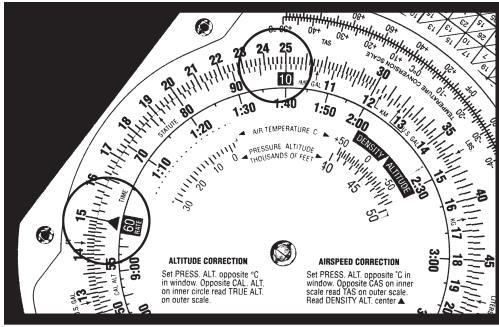

Figure 3

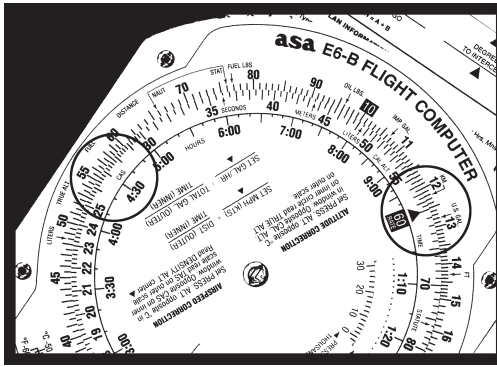

Figure 4

In the final and most common type of time-speed-distance problem, the time and distance are known, and you need to solve for **unknown speed**. The rate arrow represents the answer. You will have flown between two known ground reference points 26 NM apart and checked the time between them to be: 13 (thirteen minutes, that is, not thirteen hours).

1. Set thirteen minutes on the middle scale opposite to 26 on the outer scale. *See* Figure 5.
2. The rate arrow points to your ground speed, 120 knots.

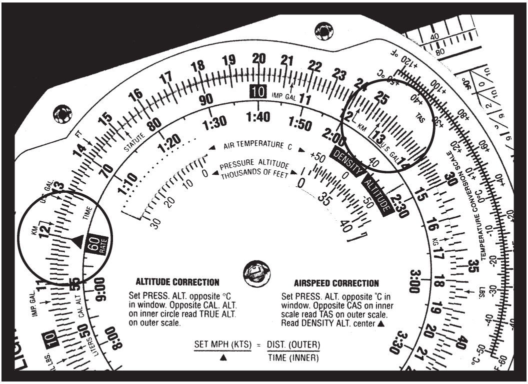

Figure 5

Try these time-speed-distance problems:
(Answers are on Page 37)

	SPEED	**TIME**	**DISTANCE**
1.	125 KTS	_____	524 NM
2.	_______	2:30	345
3.	110 KTS	1:40	_______
4.	_______	0:24	44
5.	95	1:24	_______

Fuel Consumption Problems

Problems involving fuel consumption, fuel endurance, and fuel capacity are solved using the same numbers you used in the time-speed-distance problems. With the exception of time values, only the names change.

Assume that your airplane's Approved Flight Manual indicates fuel consumption of 8.4 gallons per hour at a given power setting and that the usable fuel capacity is 64 gallons. How many hours **endurance** do you have in the tanks?

1. Line up the rate arrow ("something per hour") with 8.4 on the outer scale. *See* Figure 6.
2. Now find 64 on the outer scale.
3. Opposite of 64, read fuel endurance in hours: 7:37 on the inner scale. The outer scale, which was used for speed and distance, is now used to indicate gallons per hour and fuel capacity.

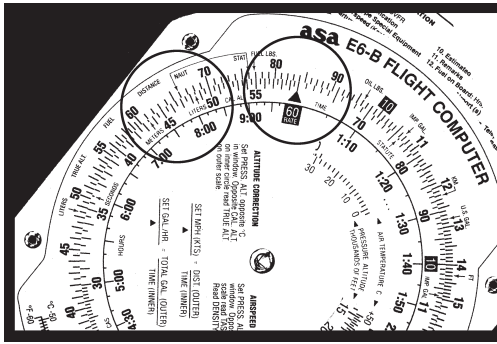

Figure 6

When you paid for your fuel you noted on the delivery ticket that it took 32 gallons to top the tanks. You flew four hours and twenty minutes before stopping for fuel. What was the **average fuel consumption**? This time the rate arrow provides the answer.

1. Set 4:20 on the inner scale (or 260 on the middle scale) opposite of 32 on the outer scale. *See* Figure 7.
2. The rate arrow indicates the average fuel burn rate: 7.4 gallons per hour.

Remember that fuel consumption is greater during the climb to altitude, so this average value does not accurately reflect fuel consumption in cruising flight.

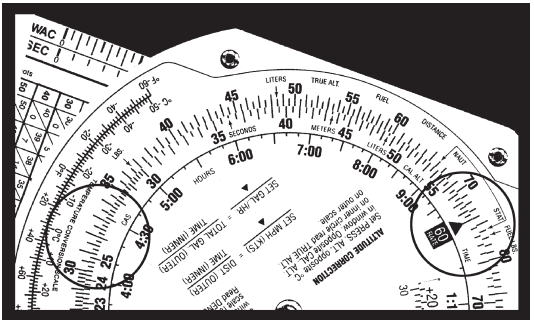

Figure 7

Try these examples:
(Answers are on Page 37)

	GALLONS PER HOUR	TIME	TOTAL USED
1.	7.8	3:20	_____
2.	_____	4:50	62
3.	8.5	_____	38
4.	10	2:30	_____
5.	12		22

You can convert either **nautical or statute miles to kilometers**. Find the KM marking on the outer scale. Set the known value beneath the NAUT or STAT arrow as before, and read kilometers under the KM marking. For example, to convert 115 statute miles to kilometers:

1. Set 115 opposite of the STAT arrow.
2. Read 185 under the KM marking.
   See Figure 9.

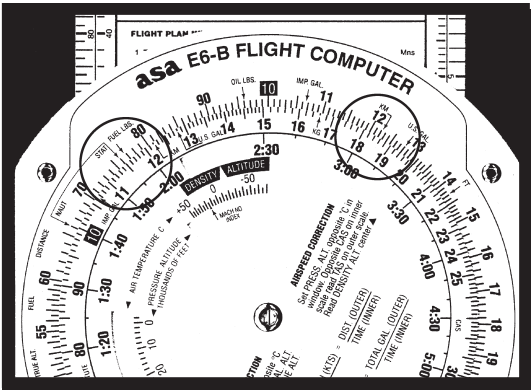

Figure 9

Try these sample problems:
(Answers are on Page 37)

	NAUT	STAT	KM
1.	20	_____	_____
2.	_____	48	_____
3.	_____	_____	110

U.S. Gallons to Imperial Gallons

Your Approved Flight Manual lists fuel capacity in U.S. gallons, but in many countries fuel is delivered in Imperial gallons. Arrows marked U.S. GAL and IMP. GAL are provided on both middle and outer scales to help you convert between these quantities. Your tanks are placarded to hold 64 U.S. gallons. How many Imperial gallons will they hold?

1. Line up the U.S. GAL arrow on the middle scale opposite the IMP. GAL arrow on the outer scale.
2. Find 64 on the middle scale.
3. Read 53.2 Imperial gallons on the outer scale (*see* Figure 10). Because Imperial gallons are larger than U.S. gallons, the number of U.S. gallons will always be larger.

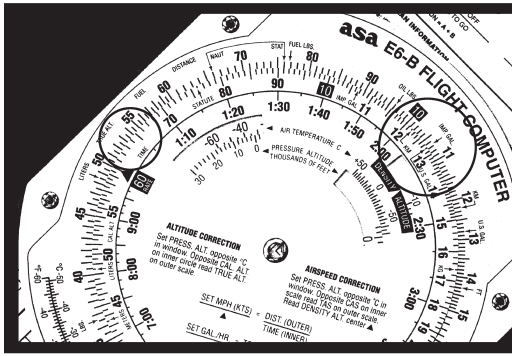

Figure 10

You have purchased fuel in Canada and the delivery slip says 32 Imperial gallons. How many U.S. gallons have you purchased? Line up the IMP. GAL arrow with the U.S. GAL arrow. Find 32 on the

middle scale and read 38.5 U.S. gallons on the outer scale.

Quantity/Weight Conversions

Aviation gasoline weighs 6 pounds per U.S. gallon. For weight and balance calculations, aviation gasoline weight-per-gallon can be determined by lining the U.S. GAL arrow on the middle scale with the FUEL LBS arrow on the outer scale. Fuel gallons are read on the middle scale and fuel weight on the outer scale. To find the weight of 32 U.S. gallons:

1. Align the arrows.
2. Read 192 pounds on the outer scale opposite of 32 gallons on the middle scale. *See* Figure 11.

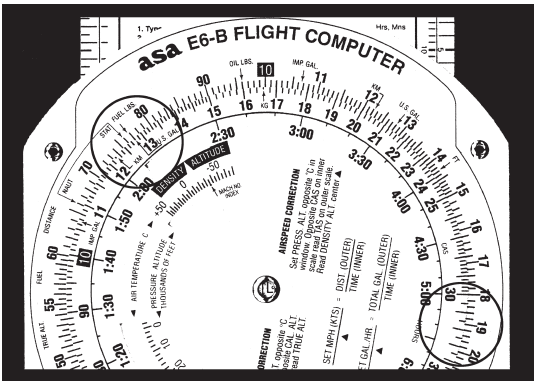

Figure 11

Similarly, oil weight may be determined by lining the **U.S. GAL** arrow on the middle scale with the **OIL LBS** arrow on the outer scale. Oil gallons are read on the middle scale and oil weight is read on the outer scale. To find the weight of 2 gallons (8 quarts) of oil:

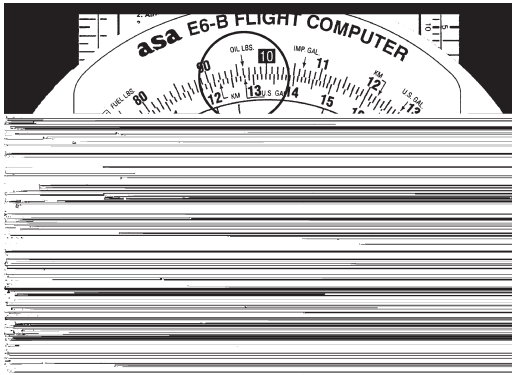

Figure 12

1. Align the arrows.
2. Read 15 pounds on the outer scale opposite of 2 gallons on the middle scale. *See* Figure 12.

Imperial gallon weight of fuel and oil may also be determined in the same manner by lining up the IMP. GAL arrow on the middle scale with the FUEL LBS or OIL LBS arrow on the outer scale.

You can convert **liters to U.S. gallons**, **pounds to kilograms**, or **feet to meters** by aligning the appropriate arrows on the middle and outer scales. For example, to convert pounds to kilograms:

1. Find the arrows marked LBS. and KG, and line them up.
2. Any value in pounds on the outer scale will be opposite of its converted value in kilograms on the middle scale: 2,000 lbs is 901 kg, and 160 kg is 351 lbs.
3. The same procedure is followed for the other conversions.

Using the Altitude and Speed Correction Windows

Altimeters and airspeed indicators are designed to give correct indications under standard conditions at sea level. The consistency of the earth's atmosphere does not change linearly as you gain altitude; its density is affected by variations in temperature and pressure. The E6-B provides windows on the slide rule side so you can allow for these variations when converting calibrated airspeed to true airspeed or indicated altitude to true altitude.

True Airspeed and Density Altitude

Note that the outer scale of your flight computer is marked TAS (true airspeed) and the middle scale is marked CAS (calibrated airspeed).

The Approved Flight Manual for your airplane contains a conversion table that allows you to convert indicated airspeed to CAS. The difference is greatest at low speeds and becomes negligible at cruise speeds. To determine true airspeed you must first know the pressure altitude. Set your altimeter to 29.92 and read the altitude indicated; that is the pressure altitude. Note the outside air temperature and convert it to Celsius using the conversion scale at the bottom of the flight computer.

1. Set the pressure altitude in the window opposite the outside air temperature in Celsius.
2. Without moving the computer's scales, read the true airspeed on the outer scale opposite CAS on the middle scale.

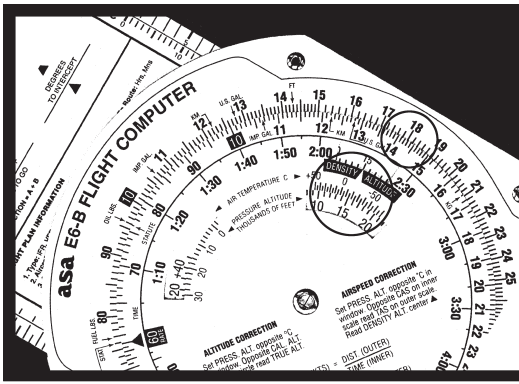

Figure 13

3. Read the density altitude over the arrow in the DENSITY ALTITUDE window. *See* Figure 13.

Figure 13 shows a pressure altitude of 15,000 feet set opposite an outside air temperature of -15°C. A calibrated airspeed of 145 knots converts to a true airspeed of 183 knots and a density altitude of 15,000 feet under these conditions.

Here are some sample problems:

(Answers are on Page 37)

	PRESSURE ALTITUDE	TEMP	CAS	TAS	DENSITY ALTITUDE
1.	14,000	5°C	160	_____	_____
2.	20,000	-20°C	200	_____	_____
3.	8,000	15°C	150	_____	_____

Converting Mach Number to True Airspeed

To convert Mach Number to True Airspeed (or vice versa), rotate the inner dial until you see the Mach No. Index inside the airspeed correction window on the inner dial. Line up the true or outside air temperature (do not use Indicated Air Temperature) opposite this Mach No. Index. Mach Number on the inner scale reads opposite True Airspeed (in nautical miles per hour) on the outer scale. In Figure 14, at an outside air temperature of +15°C and Mach 1 (10 on the inner scale), read 661 knots on the outer scale.

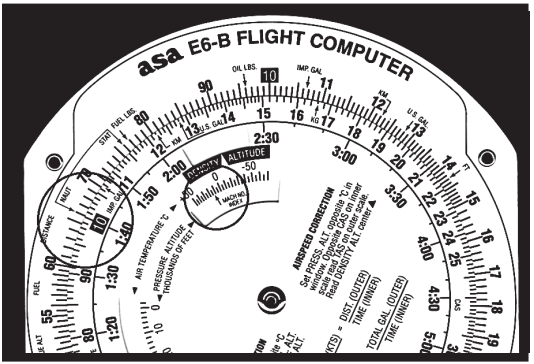

Figure 14

True Altitude

When the air is colder than standard your altimeter can mislead you into thinking you are higher than you actually are. Determine true altitude by the following steps:

1. Determine pressure altitude by setting 29.92 momentarily on the altimeter.
2. Set pressure altitude next to outside air temperature in the altitude correction window.
3. Subtract station altitude from indicated/calibrated altitude to determine calibrated altitude AGL.
4. Find calibrated altitude AGL on the middle scale and read the correction to station altitude on the outer scale.
5. Add the correction to station altitude to get true altitude MSL.

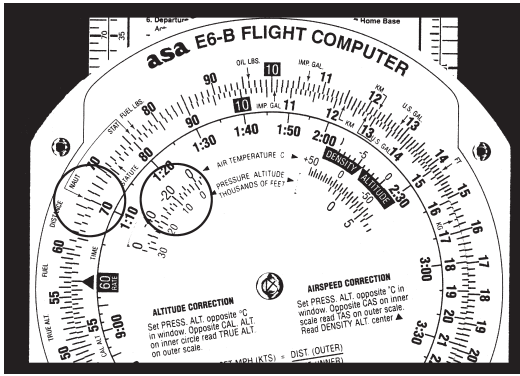

Figure 15

If the station altitude is unknown, read calibrated altitude MSL on the middle scale and true altitude MSL on the outer scale.

In Figure 15 the pressure altitude is 10,000 feet, station altitude is 5,000 feet, outside air temperature is -19°C, and your indicated (calibrated) altitude is 12,000 feet. The difference between 5,000 feet station altitude and 12,000 feet indicated altitude is 7,000 feet. Opposite 7,000 feet on the middle scale read correction to station altitude (6,600 feet) on the outer scale—5,000 feet plus 6,600 feet equals 11,600 feet true altitude.

CAUTION: If the temperature between the surface and the aircraft does not decrease at the standard rate of 2°C per 1,000 feet or if the pressure at flight level is nonstandard, reliance on a computer solution to determine obstruction clearance can be very hazardous.

Find True Altitude:
(Answers are on Page 38)

	PRESSURE ALTITUDE	INDICATED/ CALIBRATED ALTITUDE	TEMP	STATION ALTITUDE	TRUE ALTITUDE
1.	10,500	10,000	-20°C	5,000	_____
2.	12,000	11,000	-30°C	3,000	_____
3.	8,000	7,600	-15°C	(unknown)	_____

Feet Per Mile vs. Feet Per Minute

Because aircraft performance characteristics vary dramatically between types, the FAA establishes climb and descent requirements in feet per mile, rather than in feet per minute. A climb of 300 feet per mile will result in a 3° climb angle for any aircraft; a light trainer climbing at that angle at 90 knots

ground speed will indicate 450 feet per minute, while a jet following that same gradient at 240 knots ground speed will show a vertical speed of 1,200 feet per minute.

You can convert feet per mile to feet per minute by placing the rate arrow opposite to the ground speed, finding the feet per minute value on the outer scale lined up with the feet per mile value on the middle scale. Try these two examples:

1. Set the rate arrow opposite of 90.
2. Find 300 feet per mile on the middle scale (*see* Figure 16).
3. The climb rate in feet per minute, 450, is found on the outer scale opposite of 300.

1. Set the rate arrow at 240 knots.
2. Look above 300 on the middle scale.
3. You should find a vertical speed of 1,200 feet per minute.

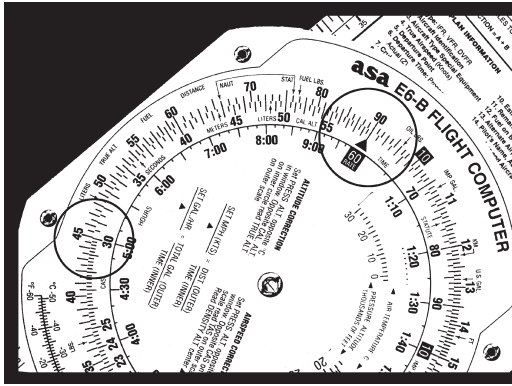

Figure 16

(Answers are on Page 38)

	GROUND SPEED	FEET PER MILE REQUIRED	FEET PER MINUTE
1.	120	350	_____
2.	100	250	_____
3.	150	300	_____

Off-Course Problems

When you navigate by pilotage, you will occasionally find your airplane has drifted off the planned course due to the wind. If you find yourself over a landmark to one side of the course line you should be able to estimate the distance you have drifted off course (the scale of sectional charts is 8 statute miles to the inch), and your flight log should help determine how far you have flown and how far it is to your destination.

Two computer setups are required. The first will give you the heading correction necessary to offset wind drift, or "course to parallel." On the middle scale, set the distance flown opposite of the distance off course on the outer scale; the rate arrow points to the degrees of heading change to parallel the course.

Example: After flying 125 miles, you note that you are 8 miles off course. (*See* Figure 17.)

1. Set 125 on the middle scale to line up with 8 on the outer scale.
2. Read approximately 3.8° at the rate arrow.

The second setup will give you the additional heading change required to fly back to the original course line. On the middle scale, set distance remaining

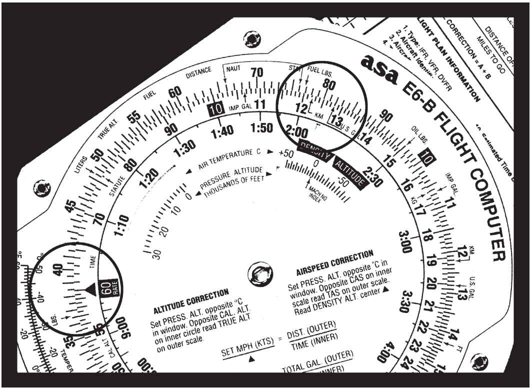

Figure 17

opposite of the distance off course; read additional degrees of heading change opposite of the rate arrow. Add the two answers and apply the result to your heading.

Example: Your destination is 235 miles ahead (*see* Figure 18 on the next page).

1. Set 235 on the middle scale opposite 8 on the outer scale.
2. Read 2.4° at the rate arrow.
3. Change course 6° (3.8 + 2.4) toward the course line and, if the wind doesn't change, you will rejoin the original course line as you approach the destination.

See also Figure 19 on the next page.

Figure 18

Figure 19 shows the setups in equations.

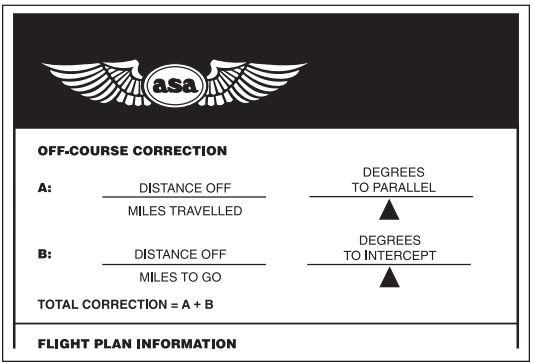

Figure 19

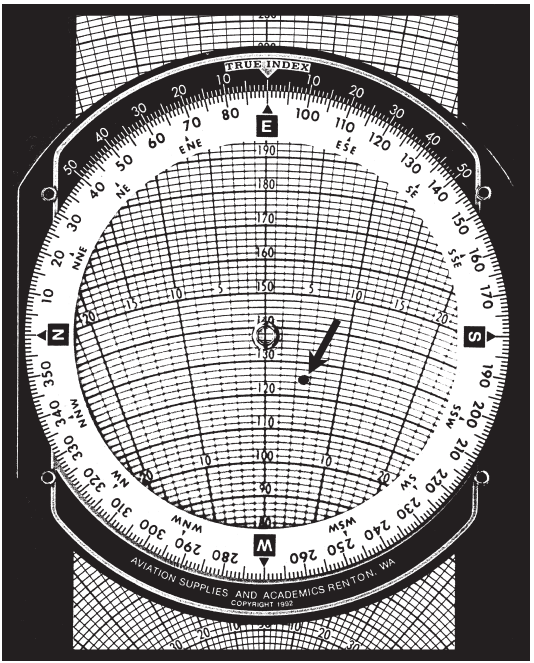

Figure 23

Determining Winds in Flight

Winds aloft forecasts are frequently in error. If you have an autopilot and some free time, you can calculate the actual winds at your location and altitude. It helps if you have GPS, too.

To solve an inflight wind problem you need your ground speed, true heading, true course, and true airspeed. Let's assume your true course is 180°, your true heading is 160°, your last ground speed

check came out to be 120 knots, and you calculate the true airspeed at your altitude to be 140 knots.

1. Set 180° at the TRUE INDEX on the wind side of the computer.
2. Move the slide until the grommet falls over the line marked 120. The true heading is 20° less than the true course, which means that you have a 20° left wind correction angle.
3. With the grommet on the 120-knot ground speed line, find the point on the slide where the 20° left wind correction angle crosses the line marked 140 and make a pencil mark (*see* Figure 24 on the next page).
4. Rotate the azimuth disk until the pencil mark is on the centerline between the grommet and the true index.
5. Determine the wind velocity by counting the lines between the grommet and the pencil mark.
6. Read the true wind direction under the true index. You should have a wind direction of 104° and a wind speed of 50 knots (*see* Figure 25 on Page 35).

If you have GPS, the direct track readout is used instead of true heading. Correct for variation, because the direct track information is magnetic.

Sample problems:
(Answers are on Page 38)

	TRUE HDG	TRUE COURSE	TAS	GROUND SPEED	WIND DIREC.	WIND VELOCITY
1.	320	315	140	128	_____	_____
2.	175	160	150	115	_____	_____

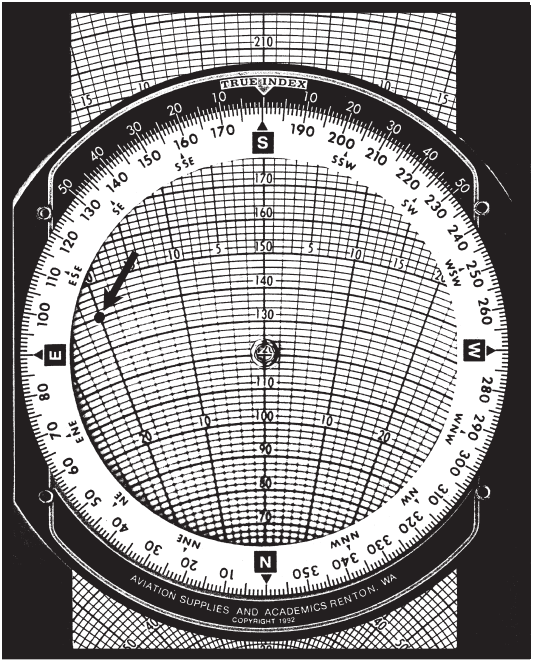
TRUE INDEX
S
E
W
N
AVIATION SUPPLIES AND ACADEMICS RENTON, WA
COPYRIGHT 1992

Figure 24

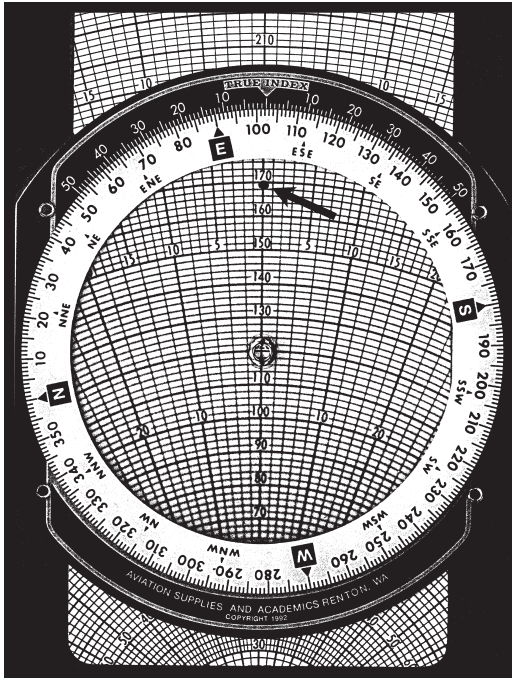
BRUE INDEX
AVIATION SUPPLIES AND ACADEMICS RENTON, WA
COPYRIGHT 1992

Figure 25

Notes

Answers to Sample Problems

Time-Speed-Distance Problems, Page 10

1. 4 Hours and 12 Minutes
2. 138 Knots
3. 183 Nautical Miles
4. 110 Knots
5. 133 Nautical Miles

Fuel Consumption Problems, Page 12

1. 26 Gallons
2. 12.8 GPH
3. 4 Hours and 28 Minutes
4. 25 Gallons
5. 1 Hour and 50 Minutes

Distance Conversion Problems, Page 14

1. 23 Statute Miles, 37 Kilometers
2. 41.7 Nautical Miles, 77.2 Kilometers
3. 59.4 Nautical Miles, 68.4 Statute Miles

Airspeed Conversion Problems, Page 19

1. 204 Knots TAS, 16,000' DA
2. 273 Knots TAS, 20,500' DA
3. 174 Knots TAS, 9,800' DA

Altitude Correction Problems, Page 22

1. 9,750' True Altitude
2. 10,350' True Altitude
3. 7,200' True Altitude

Feet per Mile vs. Feet per Minute Problems, Page 24

1. 700 FPM
2. 415 FPM
3. 750 FPM

Wind Problems, Page 31

	TRUE HDG	GROUND SPEED
1.	288	143
2.	133	149
3.	014	163
4.	258	240

Wind Problems, Page 33

	WIND DIREC.	WIND VELOCITY
1.	002	17
2.	212	49