



**AIR CLASSICS<sup>TM</sup>**

CX-1a

Pathfinder<sup>TM</sup>

Flight Computer

**Instructions**

Aviation Supplies & Academics, Inc.  
Newcastle, Washington 98059-3153

## CX-1a Pathfinder Instructions

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# Introduction

The ASA CX-1a Pathfinder calculator is the next generation aviation computer. Using the latest microchip technology and a unique menu-driven format, it out performs its most sophisticated electronic rivals at a cost which approaches that of the mechanical “slide rule” type computers.

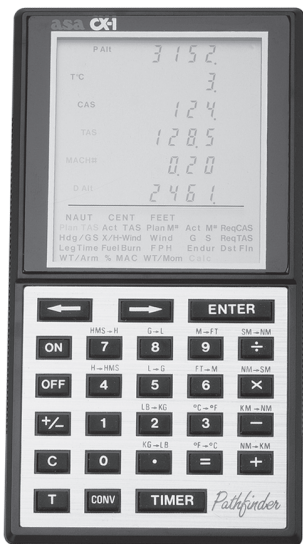


Figure 1. The CX-1a calculator

## *Features of the CX-1a include:*

### Numerous Aviation Functions

You can calculate everything from True Airspeed and Mach Number, to Runway Crosswind Component, to Center of Gravity (CG) and everything in between. A menu of 18 functions gives you access to an incredible 31 aviation calculations.

### User Friendly

The CX-1a can display up to six lines of numbers. In aviation functions, all inputs and results are displayed together, and each line is labeled. In addition, prompts are displayed for the menu item in use, timer, and unit values. There is more useful and usable information in the CX-1a display than any other calculator. An additional advantage of the CX-1a display is that it has a very simple keyboard. These features make it the most “user friendly” calculator on the market.

### Conversions

The CX-1a performs 14 conversion functions. These are reciprocal conversions for Nautical and Statute miles, Nautical miles and Kilometers, feet and meters, Fahrenheit and Centigrade temperatures, gallons and liters, pounds and kilograms, and between time in an hours:minutes:seconds format and time in decimal format.

## Timer

The CX-1a has a built-in timer which has options of counting either up or down. The “count up” feature can be used to keep track of elapsed time for the flight or to determine the time required to fly a known distance. The “count down” mode can be used as a reminder to switch fuel tanks or to determine the missed approach point on a non-precision instrument approach.

## Interactive Functions

The CX-1a has been designed so that, to the maximum extent possible, all of its features can be used together.

You can perform “chain” calculations where the answer to a preceding problem can be entered in a subsequent one with a single keystroke. These chains can run through as many as four separate menu functions. You can also use this feature to work the same problem a number of times, changing only one input item and re-entering the rest with a single keystroke.

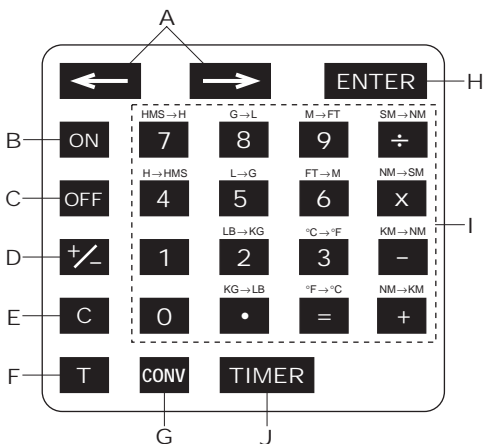
Standard mathematical calculations and conversions can be performed while in an aviation function.

Timer results can be entered directly as input in those problems requiring a time; and the results of time calculations can be used to start the count down timer.

As you will soon see, all these features make the CX-1a the most versatile and useful aviation calculator ever.

# Keyboard Layout

The extremely simple keyboard of the CX-1a is possible because of the sophistication of its software and its display screen. The advantages of such a keyboard are twofold. A calculator with 26 keys is much easier to use than one with 40 or more; and it also allows us to keep the calculator “shirt-pocket” sized. Both of these advantages make the CX-1a more useful to a pilot in day-to-day operations.



**Figure 2.** CX-1a Keyboard



- A
  - 1. Moves cursor through menu.
  - 2. Ends WT/Arm and WT/Mom functions.
  
- B
  - 1. Turns CX-1a on.  
Features a depressed **ON** button.
  - 2. Resets CX-1a.
  
- C
  - Turns CX-1a off.
  
- D
  - Changes sign either negative or positive of current input line.
  
- E
  - Clears current input line.
  
- F
  - Separates HRS from MINS and MINS from SECS on time inputs.
  
- G
  - 1. Sets math function keys to conversion function.
  - 2. Starts countdown timer if followed by **ENTER** key.
  
- H
  - Selects menu function, enters data input.
  
- I
  - 1. Standard math function inputs.
  - 2. Conversion functions active if preceded by **CONV** key.
  
- J
  - 1. Starts count up timer.
  - 2. Starts count down timer if preceded by **CONV** key.
  - 3. Stops either timer mode when pushed a second time.

# Screen Layout

The heart of the CX-1a is its display screen. Figure 3 shows the location of all possible displays. You will note that there are six lines of numbers, and each line has several labels available for various functions. Below the numerical displays are five lines of characters which include the full menu of aviation functions as well as some other prompts. All of this may look rather intimidating at first, but you will soon see this screen really makes the CX-1a easier to use than any other calculator on the market.

P Alt W DirWT	8 8 8 8 8 8	- Dist LEMAC
T°CW Spd I°CArm	8 8 8 8 8 8	- GS
CAS Crs MomRwy	8 8 8 8 8 8	- TIME %MAC
TAS CG	8 8 8 8 8 8	- FPH
MACH#GS RFX-Wind	8 8 8 8 8	- MAC Low V.
D AltHdg GWH-Wind	8 8 8 8 8 8	- Fuel

NAUT	CENT	FEET	CONV	
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	Calc	Timer

**Figure 3.** The Display Screen

# Getting Started

Push the **ON** button and the display shown in Figure 4 should appear. Obviously, the **OFF** button will turn the calculator off. The CX-1a will also turn off if approximately 7 minutes have elapsed since the last key was pressed. This feature prevents battery exhaustion if the calculator is inadvertently left on.

Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
<b>LegTime</b>	FuelBurn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<b>Calc</b>	

**Figure 4.** CX-1a Initial Display

The display consists of the 18 aviation menu items, plus the “CALC” prompt. Note that “Calc” and “Leg Time” are flashing on and off. (Flashing prompts are designated in figures with a box around the words.)

The flashing “Leg Time” prompt indicates that the menu “cursor” is on the “Leg Time” function. This function can be selected by pushing the **ENTER** key. We will cover movement of the “cursor” to other menu functions shortly.

The “CALC” prompt indicates that the standard calculator functions (add, subtract, multiply and divide) are available at present. This prompt will be flashing most of the time.

## Arithmetic Functions

The CX-1a performs the standard four arithmetic functions (add, subtract, multiply and divide). It can display a maximum of 6 digits with a floating decimal point and a minus sign. The sign of any number can be changed with the  $\pm/\square$  key. Although the CX-1a displays only 6 digits, internally it performs all its calculations to eight significant digits.

With the CX-1a turned on, add the numbers 123 and 456 by pressing:

**1 2 3 + 4 5 6 =**

The number 579 should be displayed on the bottom line. Now press the  $\pm/\square$  key. As a final step, multiply 579- by 6.5 by keying in:

**x 6 . 5 = 3763.5-**

As you can see, standard mathematics is completely conventional in the CX-1a. You may want to refer to Appendix A for additional practice problems.

## Conversions

There are many times when it is necessary to convert from one unit of measurement to another. The CX-1a has 14 different conversion functions. These are all performed by pushing the **CONV** key, and then the appropriate function key. Note the labels above the 14 keys with conversion functions.

Statute to Nautical  
Nautical to Statute



Many of the aviation functions of the CX-1a require distance inputs in nautical miles or speed inputs in knots (nautical miles per hour). Many aircraft, especially older ones, have their airspeed indicators and flight manual set up for statute miles. The CX-1a allows you to convert to nautical easily. For example, to convert 180 MPH to knots, key in:

**1 8 0 CONV ÷**

You should get an answer of 156.416 knots.

The CX-1a converts statute miles to nautical in much the same way. To convert 200 knots to MPH, enter:

**2 0 0 CONV X**

You should get a result of 230.156 MPH.

Kilometers to Nautical  
Nautical to Kilometers

KM → NM  
**CONV -**  
NM → KM  
**CONV +**

These reciprocal conversions are performed in the same way as for nautical and statute. To convert 100 KM to nautical miles, enter:

**1 0 0 CONV -**

You should get 53.9957 NM.

To convert 200 knots to KPH (Kilometers per hour), enter:

**2 0 0 CONV +**

The answer is 370.4 KPH.

Kilometers to Statute

CONV KM → NM **-**

CONV NM → SM **X**

Statute to Kilometers

CONV SM → NM **÷**

CONV NM → KM **+**

The CX-1a does not have a function which allows direct conversion of statute miles and kilometers. However, since both can be converted to and from nautical units, you can “chain” two conversions with an interim answer in nautical.

For example, to convert 10 kilometers to statute miles, enter:

**1 0** CONV **-**

(the interim answer is 5.39957 NM), then enter:

CONV **X**

and the final answer is 6.21371 SM.

To convert 55 MPH to KPH, enter:

**5 5** CONV **÷** CONV **+**

The interim answer is 47.7937 knots, and the final answer is 88.5139 KPH.

Meters to Feet

CONV M → FT **9**

Feet to Meters

CONV FT → M **6**

To convert 100 meters to feet, enter:

**1 0 0** CONV **9**

The answer is 328.084 feet.

To convert 10000 feet to meters, enter:

**1 0 0 0 0** **CONV** **6**

The answer is 3048 meters.

Fahrenheit to Centigrade

**CONV** **=** <sup>°F → °C</sup>

Centigrade to Fahrenheit

**CONV** **3** <sup>°C → °F</sup>

The CX-1a allows direct conversion between Fahrenheit temperatures and those in Celsius (Centigrade). For example, to convert 59° Fahrenheit to its Centigrade equivalent, enter:

**5 9** **CONV** **=**

The answer is 15 degrees Centigrade.

To convert -20 degrees Centigrade to Fahrenheit, enter:

**2 0** **+/-** **CONV** **3**

The answer is -4 degrees F.

Gallons to Liters

**CONV** **8** <sup>G → L</sup>

Liters to Gallons

**CONV** **5** <sup>L → G</sup>

To convert 50 gallons to liters, enter:

**5 0** **CONV** **8**

The answer is 189.271 liters.

To convert 100 liters to gallons, enter:

**1 0 0** **CONV** **5**

The answer is 26.4172 gallons.

Pounds to Kilograms

CONV LB → KG **2**

Kilograms to Pounds

CONV KG → LB **•**

To convert 2000 pounds to kilograms, enter:

**2 0 0 0** CONV **2**

The answer is 907.185 kilograms.

To convert 160 KG to pounds, enter:

**1 6 0** CONV **•**

The answer is 352.74 pounds.

Time Entry

CONV **4** **T** **T** **=**

HM:MM:SS to H.h

CONV HMS → H **7**

H.h to HH:MM:SS

CONV H → HMS **4**

The CX-1a can display time in either of two formats. It will display hours, minutes and seconds separated by colons (HH:MM:SS) or it will display time in hours only (H.h, e.g., 2 hours, 30 minutes is displayed at 2.5 hours). It can also convert from one mode of display to the other.

Let's start off by entering 2 hours, 30 minutes and 30 seconds. First clear the display, if necessary, by pushing the **C** key. Next, push:

CONV **4**

The display should be 00:00:00. Now enter:

**2** **T**



The display should be 02:00:00 (2 hours). Next, enter:

**3 0 T**

The display should now be 02:30:00 (2 hours, 30 minutes). Finally, key in:

**3 0 T**

The display should be 02:30:30.

The **CONV 4** function sets the HH:MM:SS mode and the **T** key has the effect of entering a colon. The seconds entry must be followed by one of the five math function keys ( = , - , X , ÷ , = ). The “equals” key will be used in this example.

Let’s add 30 seconds to the display by keying:

**+ 0 T 0 T 3 0 T =**

When adding time you must enter seconds, even if it is 0, to complete the sequence.

The display should be 02:31:00. The HH:MM:SS display can be converted easily to an H.h format. To convert the 2:31:00 in the current display, key in:

**CONV 7**

The display should be 2.51667 hours.

Times of H:M:S mode is maximum of 99:59:59. Greater than 99:59:59 the screen will display “ERROR.”

Time entries of 100 or more hours must be made in the H.h format.

Let’s do a simple problem requiring a conversion to HH:MM:SS. Assume you are planning to

fly 63 nautical miles at a groundspeed of 120 knots and that you wish to calculate the time required. The formula is:

$$\text{Distance} \div \text{Speed} = \text{Time}$$

KEY IN	DISPLAY
<b>6</b> <b>3</b> <b>÷</b>	63
<b>1</b> <b>2</b> <b>0</b>	120
<b>=</b>	.525

This is .525 hours. To convert to HH:MM:SS, key in:

**CONV** **4**

The display should be 00:31:30. *Note: This calculation and conversion are performed automatically by the “Leg Time” function in the aviation menu.*

## Timer Operation

The CX-1a has a built-in timer which has both “count up” and “count down” modes of operation. The “count up” mode will count from zero (or another preset time) to as high as 99:59:59. In the “count down” mode, the timer will run from preset value down to zero. Both timer modes automatically go to the HH:MM:SS format.

### Count Up Timer

**TIMER**

To run the timer:

Starting at zero, simply clear any previous display (**C** key), then:

KEY IN	DISPLAY
TIMER	00:00:01 (timer running)

Notice that the “Timer” prompt is flashing to indicate timer operation.

To stop the timer:

KEY IN	DISPLAY
TIMER	00:02:35 (stopped after 2 min., 35 sec.)

All standard math and conversion functions can be performed with this display. For example, let’s add .5 hours then restart the timer.

KEY IN	DISPLAY
+ . 5	.5
=	00:32:35
TIMER	00:32:36 (timer running)

### Count Down Timer

CONV

TIMER

The “count down” timer will count from any preset value (as high as 99:59:59) down to zero. Suppose you plan to fly a non-precision instrument approach at an average groundspeed of 100 knots and that the distance from the final approach fix to the missed approach point is 5.0 nautical miles. The formula for determining the time required for the approach is:

$$\text{Time} = \text{Distance} \div \text{Groundspeed}$$

*Note: This function is performed by the “Leg Time” function in the aviation menu.*

KEY IN	DISPLAY
<b>5</b> <b>÷</b>	5
<b>1</b> <b>0</b> <b>0</b>	100
<b>=</b>	.05

This display could be converted to the HH:MM:SS format (00:03:00) with the **CONV** **4** keys but it is not necessary to do so since the timer will automatically convert when it starts running.

To run the count down timer:

KEY IN	DISPLAY
<b>CONV</b> <b>TIMER</b>	00:02:59 (timer running)

When the timer reaches zero, it turns itself off.

The “count down” function can be interrupted by pressing the **TIMER** key, and can be restarted by pressing **CONV** **TIMER**.

## Aviation Functions

The functions we have covered so far are obviously useful, but you will see that it is in the aviation functions that the CX-1a really shines. Features include:

### A Menu of 18 Aviation Functions

The menu includes five functions involving true airspeed, density altitude, and Mach number calculations; four functions using wind corrections: three for time, speed and distance problems; three for fuel consumption; and a final three for weight and balance.

## Easy to Use

Six display lines make it possible to see all input and answers at the same time. All lines are clearly labeled. A flashing prompt reminds you of the current input line. When nautical miles, altitude in feet, or temperature in centigrade must be used, a prompt appears to remind you of the correct units.

## All Functions are Interactive

All math and conversion functions can be carried out on any input line. Time input can be made directly from the timer with a single keystroke.

There are individual registers for True Airspeed, Groundspeed, Time, Fuel Flow and Center of Gravity. The registers contain the most recent display of each of those items, whether it was as input or as an answer. The register contents will be offered as an input for any function requiring that item. The entry can be made with a single keystroke. This allows “chains” of problems, where a value which is an answer in one function can be automatically entered as input in a succeeding one.

If a function is repeated, any and all input lines can be re-entered with a single keystroke. This allows you to repeat a calculation, where only one or two inputs are changed, with a minimum of effort.

## Menu Selection

You select the function you wish to use by moving the cursor to the appropriate menu item. The cursor is moved with the **←** and **→** keys, and function selection is made by pressing the **ENTER** key.

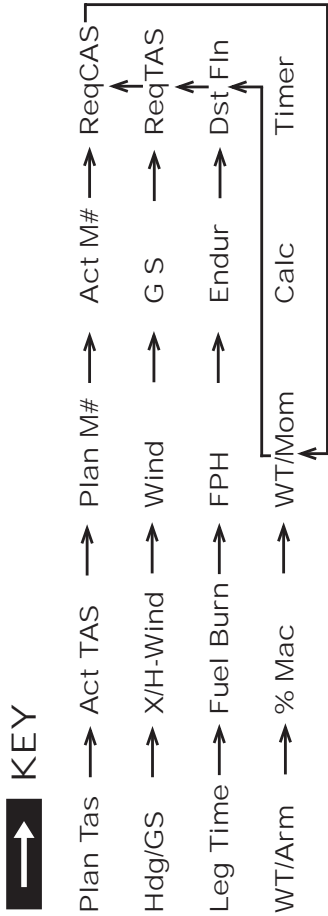
The cursor position is designated by the flashing function prompt. When the CX-1a is initially turned on, the cursor is on the “Leg Time” function. The cursor is moved to the right with the **→** key, and to the left with the **←** key.

If the **→** key is pushed with the cursor at the far right side of a line, the cursor will move to the far righthand item in the next line up. If the **→** key is pushed with the cursor on “ReqCAS” (top right corner), the cursor will move to “WT/Mom.”

The **←** key works in a similar manner. It will move the cursor to the left on any line until it reaches the leftmost menu item. Pushing the **←** key then will move the cursor DOWN to the next line. With the cursor at “WT/Arm,” the **←** will move it to “Plan TAS.”

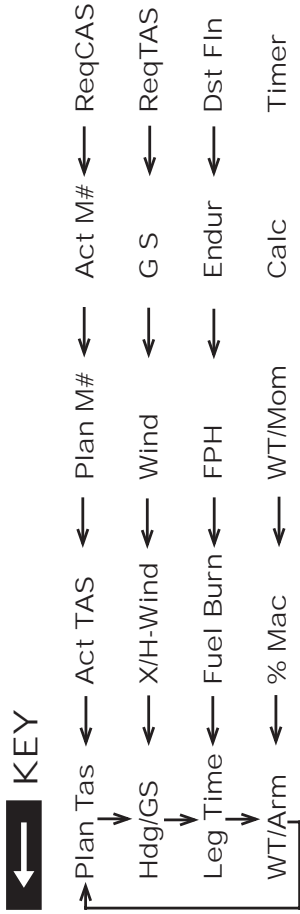
Take the time now to practice moving the cursor around. You’ll see that it never takes more than six keystrokes to get to any position in the menu. You’ll also see that, in most cases, functions which logically follow another are only one keystroke away.

*See Figures 5a and 5b on following pages.*



Start position is: "Leg Time"

**Figure 5a.** Cursor Movement with the **→** Key



**Figure 5b.** Cursor Movement with the **KEY**



# True Airspeed Functions

All of the True Airspeed functions are located on the top row of the menu. The “Plan TAS” and “Act TAS” functions allow you to calculate not only the TAS for a given CAS, altitude and temperature, but also the Mach number and Density altitude. “Plan M#” and “Act M#” give us the TAS for a given Mach number and temperature. “ReqCAS” calculates the CAS and/or Mach number required to maintain a given True Airspeed.

The formulas used for these functions require that speed inputs be made in knots, temperature inputs be in degrees centigrade, and altitude input be in feet. The “NAUT,” “CENT,” and “FEET” prompts are visible when using these functions to remind you of those requirements. Necessary conversions can be made on the input lines.

## Plan TAS and Act TAS

Both of these functions calculate TAS, Mach number, and density altitude. Both require inputs of pressure altitude, temperature and calibrated airspeed. The difference between the two is in the temperature input. “Plan TAS” requires use of “True temperature” ( $T^{\circ}\text{C}$ ) while “Act TAS” uses “Indicated temperature” ( $I^{\circ}\text{C}$ ).

True temperature is the ambient or free air temperature. This is also known as Outside Air Temperature (OAT) or as Static Air Temperature (SAT).

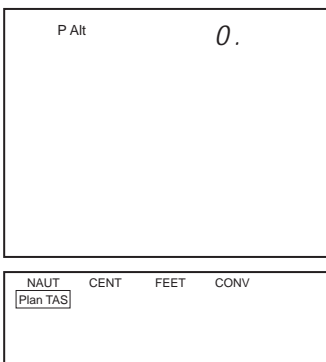
It is the temperature you read from a thermometer on the ground and is the temperature found in the winds aloft forecasts.

As an airplane moves through the air, the temperature rises due to skin friction and compression of the air ahead of the airplane. The air temperature read in the aircraft will reflect this rise and will thus be higher than the True temperature. This reading is called Total Air Temperature (TAT) and is the same as our “I°C” input in the “Act TAS” function.

Since the “Act TAS” function uses a correction for temperature rise, and “Plan TAS” does not, it is important to use the function appropriate to the type temperature available. As a general rule — use “Plan TAS” for preflight planning and use “Act TAS” for in-flight calculations.

## Calculations

Move the cursor to “Plan TAS” and press the **ENTER** key. Your display should be:



**Figure 6.** Initial “Plan TAS” Display

All of the menu has disappeared except for “Plan TAS,” which is flashing. This indicates that you are in that aviation function. The “NAUT,” “CENT” and “FEET” prompts are visible to remind you of the necessity of using those units. On the top line “P Alt” is flashing to indicate that the CX-1a is ready to accept a Pressure Altitude input. Key in:

**8 5 0 0** **ENTER**

The display should now be:

P Alt	8500.
<input type="checkbox"/> T°C	0.

NAUT	CENT	FEET
<input type="checkbox"/> Plan TAS		

**Figure 7.** 8500 feet P Alt

This indicates that you have entered a Pressure Altitude of 8500 feet and that the CX-1a is ready to accept a T°C entry. Key in:

**5** **+/-** **ENTER**

The display should be:

P Alt	8500.
T°C	5.-
<input type="text" value="CAS"/>	0.

NAUT	CENT	FEET
<input type="text" value="Plan TAS"/>		

**Figure 8.** T°C of -5

This indicates a T°C of -5 degrees and that the CX-1a is ready for a CAS entry. To enter a CAS of 125 knots, key in:

**1 2 5** ENTER

The display should be:

P Alt	8 500.
T°C	5.-
CAS	1 25.
<input type="text" value="TAS"/>	1 41.0
<input type="text" value="MACH#"/>	0.22
D Alt	8 123.

NAUT	CENT	FEET	CONV	
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 9.** Completed “Plan TAS” Problem

The “TAS,” “MACH#” and “D Alt” prompts are flashing, indicating a calculated True Airspeed of 141.0 knots, a Mach number of .22 (22% of the speed of sound) and a Density Altitude of 8123 feet. If you want to determine just Density Altitude, simply enter P Alt and T°C leaving CAS blank.

Let’s say that you want to see what True Airspeed would result from a 10-knot increase in CAS. Key in .

The display should be:

<input type="text" value="P Alt"/>	8 500.
T°C	5.-
CAS	125.
<input type="text" value="TAS"/>	141.0
<input type="text" value="MACH#"/>	0.22
<input type="text" value="D Alt"/>	8123.

NAUT	CENT	FEET
<input type="text" value="Plan TAS"/>		

**Figure 10.** Re-enter “Plan TAS” Problem

All the numbers from the previous problem remain. However, the only menu function displayed is the flashing “Plan TAS” indicating that function is active. Also the “P Alt” prompt is flashing indicating that a Pressure Altitude input can be entered. Since we wish to use the displayed 8500 feet, simply press the **ENTER** key. The “P Alt” prompt stops flashing and the “T°C” prompt starts. To re-enter -5 degrees, press **ENTER** again. To enter the new CAS of 135, key in:

**1 3 5 ENTER**

The old display line does not have to be cleared prior to entering a new number. The display should look like:

P Alt	8500.
T°C	5.-
CAS	135.
<input type="text" value="TAS"/>	152.3
<input type="text" value="MACH#"/>	0.24
<input type="text" value="D Alt"/>	8123.

NAUT	CENT	FEET		
<input type="text" value="Plan TAS"/>	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 11.** Second “Plan TAS” Problem

Next, move the cursor to “Act TAS” and press **ENTER**. The operation of this function is identical to “Plan TAS” except that “I°C” is entered instead of “T°C”.

Compute the TAS, etc., at 6500 feet pressure altitude, +10 degrees Centigrade, at a CAS of 150 MPH. Remember that the 150 MPH will have to be converted to knots, and that this can be done on the entry line. Key in:

**6 5 0 0** **ENTER**  
**1 0** **ENTER**  
**1 5 0** **CONV** **÷** **ENTER**



The display should be:

P Alt	6500.
I°C	10.
CAS MomRwy	130.346.
<input type="text" value="TAS"/>	144.8
<input type="text" value="MACH#"/>	0.22
<input type="text" value="D Alt"/>	7100.

NAUT	CENT	FEET	CONV	
Plan TAS	<input type="text" value="Act TAS"/>	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 12.** “Act TAS” Problem

## CAUTION

*The “I°C” input assumes that Total Air Temperature is used. Some older aircraft have Ram Air Temperature (RAT) indicators instead. These instruments give a reading which falls between the ambient temperature and TAT. Use of RAT will result in erroneous answers in any of the TAS functions. At speeds of less than about 200 knots and at altitudes of less than about 15,000 feet, this error is relatively minor and can usually be ignored. At high altitude and/or airspeeds, RAT must be corrected to TAT (I°C) or OAT (T°C) using the Aircraft’s Flight Manual.*

## Pressure and Density Altitudes

Pressure Altitude is indicated altitude corrected to standard pressure. Another way of saying this is that Pressure Altitude is what the altimeter reads when set to 29.92" Hg. Pressure Altitude is used to calculate True Airspeed and Density Altitude and is often used on takeoff and landing charts. Since one inch of pressure is approximately equal to 1000 feet in altitude, you can easily calculate pressure altitude.

For example: Your altimeter is set to 30.15 and is indicating 4500 feet. To correct for pressure altitude, you perform the following calculation:

Subtract: 29.92 **-** 30.15 **=** -0.23 and then multiply -0.23 **x** 1000 **=** -230 feet.

Your Pressure Altitude is 4500 minus 230 feet, or 4270 feet. To keep the signs right, always begin the calculation with standard pressure (29.92) and subtract actual pressure.

Move the cursor to "Plan TAS" and press the **ENTER** key.

To calculate the Pressure Altitude, key in the standard pressure, 29.92, press **-** and enter the actual pressure 30.15. Press **=** and the display will read 0.23-. Multiply this figure **x** the conversion factor, 1000 feet/inch 1000 **=** and the display will show 230- **+** the indicated altitude 4500 **=** **Pressure Altitude** 4270 feet **ENTER**.

Density Altitude is pressure altitude corrected for non-standard temperature. Density Altitude is used

in true airspeed and aircraft performance calculations, for takeoff and landing distances, and for fuel burn. The CX-1a calculator has Density Altitude included in the True Airspeed (Plan TAS) function. To continue the example above, let's assume the indicated air temperature is 5 degrees Celsius.

Key in the indicated air temperature 5 and press **ENTER**.

The display will ask for calibrated airspeed (CAS) which can be either entered or ignored when Density Altitude is needed. In this case, we will ignore it and enter zero. CAS 0 **ENTER**.

The display will show:

P Alt	4270.
T°C	5.
CAS	0.
<input type="text" value="TAS"/>	0.0
<input type="text" value="MACH#"/>	0.00
<input type="text" value="D Alt"/>	4087.

NAUT	CENT			
<input type="text" value="Plan TAS"/>	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 13.** Density Altitude

So the **Density Altitude** is 4087 feet.

## Density Altitude at Destination or Alternate Airport

To calculate the density altitude at a destination or alternate airport along your route of flight, you will need three things:

Field Altitude

Altimeter Setting at Field

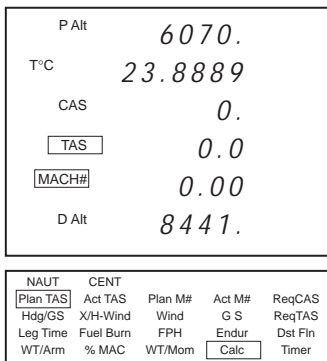
Temperature at Field

Density Altitude can be calculated in the same manner as given above using the calculator's "Plan TAS" function. Let's assume you want the Density Altitude for Truckee-Tahoe Airport. The airport is at 5900 feet, and Flightwatch tells you that the altimeter setting is 29.75. The forecast is for 75 degrees Fahrenheit at your estimated time of arrival (ETA).

Move the cursor to "Plan TAS" and press **ENTER**. Then calculate Pressure Altitude as before: key in the Standard Pressure 29.92 **-** the Actual Pressure 29.75 **=**. The display will show 0.17. Multiply this number **x** the conversion factor, which is 1000 feet/inch 1000 **=**; this displays Altitude Correction 169.998. This figure **+** Airport Altitude 5900 **=** **Pressure Altitude** 6070 feet **ENTER**.

Expected Temperature Fahrenheit is 75. Press **CONV** **=** ( $^{\circ}\text{F} \rightarrow ^{\circ}\text{C}$ ) and the display will show Temp Celsius 23.8889; **ENTER**. Ignore CAS 0 **ENTER**.

The display will show:



**Figure 14.** Density Altitude at Destination

The **Density Altitude** at Truckee-Tahoe is expected to be 8441 feet at the time of your arrival.

## Plan M# and Act M#

Many jet aircraft use a cruise Mach number rather than airspeed. These two functions allow you to calculate the TAS for a given Mach number and temperature combination. As with the two previous functions, “Plan M#” utilizes “T°C” and should be used for preflight planning, while “Act M#” should be used in flight, with indicated temperatures.

Move the cursor to “Plan M#” and compute the TAS at .72 Mach and -35 degrees C.

KEY IN	DISPLAY
<b>3</b> <b>5</b> <b>+/-</b> <b>ENTER</b>	T°C
<b>•</b> <b>7</b> <b>2</b> <b>ENTER</b>	MACH#

The display should be:

T°C	35. -
<input type="text" value="TAS"/>	433.0
MACH#	0.72

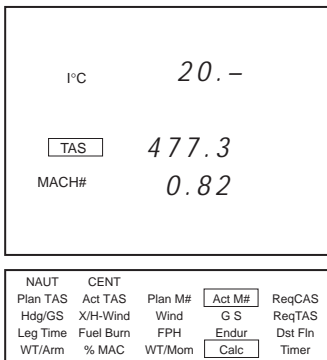
NAUT	CENT	<input type="text" value="Plan M#"/>	Act M#	ReqCAS
Plan TAS	Act TAS	Wind	G S	ReqTAS
Hdg/GS	X/H-Wind	FPH	Endur	Dst Fln
Leg Time	Fuel Burn	WT/Mom	<input type="text" value="Calc"/>	Timer
WT/Arm	% MAC			

**Figure 15.** “Plan M#” Problem

Assume you are flying along in your Boeing 727 at .82 Mach with a TAT reading of -20 degrees C. To determine the TAS, move the cursor to “Act M#,” press **ENTER** and key in the following:

KEY IN	DISPLAY
<b>2</b> <b>0</b> <b>+/-</b> <b>ENTER</b>	T°C
<b>•</b> <b>8</b> <b>2</b> <b>ENTER</b>	MACH#

The display should be:



**Figure 16.** “Act TAS” Problem

## ReqCAS

Occasionally it is desirable to calculate the CAS or Mach number required to maintain a desired TAS. Assume a Pressure Altitude of 6500 feet, a T°C of -5 degrees C., and a desired TAS of 150 knots. Move the cursor to “ReqCAS” and key in the following:

KEY IN	DISPLAY
6 5 0 0 ENTER	P Alt
5 +/- ENTER	T°C
1 5 0 ENTER	TAS

*Note: If the calculator has been on continuously, you have gotten a display of the most recently computed TAS from the TAS register.*

The display should be:

P Alt	6500.
T°C	5.-
<input type="text" value="CAS"/>	138.1
TAS	150.
<input type="text" value="MACH#"/>	0.24
<input type="text" value="D Alt"/>	5642.

NAUT	CENT	FEET		
Plan TAS	Act TAS	Plan M#	Act M#	<input type="text" value="ReqCAS"/>
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

Figure 17. "ReqCAS" Problem



# Wind Functions

There are four functions, all located on the second menu line, which involve wind calculations. These are “Hdg/GS,” “X/H-Wind,” “Wind” and “ReqTAS.” The “GS” function, also located on line two, is a time, speed, distance problem which we will cover later.

The “NAUT” prompt appears with all wind functions to remind you that all speeds (both winds and aircraft) should be entered in knots. While this is not an absolute requirement for accuracy, it is good practice since the contents of the GS and TAS registers are affected with each problem.

You should also pay close attention to whether True or Magnetic directions are used. Either can be used in a given problem, but you must not mix True and Magnetic directions.

## Hdg/GS

The “Hdg/GS” function computes the heading required to maintain a desired course and the groundspeed. The required input are Wind Direction (W Dir), Wind Speed (W Spd), Course (Crs), and True Airspeed (TAS). If there is a TAS in the register it will be offered as an input.

Assume winds of 350 degrees at 15 knots at cruise altitude. On a course of 155 degrees true and at a speed of 125 knots, what groundspeed and heading can you expect? Move the cursor to “Hdg/GS,” press **ENTER** and key in the following:

KEY IN	DISPLAY
<b>3</b> <b>5</b> <b>0</b> <b>ENTER</b>	W Dir
<b>1</b> <b>5</b> <b>ENTER</b>	W Spd
<b>1</b> <b>5</b> <b>5</b> <b>ENTER</b>	Crs
<b>1</b> <b>2</b> <b>5</b> <b>ENTER</b>	TAS

The ending display should be:

W Dir	350.
W Spd	15.
Crs	155.
TAS	125.
<input type="text" value="GS"/>	139.4
<input type="text" value="Hdg"/>	153.

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
<input type="text" value="Hdg/GS"/>	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 18.** First “Hdg/GS” Problem

As with the previous functions, conversions and other math can be performed on the input line. Assume a wind of 280 degrees at 30 knots, a course of 220 degrees magnetic, a local variation of 20 degrees East, and a TAS of 145 MPH. The TAS must be converted to knots and the wind direction or course must be changed so that both are either true or magnetic. In this case, we will convert the magnetic course to true by adding 20 degrees.

KEY IN	DISPLAY
<b>2</b> <b>8</b> <b>0</b> <b>ENTER</b>	W Dir
<b>3</b> <b>0</b> <b>ENTER</b>	W Spd
<b>2</b> <b>2</b> <b>0</b>	
<b>+</b> <b>2</b> <b>0</b>	
<b>=</b> <b>ENTER</b>	Crs
<b>1</b> <b>4</b> <b>5</b> <b>CONV</b>	
<b>÷</b> <b>ENTER</b>	TAS

The display should be:

W Dir	280.
W Spd	30.
Crs	240.
TAS	126.002
<input type="text" value="GS"/>	101.5
<input type="text" value="Hdg"/>	249

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
<input type="text" value="Hdg/GS"/>	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 19.** Second “Hdg/GS” Problem

## X/H-Wind

The “X/H-Wind” function computes the head or tailwind component and the left or right crosswind component for a given wind and runway. The wind speed must be in knots and, since runways are numbered by their magnetic course, the “W Dir” must be magnetic as well. Note that the runway number is entered and not the course. If a number greater than 36 is entered, the answer displays will remain blank.

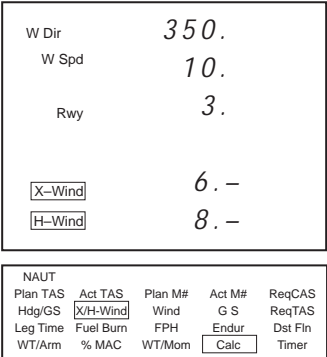
Crosswinds are shown beside the “X-Wind” prompt. A crosswind from the right is shown as a positive number and a wind from the left is negative.

Headwinds and tailwinds are both shown by the “H-Wind” prompt. A headwind is a negative number (it reduces your groundspeed) and a tailwind is positive.

Assume a wind of 350 degrees at 10 knots. What are the head/tailwind and crosswind components for a landing on runway 03? Move the cursor to “X/H-Wind,” and press the **ENTER** key. Then key in the following:

KEY IN	DISPLAY
<b>3</b> <b>5</b> <b>0</b> <b>ENTER</b>	W Dir
<b>1</b> <b>0</b> <b>ENTER</b>	W Spd
<b>3</b> <b>ENTER</b>	Rwy

The display should be:



**Figure 20.** “X/H-Wind” Problem

The “X-Wind” display of 6- indicates a cross-wind from the left of 6 knots. The “H-Wind” display of 8- is a headwind component of 8 knots.

To compute the components for runway 24 using the same wind:

KEY IN	DISPLAY
<span style="background-color: black; color: white; padding: 2px 5px;">ENTER</span>	W Dir
<span style="background-color: black; color: white; padding: 2px 5px;">ENTER</span>	W Spd
<span style="background-color: black; color: white; padding: 2px 5px;">2</span> <span style="background-color: black; color: white; padding: 2px 5px;">4</span> <span style="background-color: black; color: white; padding: 2px 5px;">ENTER</span>	Rwy

The resulting display is:

W Dir	350.
W Spd	10.
Rwy	24.
<input type="text" value="X-Wind"/>	9.
<input type="text" value="H-Wind"/>	3.

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	<input type="text" value="X/H-Wind"/>	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 21.** Second “X/H-Wind” Problem

In this case we have a right crosswind of 9 knots and a tailwind of 3 knots.

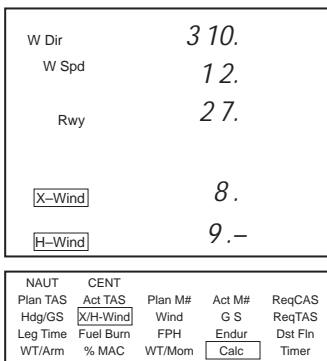
## En Route Crosswind and Headwind Components

Crosswind and Headwind components are most useful on takeoff and landing. For en route calculations, you will most often use a wind correction angle (crab angle) and groundspeed. These functions are the X/H-Wind and Hdg/GS functions on your CX-1a Pathfinder Flight Computer. If you wish, to calculate a cross- and headwind component while en route, you may use the X/H-Wind function if you remember to round off your course to the nearest ten degrees as if it were a runway

heading. In the following example, if you are flying West (270 degrees) and the winds are from 310 degrees at 12 knots, you:

Key in X/H-Wind Function, key in Wind Direction 310, press **ENTER** and key in Wind Speed 12 **ENTER**. For Rwy, key in rounded-off course 27 and press **ENTER**.

The display will show:



**Figure 22.** En Route Wind Components

So you are flying in a right crosswind at 8 knots and into a 9-knot headwind.

Be careful to keep both your course and the winds in either true or magnetic degrees. Predicted winds aloft are given in true, rather than magnetic orientation, while both your course and heading are

probably magnetic. This is not a problem on take-off and landing because airport wind advisories and runway headings are both magnetic.

## Wind

The “Wind” function allows you to compute an unknown wind given inputs of “Hdg,” “GS,” “TAS” and “Crs.” As with the other functions in this section, speeds must be in knots and direction must both be magnetic or both be true.

To calculate the wind given a True Course of 355 degrees, a heading of 350 degrees (true), a ground-speed of 478 knots and a true airspeed of 500 knots, key in the following:

KEY IN	DISPLAY
<b>3</b> <b>5</b> <b>0</b> <b>ENTER</b>	Hdg
<b>4</b> <b>7</b> <b>8</b> <b>ENTER</b>	GS
<b>5</b> <b>0</b> <b>0</b> <b>ENTER</b>	TAS
<b>3</b> <b>5</b> <b>5</b> <b>ENTER</b>	Crs



The display is:

W Dir	290.
W Spd	48.
Crs	355.
TAS	500.
GS	478.
Hdg	350.

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	Calc	Timer

**Figure 23.** “Wind” Problem

## ReqTAS

Occasionally it is necessary to arrive at a checkpoint at a specific time. In order to do this, the groundspeed must be precisely controlled. This means that the aircraft’s TAS must be made to vary depending on the wind conditions.

The “ReqTAS” function allows you to compute the true airspeed required to maintain a given groundspeed under specific wind conditions. It also computes the heading required to stay on course. Inputs are “W Dir,” “W Spd,” “Crs” and “GS.” The usual cautions about using knots and not mixing true and magnetic apply.

Assume you want to maintain a groundspeed of 143 knots while flying on a true course of 010 degrees. The winds aloft forecast indicates winds of

250 degrees at 25 knots at cruise altitude. Move the cursor to “ReqTAS,” press **ENTER**, and key in the following:

KEY IN	DISPLAY
<b>2</b> <b>5</b> <b>0</b> <b>ENTER</b>	W Dir
<b>2</b> <b>5</b> <b>ENTER</b>	W Spd
<b>1</b> <b>0</b> <b>ENTER</b>	Crs
<b>1</b> <b>4</b> <b>3</b> <b>ENTER</b>	GS

The display is:

W Dir	250.
W Spd	25.
Crs	10.
<input type="text" value="TAS"/>	132.3
GS	143.
<input type="text" value="Hdg"/>	1.

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	GS	<input type="text" value="ReqTAS"/>
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 24.** “ReqTAS” Problem

# Rate Functions

The CX-1a performs 6 different rate functions. Three of these involve time, speed and distance computations and the other three deal with fuel consumption. The three rate functions are:

	INPUT	OUTPUT
"Leg Time"	Dist GS*	Time*
"Dst Fln"	Time* t GS*	Dist
"GS"	Dist Time* t	GS*

**Figure 25.** Time, Speed, Distance Functions

The three fuel consumption functions are:

	INPUT	OUTPUT
"Fuel Burn"	Time* t FPH*	Fuel
"FPH"	Time* t Fuel	FPH*
"Endur"	Fuel FPH*	Time* t

**Figure 26.** Fuel Consumption Functions

\* Indicates a value for which there is a register. Any number in a register will be offered as an input to be entered by pressing the **ENTER** key.

t Indicates that a "Time" input can be entered directly from the timer.

## Leg Time

“Leg Time” is probably the most commonly used aviation function. That is why it is the initial cursor position.

To compute the time required to fly 153 nautical miles at a groundspeed of 123 knots, position the cursor on “Leg Time,” press the **ENTER** key, and

KEY IN	DISPLAY
<b>1</b> <b>5</b> <b>3</b> <b>ENTER</b>	Dist
<b>1</b> <b>2</b> <b>3</b> <b>ENTER</b>	GS

The display is:

153.	Dist
123.	GS
01:14:38	<input type="text" value="TIME"/>

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
<input type="text" value="Leg Time"/>	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 27.** “Leg Time” Problem

## Fuel Burn

This function computes the fuel burned, given a burn rate, which we abbreviate “FPH” (fuel per hour); and a time.

Assume a burn rate of 9.5 gallons per hour and the time previously computed in the “Leg Time” function. Move the cursor to “Fuel Burn,” press the **ENTER** key, and key in the following:

KEY IN	DISPLAY
<b>ENTER</b>	Time
<b>9</b> <b>.</b> <b>5</b> <b>ENTER</b>	FPH

The display is:

<i>01:14:38</i>	TIME
<i>9.5</i>	FPH
<i>11.8</i>	<input type="text" value="Fuel"/>

Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	<input type="text" value="Fuel Burn"/>	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 28.** “Fuel Burn” Problem

## FPH

The “FPH” function computes the fuel burn rate per hour (FPH) given a time and fuel quantity burned.

Assume that in the last 2 hours, 30 minutes, you have burned 9,500 pounds of fuel. To determine the burn rate, position the cursor to “FPH,” press the **ENTER** key, and key in the following:

KEY IN	DISPLAY
<b>2</b> <b>T</b> <b>3</b> <b>0</b> <b>T</b> <b>ENTER</b>	Time
OR	
<b>2</b> <b>.</b> <b>5</b> <b>ENTER</b>	
<b>9</b> <b>5</b> <b>0</b> <b>0</b> <b>ENTER</b>	Fuel

The display is:

<i>02:30:00</i>	TIME
<i>3800.0</i>	<input type="text" value="FPH"/>
<i>9500.</i>	Fuel

Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	<input type="text" value="FPH"/>	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 29.** “FPH” Problem

## Endur

The endurance function allows you to calculate the flight time available given a fuel quantity and burn rate.

Assume you have 38 gallons of usable fuel (plus reserves) and plan to use a power setting which will give a fuel burn rate of 9.5 gallons per hour. Move the cursor to “Endur,” press the **ENTER** key, and key in the following:

KEY IN	DISPLAY
<b>3</b> <b>8</b> <b>ENTER</b>	Fuel
<b>9</b> <b>.</b> <b>5</b> <b>ENTER</b>	FPH

The display should be:

<i>0 4:00:00</i>	<input type="text" value="TIME"/>
<i>9.5</i>	FPH
<i>38.</i>	Fuel

Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	GS	ReqTAS
Leg Time	Fuel Burn	FPH	<input type="text" value="Endur"/>	Dst Flt
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 30.** “Endur” Problem

## Dst Fln

The distance flown function allows you to compute how far you will fly (or have flown) given a GS and time.

Suppose you have flown for 24 minutes at an average speed of 130 knots. Move the cursor to “Dst Fln,” press **ENTER**, and key in the following:

KEY IN	DISPLAY
<b>T 2 4 T ENTER</b>	Time
<b>1 3 0 ENTER</b>	GS

The display should be:

52.0	Dist
130.	GS
00:24:00	TIME

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	Calc	Timer

**Figure 31.** “Dst Fln” Problem



## GS

The groundspeed function allows you to compute the groundspeed given a distance and time. This is a function where the timer is particularly useful. You can use the timer flying over a known distance and then enter that time directly into the calculator.

Let's simulate this feature by letting the timer run for this problem. Assume a distance flown of 5 nautical miles. Move the cursor to "GS," press the **ENTER** key, and key in the following:

KEY IN	DISPLAY
<b>5</b> <b>ENTER</b>	Dist
<b>TIMER</b>	Time (to start timer)
<b>TIMER</b> <b>ENTER</b>	Time (to stop and enter)

My timer ran for 2 minutes, 32 seconds. The results were:

5.	Dist
118.4	<input type="text" value="GS"/>
00:02:32	TIME

NAUT				
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	<input type="text" value="GS"/>	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Fln
WT/Arm	% MAC	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 32.** "GS" Problem

# Weight and Balance Functions

The CX-1a has three weight and balance functions, and between them you can perform all the calculations necessary for proper aircraft loading. The “WT/Arm” and “WT/Mom” functions allow you to calculate your aircraft’s center of gravity (CG) and also to determine the effects of adding, subtracting or shifting weight in the aircraft. The “% MAC” function converts a CG expressed in inches aft of datum to percent of mean aerodynamic chord.

## WT/Arm

Move the cursor to the “WT/Arm” function and press the **ENTER** key. You should see a flashing prompt for weight “WT.” Key in:

**1 4 5 4** **ENTER**

This is the empty weight of an airplane. You should now see a flashing “Arm” prompt. Key in:

**3 9 • 6** **ENTER**

This is the empty center of gravity of the airplane. You should now see a flashing “RF” prompt and the number “1.” RF denotes the reduction factor. This number comes from the weight and balance portion of your aircrafts owner’s manual and is normally 100 or 1000. Its purpose is to make the numbers (or more specifically the moments) that you are working with easier to manage. It is

necessary to enter the correct RF to determine the proper weight and balance. Just enter the default value by pressing **ENTER**.

The display should now look like:

WT	1454.
Arm	39.6
Mom	57578.4
CG	39.6
RF	1.
GW	1454.

WT/Arm
--------

**Figure 33.** Initial “WT/Arm” Display

Unlike the functions we have covered up to this point, the “WT/Arm” function does not return the user to the menu when the calculation is complete. To return to menu press **←** key. This is indicated by the fact that the only menu function visible is the flashing “WT/Arm” and by the flashing “WT” prompt which indicates it is ready for another input.

The flashing “Mom” prompt designates the moment of the latest weight and arm inputs. It is determined by the formula:

$$\text{Weight} \times \text{Arm} : \text{RF} = \text{Moment} (1454 \times 39.6:1)$$

If we had used an RF (reduction factor) of 10 or 100 the displayed moment would have been smaller by that factor. It is never necessary to use an RF of other than 1 in the “WT/Arm” mode. If a moment is longer than 6 digits an “E” will be displayed, but this does not affect the accuracy of the calculation.

The flashing “CG” and “GW” prompts indicate running totals for center of gravity and gross weight. These are currently the same as the single entries made so far.

Next, add 40 gallons of gasoline (at 6 pounds per gallon) at station (arm) 36.0.

KEY IN	DISPLAY
<b>4</b> <b>0</b> <b>x</b> <b>6</b> <b>=</b>	
<b>ENTER</b>	WT
<b>3</b> <b>6</b> <b>ENTER</b>	Arm

Notice that the RF did not have to be entered again.

The display should now be:

<input type="text" value="WT"/>	240.
Arm	36.
<input type="text" value="Mom"/>	8640
<input type="text" value="CG"/>	39.1
RF	1.
<input type="text" value="GW"/>	1694

<input type="text" value="WT/Arm"/>
-------------------------------------

**Figure 34.** Second “WT/Arm” Entry

The “WT,” “Arm” and “Mom” lines show the latest inputs and the flashing “WT” prompt indicates it’s ready for another input. The current GW is 1694 and the current CG is at 39.1 inches.

Finish the problem by entering the following data:

	WT	/	Arm
Front seat occupants .....	240 lbs.	/	37.0"
Back seat occupant .....	170 lbs.	/	73.0"
Baggage .....	96 lbs.	/	95.0"



The display should be:

WT	96.
Arm	95.
Mom	9120.
CG	43.9
RF	1.
GW	2200.

WT/Arm	
--------	--

**Figure 35.** Final Display of “WT/Arm” Problem

This indicates a gross weight of 2200 pounds and a CG at 43.9 inches. To get out of the “WT/Arm” mode, press either the  or  key.

### Adding and Subtracting Weight

Let's suppose that in the airplane above, we need to change the load by letting a 150-pound passenger out of the front seat (37.0 inches) and by adding 50 pounds at the station 123.0 inches.

Clear the machine and re-enter the weight of 2200 pounds and arm of 43.9 inches. Entering a reduction factor of 1 will yield a CG of 43.9.

Then key in the following:

KEY IN	DISPLAY
<b>1</b> <b>5</b> <b>0</b> <b>+/-</b> <b>ENTER</b>	WT
<b>3</b> <b>7</b> <b>ENTER</b>	Arm
<b>5</b> <b>0</b> <b>ENTER</b>	WT
<b>1</b> <b>2</b> <b>3</b> <b>ENTER</b>	Arm

The new display is:

WT	50.
Arm	123.
Mom	6150.
CG	46.3
RF	1.
GW	2100.


WT/Arm
--------

**Figure 36.** Weight Add/Subtract Problem

Notice that any weight taken out is entered as a negative number and weight added is a positive number. Only the sign of the weight is changed — not the Arm.

## Shifting Weight

Suppose now, that the 170-pound passenger in the back seat wants to move up to the front. The weight shift calculation is handled just as though it is a separate weight add/subtract problem. Simply remove the weight of the passenger from station 73 and add it to station 37 by keying in the following:

KEY IN	DISPLAY
<b>1 7 0</b>  <b>ENTER</b>	WT
<b>7 3</b> <b>ENTER</b>	Arm
<b>1 7 0</b> <b>ENTER</b>	WT
<b>3 7</b> <b>ENTER</b>	Arm

The new display is:

<input type="text" value="WT"/>	170.
Arm	37.
<input type="text" value="Mom"/>	6290.
<input type="text" value="CG"/>	43.4
RF	1.
<input type="text" value="GW"/>	2100
<input type="text" value="WT/Arm"/>	

**Figure 37.** Weight Shift Problem



## WT/Mom

The “WT/Mom” function operates in a manner very similar to “WT/Arm.” Many flight manuals list a moment for weights at a certain location instead of the arm. Note that in this mode, the RF is much more critical since a moment of more than 6 digits cannot be entered.

Let’s work a weight and balance problem for a Boeing 727 from the FAA’s flight engineer written test guide. Move the cursor to “WT/Mom,” press the **ENTER** key and then key in the empty weight of 105000 pounds. Then enter the empty moment of 92827.0 and the reduction factor of 1000.

The initial display should be:

<input type="text" value="WT"/>	<i>1 05000.</i>
Mom	<i>9 2827.</i>
<input type="text" value="CG"/>	<i>8 84.1</i>
RF	<i>1 000</i>
<input type="text" value="GW"/>	<i>1 05000</i>

<input type="text" value="WT/Mom"/>
-------------------------------------

**Figure 38.** Initial “WT/Mom” Display

Now enter the following:

	WT	/	Mom	/1000*
10 First-class pax .....	1700	/	989	
90 Coach pax .....	15300	/	15728	
Fwd cargo pit .....	1000	/	680	
Aft cargo pit .....	600	/	700	
Fuel tank # .....	11500	/	11463	
Fuel tank #2 .....	12000	/	10993	
Fuel tank #3 .....	11500	/	11463	

*\*Note: Reduction factor (RF) must be entered for correct results.*


The final display is:

<input type="text" value="WT"/>	1 15000.
Mom	1 1463.
<input type="text" value="CG"/>	9 13.3
RF	1 000.
<input type="text" value="GW"/>	1 58600.

<input type="text" value="WT/Mom"/>
-------------------------------------

**Figure 39.** Final “WT/Mom” Display

To return to menu, press the  key.

## Weight Shift / Weight Add or Subtract

These calculations are done in a manner similar to the “WT/Arm” mode. The only difference is that when taking weight out of a station, either to remove it or to shift it, both the weight and moment must be entered as negative numbers.

Using the results of the previous problem, remove 100 pounds from the forward cargo pit (moment 68) and add 10 passengers to the coach cabin (moment 1748). To calculate total “moment”:

$$CG \times GW \div RF = Mom.$$

KEY IN	DISPLAY
<b>1</b> <b>0</b> <b>0</b> <b>+/-</b> <b>ENTER</b>	WT
<b>6</b> <b>8</b> <b>+/-</b> <b>ENTER</b>	Mom
<b>1</b> <b>7</b> <b>0</b> <b>0</b> <b>ENTER</b>	WT
<b>1</b> <b>7</b> <b>4</b> <b>8</b> <b>ENTER</b>	Mom

The display is now:

<input type="text" value="WT"/>	<i>1 700.</i>
Mom	<i>1 748.</i>
<input type="text" value="CG"/>	<i>9 14.6</i>
RF	<i>1 000</i>
<input type="text" value="GW"/>	<i>1 60200</i>
<input type="text" value="WT/Mom"/>	

**Figure 40.** Weight Add/Subtract Problem

## % MAC

Large aircraft operations often require that the CG be expressed in percent of the mean aerodynamic chord.

Return to menu by pressing **←**, then move to % MAC **ENTER**. This will convert the CG from the previous problem to % MAC. Assume for this problem that LEMAC is 860.2 inches and the MAC is 180.7 inches.

KEY IN	DISPLAY
<b>1 8 0 . 7</b>	
<b>ENTER</b>	MAC
<b>ENTER</b>	CG (from the register)
<b>8 6 0 . 2</b>	
<b>ENTER</b>	LEMAC

The display is:

	<i>860.2</i>	LEMAC
	<i>30.1</i>	<input type="text" value="%MAC"/>
CG	<i>914.625</i>	
	<i>180.7</i>	MAC

Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	<input type="text" value="% MAC"/>	WT/Mom	<input type="text" value="Calc"/>	Timer

**Figure 41.** % MAC Problem

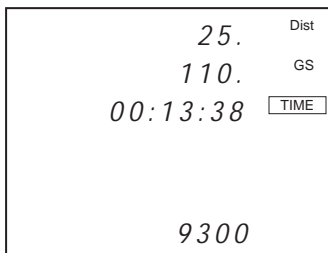
# Rate of Climb and Descent

**Example 1:** You are at an altitude of 11500 feet and need to descend to a pattern altitude of 2200 feet. You have just crossed over a checkpoint 25 nautical miles from your destination and are tracking at a groundspeed of 110 knots. To find your rate of descent, you must divide the altitude to be lost by the en route time.

For this example, subtract 11500 feet  $-$  2200 feet which equals 9300 feet to descend. You can find the time by using the “Leg Time” function of the calculator.

- Move the cursor to “Leg Time” and press **ENTER**.
- Key in the Distance, 25, and press **ENTER**.
- Key in the Groundspeed, 110, and press **ENTER**.

The display will show the time as 00:13:38.



NAUT	CENT			
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	Dst Flt
WT/Arm	% MAC	WT/Mom	Calc	Timer

**Figure 42.** Example 1: Climb and Descent

Then convert 13 minutes and 38 seconds to decimal using the calculator at the bottom of the screen. Enter the time 00T 13 T 38 T and display will show 00:13:38. Convert to decimal **CONV** **7** (HMS→H) and the display will show hours 0.22722 **x** Minutes per Hour, 60, **=**. The display will show minutes 13.6333.

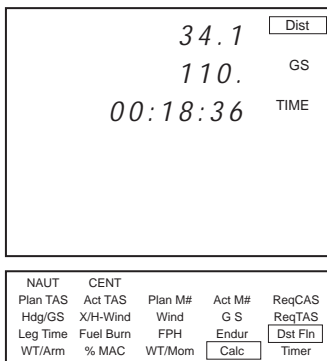
Then divide 9300 feet by 13.63 minutes to determine that a descent rate of 682 feet per minute will be required.

**Example 2:** In the same case as in the preceding example, descending from 11500 to 2200 feet, assume that you wish to maintain a constant descent rate of 500 feet per minute. How far away should you begin your descent and how long will the descent take? By dividing 9300 feet by 500 feet per minute, you can determine that it will take 18.6 minutes to descend to pattern altitude. Then using the calculator's "Dst Fln" function, you can determine where to begin your descent.

Move the cursor to "Dst Fln" and press the **ENTER** key.

Key in the time required, 18.6, **÷** Minutes per Hour, 60, **=**. Display will show time 00:18:36 **ENTER**. Key in groundspeed 110 **ENTER**.

The display will show distance 34.1.



**Figure 43.** Example 2: Climb and Descent

You will need to begin your descent 34.1 nautical miles from your destination airport and you can expect to arrive in about 18.6 minutes, if your groundspeed remains at 110 knots.

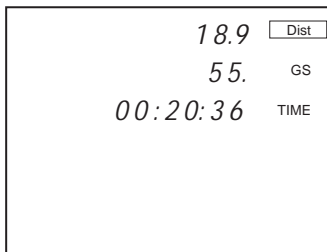
**Example 3:** You need to climb from an airport at 1200 feet to a cruising altitude of 11500 and maintain a cruise climb of 500 feet/minute at a groundspeed of 55 knots.

Dividing the altitude you need to climb (11500 feet minus 1200 feet equals 10300 feet) by 500 feet per minute equals 20.6 minutes to make the climb. Move the cursor to “Dst Fln” and press **ENTER**.

Enter Time Required 20.6  $\div$  Minutes per Hour, 60, =; display will show time 00:20:36.

Press **ENTER** and key in Expected Groundspeed, 55, **ENTER**.

The display will show 18.9 Nautical Miles.



NAUT	CENT			
Plan TAS	Act TAS	Plan M#	Act M#	ReqCAS
Hdg/GS	X/H-Wind	Wind	G S	ReqTAS
Leg Time	Fuel Burn	FPH	Endur	<b>Dst Fln</b>
WT/Arm	% MAC	WT/Mom	<b>Calc</b>	Timer

**Figure 44.** Example 3: Climb and Descent

You will reach cruising altitude in about 20.6 minutes at approximately 18.9 nautical miles from your departure point.

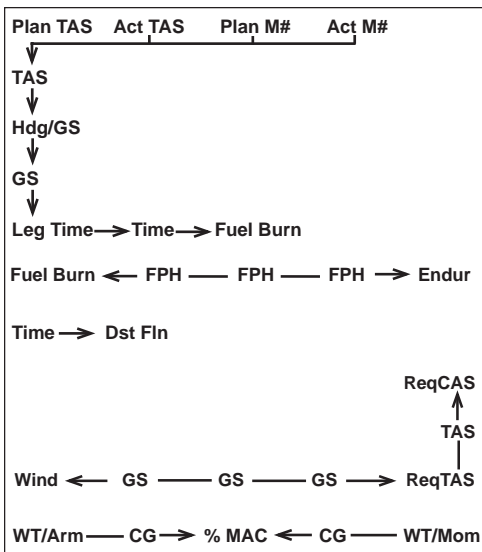


## Chain Calculations

As mentioned previously, there are registers for TAS, GS, TIME, FPH, and CG. Anytime that a number appears either as an input or as a result, it is stored in the appropriate register. When an input requires one of these quantities, it is automatically displayed and can be used simply by pressing the **ENTER** key.

To take full advantage of this feature, the menu is laid out so that functions which logically follow each other are within a single stroke of the left or right arrow keys. For example, it is logical that the TAS output of the “Plan TAS” function, and that the GS output of “Hdg/GS” be used in “Leg Time,” etc.

You'll find diagrams in Figure 45 on the following page showing some of the most useful chains.



**Figure 45.** Useful Chain Calculations

Some examples of chain problems are included in Appendix A.

## Standard Temperature

There are occasions when it is helpful to know the Standard Temperature in order to compare actual or observed conditions. Standard Temperature at Sea Level is 59 degrees Fahrenheit (15 degrees Celsius) and the lapse rate (standard reduction with altitude) is 3.5 degrees per 1000 feet (2 degrees Celsius/1000 feet). To calculate Standard Temperature, multiply the conversion factor times your altitude and subtract that product from Standard Temperature.

For example, to calculate Standard Temperature at 12500 feet, the Fahrenheit conversion factor being 0.0035:

Enter Conversion Factor .0035 **x** Indicated Altitude 12500 **=**; display will show 43.75. Change Signs and Add **+/-** **+** Standard Temperature at Sea Level 59 **=** Standard Temperature Aloft 15.25 degrees F.

To do the example in Celsius, use a conversion factor of .002 and a Standard Temperature of 15 degrees. An example follows:

Key in Conversion Factor .002 **x** Indicated Altitude 12500 **=**; display will show 25. Change Signs and Add **+/-** **+** Standard Temperature at Sea Level 15 **=** Standard Temperature Aloft 10-Degrees Celsius.

*Note: The standard temperature lapse rate is not constant above 35000 feet.*

# Appendix A: Sample Problems

## Answers

### Math Review

$$(2 + 63) \times 3 = \underline{\hspace{2cm}} \quad 195$$

$$17 \div 6 = \underline{\hspace{2cm}} \quad 2.83333$$

$$5 - 12.5^\circ = \underline{\hspace{2cm}} \quad -7.5$$

### Time

$$2:30:00 + 00:37:30 = \underline{\hspace{2cm}} \quad 03:07:30$$

$$8:30:00 - 5:15:00 = \underline{\hspace{2cm}} \quad 03:15:00$$

### Conversions

$$52 \text{ Statute Miles} = \underline{\hspace{2cm}} \text{ NM} \quad 45.1868$$

$$175 \text{ MPH} = \underline{\hspace{2cm}} \text{ KTS} \quad 152.071$$

$$600 \text{ KTS} = \underline{\hspace{2cm}} \text{ MPH} \quad 690.468$$

$$600 \text{ KTS} = \underline{\hspace{2cm}} \text{ KPH} \quad 1111.2$$

$$200 \text{ MPH} = \underline{\hspace{2cm}} \text{ KPH} \quad 321.869$$

$$11000 \text{ METERS} = \underline{\hspace{2cm}} \text{ FEET} \quad 36089.2$$

$$5280 \text{ FEET} = \underline{\hspace{2cm}} \text{ METERS} \quad 1609.34$$

$$0^\circ\text{F} = \underline{\hspace{2cm}} \text{ }^\circ\text{C} \quad -17.7778$$

$$20^\circ\text{C} = \underline{\hspace{2cm}} \text{ }^\circ\text{F} \quad 68$$

$$-40^\circ\text{F} = \underline{\hspace{2cm}} \text{ }^\circ\text{C} \quad -40$$

$$200 \text{ GAL.} = \underline{\hspace{2cm}} \text{ LITERS} \quad 757.082$$

$$500 \text{ LITERS} = \underline{\hspace{2cm}} \text{ GAL.} \quad 132.086$$

$$120 \text{ POUNDS} = \underline{\hspace{2cm}} \text{ KG} \quad 54.4311$$

$$90 \text{ KG} = \underline{\hspace{2cm}} \text{ LBS.} \quad 198.416$$

<b>Input</b>	<b>Output</b>	<b>Answers</b>
Plan TAS		
P Alt 0		
T°C 65°F = _____ °C		18.333
CAS 125 MPH = _____ KTS		108.622
TAS = _____		109.2
MACH # = _____		0.16
D Alt = _____		393
P Alt 35000		
T°C - 55°C		
CAS 285 KTS		
TAS = _____		480.3
MACH # = _____		.83
D Alt = _____		34922
Act TAS		
P Alt 25000		
I°C 0		
CAS 150		
TAS = _____		234.1
MACH # = _____		.37
D Alt = _____		28028
Plan M#		
T°C - 40°C		
MACH .72		
TAS = _____		428.4
Act M#		
I°C - 17°		
MACH# .84		
_____ TAS		490.4

Input	Output	Answers
ReqCAS		
P Alt 3000		
T°C = 45°F = _____ °C		7.22222
TAS = 145		
CAS _____		139.2
MACH # _____		.22
D Alt _____		2782

Hdg/GS		
W Dir 330		
W Spd 15		
Crs 165		
TAS 145		
GS _____		159.4
Hdg _____		167

X/H-Wind		
W Dir 280		
W Spd 12		
Rwy 32		
X/Wind _____		-8 (Left)
H-Wind _____		-9 (Headwind)

Wind		
Hdg 222		
GS 159.44		
TAS 145		
Crs 215		
W Dir _____		347
W Spd _____		24

<b>Input</b>	<b>Output</b>	<b>Answers</b>
ReqTAS		
W Dir 250		
W Spd 20		
Crs 210		
GS 180		
TAS _____		195.7
Hdg _____		214
Leg Time		
Dist 75 KM = _____ NM		40.4968
GS 115 MPH = _____ KNOTS		99.9323
Time _____		00:24:19
Fuel Burn		
Time 2:45:00		
FPH 17.8 GALS./HR.		
Fuel _____		48.9
FPH		
Time 1.2		
Fuel 35		
FPH _____		29.2
Endur		
Fuel 9500 LBS.		
FPH 1500 LBS./HR.		
Time _____		06:20:00
Dst Fln		
Time 00:40:00		
GS 138		
Dist _____		92.0

GS

**Answers**

Dist 10 NM

Time 00:01:22

GS \_\_\_\_\_ KTS 439.0

WT/Arm (Use an RF of 1.)

	WT	Arm	
EW	1830	41.8	_____
Front Seats	290	35.5	_____
Rear Seat	85	70.7	_____
Bags	100	95.5	_____
Fuel—	450	48.59	_____

75 Gal @ 6 Lbs./Gal.

WT/Mom (Use an RF of 1000.)

	WT	Mom/1000	
Empty Wt	88350	80486.8	_____
Fwd Pass.	3280	1570	_____
Aft Pass.	7140	6631.6	_____
Fwd Cargo	2200	1278	_____
Aft Cargo	4450	4744	_____
Fuel Tank #1	12000	10770	_____
Fuel Tank #3	12000	10770	_____
Fuel Tank #2	12000	9793	_____

% MAC (Use CG from “WT/Mom” Problem.)

MAC 180.7"

CG 891.27 (from prior problem)

LEMAC 860.2

% MAC \_\_\_\_\_



## Answers

Mom	/	CG	/	GW
76494	/	41.8	/	1830
10295	/	40.9	/	2120
6009.5	/	42.1	/	2205
9550	/	44.4	/	2305
21865.5	/	45.1	/	2755

## Answers

CG	/	GW
911.0	/	88350
895.5	/	91630
897.9	/	98770
891.0	/	100970
898.4	/	105420
898.3	/	117420
898.2	/	129420
891.3	/	141420

17.2%

# Appendix B

## Service Policy

### Troubleshooting

1. If the CX-1a Pathfinder screen display fails to illuminate, check for improperly inserted or discharged batteries. *See* battery replacement instructions.
2. To also ensure that problems are being entered accurately, read the operating instructions once more.
3. In the event the display does not reset after inserting batteries, pressing **ON** then **OFF** will reset the display, and the computer will be ready for operation.

If your computer is not working properly after performing these three steps, return PREPAID and INSURED to:

Aviation Supplies & Academics  
7005 132nd Place SE  
Newcastle, Washington 98059-3153

For your protection, it is important that the computer be sent insured. ASA cannot assume any responsibility for loss of, or damage to, uninsured shipments.

Please describe the difficulty experienced with the computer, as well as return address information. Be sure to include name, address, city, state, and zip code. Please print. The shipment should be carefully packaged and adequately protected against shock and rough handling.

## Battery Replacement

Several types of batteries can be used with your CX-1a computer. Under normal conditions, they provide up to 100 hours of operation.

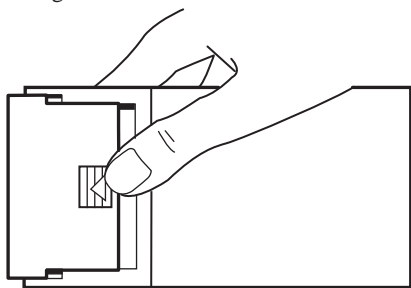
DL2032

CR2032

LF $\frac{1}{2}$ V

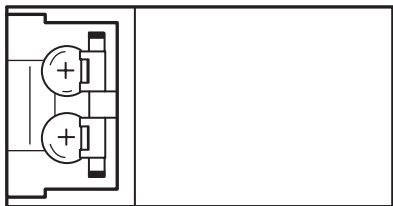
To replace batteries:

1. Place thumb on open button as shown in Figure B1.



**Figure B1.**

2. Push firmly away from computer on plastic slide piece.
3. Replace batteries by sliding them under the clips with + side up (Figure B2).



**Figure B2.**

4. Slide cover back on battery until cover clicks and fits flush with computer.

## Reminder

The CX-1a is intended to function effectively within an extensive span of atmospheric conditions. However, if subject to direct sunlight or excessive temperatures for a prolonged period of time, the display may go blank.

If this happens, remove the computer from the heat and sunlight and it will display correctly within several minutes.

## Limited Warranty

Aviation Supplies & Academics, Inc. (ASA) warrants this electronic computer, Model Number CX-1a, to the original purchaser for a period of **six months** from the initial date of purchase, against defects in material and workmanship.

Batteries are not covered by this warranty, and said warranty is null and void if:

1. The product has been damaged due to accident, misuse, abuse or negligence or other causes not originating out of defects in material or workmanship.
2. The serial number has been modified, disfigured or removed.

For the above six-month limited warranty period, ASA will either amend or substitute a reconditioned model of identical quality (at ASA's option), provided that the product is returned postage prepaid and insured to ASA. In the event of substitution with a reconditioned model, the warranty of the original computer will be upheld. Other than the above requirements, repair, adjustments and/or substitutions will be made at no charge.

ASA will not be liable for lapse or use of the computer or other secondary or sequential costs, expenditures, or damages brought about by the purchaser. Implied warranties originating out of this sale, including BUT NOT limited to the implied warranties of merchantability and fitness for a particular purpose, are limited in duration to the above

six-month period. ASA shall not be liable for loss of use of the computer or other incidental or consequential costs, expenses, or damages incurred by the purchaser.

Some states do not allow the exclusion or limitation of implied warranties or consequential damages; so, the above limitations or exclusions may not apply to you.

Record the serial number located at the back of the unit and purchase date in the space provided below. Refer to these numbers when contacting ASA regarding this product.

The CX-1a is an instruction and information aid, and is not an avionics instrument.

**Model Number:** \_\_\_\_\_

**Serial Number:** \_\_\_\_\_

**Purchase Date:** \_\_\_\_\_

## Notes

