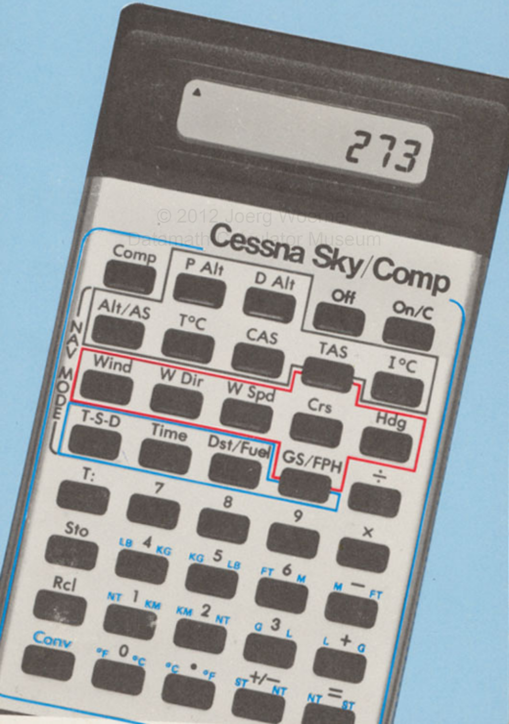
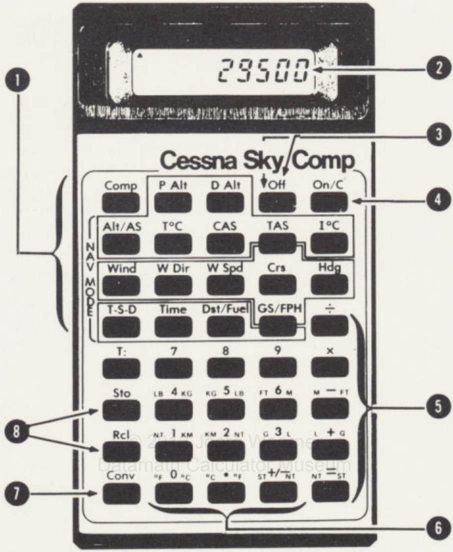
Cessna Sky/Comp

COMPUTER MANUAL





KEYBOARD LAYOUT

1. NAVIGATION MODE KEYS
2. DISPLAY
3. OFF KEY
4. ON/CLEAR KEY
5. ARITHMETIC FUNCTION KEYS
6. DATA ENTRY KEYS (0–9, . , ±)
7. CONVERSION KEYS
8. MEMORY KEYS (Store and Recall)

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INTRODUCTION

With the advent of space-age electronics, the electronic navigation computer has evolved. Easy and quick answers to flight navigation problems are provided by the simplicity of modern keyboard entry and the speed of electronic calculations. This electronic navigation computer is designed with today's air navigation problems in mind. The keyboard is laid out with a top-to-bottom flow which agrees with the normal sequence used for flight planning.

True airspeed (TAS) is determined first using the *altitude/airspeed* [Alt/AS] mode at the top of the computer. Then, the effect of wind on groundspeed is calculated, using the *wind* [Wind] mode keys (the next set of keys). Finally, the time, distance, and fuel consumption can be computed using the set of keys just below the wind-mode keys and the previously computed groundspeed.

As an additional aid, a distinctive, colored boundary line is used to group the keys used in each mode. This grouping also serves as a checklist of the data needed to solve problems in that navigation mode.

Your flight navigation computer is easy to operate because its preprogrammed design allows most problems to be entered just as they are stated. You can "talk" to the computer via the keyboard, and it will "talk" back via the display. The instructions and examples provided in this manual will help you develop skill and confidence in the use of this computer.

TABLE OF CONTENTS

BASIC OPERATIONS

It is important that you understand the basic operations and functions before proceeding with the navigation functions of the electronic computer.

TO TURN COMPUTER ON

Press [On/C] once. This applies power, clears the computer, and places it in the time-speed-distance mode. The power-on condition is indicated by the presence of a "▲" and a "0" in the display. (See Fig. 1.)

Fig. 1. Initial Display

NOTE:

Depressing and holding down any key on the top row of your computer will cause random segments to be displayed. These random segments do not affect normal operations of the computer and will disappear when the key is released.

BATTERY CONDITION INDICATOR

The small ▲ in the upper left-hand portion of the display indicates a "good battery" condition. When the ▲ becomes very dim or disappears, the batteries are weak and should be replaced. However, the batteries may still operate the computer for several more hours before it begins to operate erratically. See Appendix "C" for battery replacement instructions.

NOTE:

The entire display, including the small ▲ battery condition indicator, is blanked during the key entries and computations.

TO TURN COMPUTER OFF

Press [Off]. This removes power from the computer.

AUTOMATIC SHUTDOWN

Electronic control (as opposed to switch control) of ON and OFF allows the computer to automatically shut itself down if no key is pressed for a period of 5 to 15 minutes. This feature provides a substantial increase in the operating life of the batteries.

If the automatic shutdown feature is not desired, it can be cancelled by pressing any keys in the second, fourth, and fifth columns simultaneously; such as [°F 0 °C], [ST +/− NT], and [NT = ST]. The cancellation remains in effect until [Off] is pressed.

FLOATING MINUS SIGN

Any negative number is displayed with a minus sign immediately to the left of the number.

FLOATING DECIMAL POINT

A floating decimal point feature is incorporated in this computer. All you need to do is to insert the decimal point in the normal entry sequence, and it will be maintained in the proper position relative to other numbers.

ERROR INDICATION

The display shows "Error" whenever the computed answer exceeds the limits of the computer or when an improper mathematical operation is requested. (See Fig. 2.) When this occurs, no entry from the keyboard will be accepted until [On/C] is pressed. This clears the error condition and all pending operations.

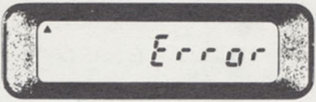


Fig. 2. Error Indication

"Error" appears for the following reasons:

1. Dividing a number by zero.

2. Computing or entering a function for a navigation mode other than the one in operation. For example, [Comp] [Hdg] in the [Alt/AS] mode, or, entering [W Dir] when operating in the [T-S-D] mode.

3. [Comp] [P Alt] or [I°C] while in the [Alt/AS] mode.

4. [Comp] [D Alt] from [P Alt] and [I°C] while in the [Alt/AS] mode.

5. When [TAS] is used as an input key, while in the [Alt/AS] mode.

6. When [D Alt] is used as an input key.

7. [Comp] [TAS] or [Crs] in the [Wind] mode.

8. [Comp] [Hdg] or [GS/FPH] if [TAS] = "0" in the [Wind] mode.

9. [Comp] [W Dir] if [WSpd] = "0" in the [Wind] mode.

10. [Comp] [Hdg] or [GS/FPH] if [Hdg] and [Crs] differ by 90° or more in [Wind] mode.

11. [Comp] [GS/FPH] if [TAS] = "0" in the [Wind] mode.

12. [Comp] [GS/FPH] if [Time] = "0" in the [T-S-D] mode.

13. [Comp] [Time] if [GS/FPH] = "0" in the [T-S-D] mode.

14. When a calculation exceeds 99,999,999.

To remove the error condition, push [On/C] once. If you are in a mathematical operation, you must return to the beginning of the problem and start again. If you are inputting navigation data, continue with your problem where you left off. You do not have to input previous data if you stay in the same navigation mode.

INPUT ERROR CORRECTION

At any point in a calculation, [On/C] can be pressed twice to clear all calculations and the display, including all errors, and start over. (The data in the navigation registers is unaffected by [On/C].)

If an incorrect number entry is made, pressing [On/C] before any nonnumber key clears the incorrect number without affecting any calculation in progress. If an incorrect operation (+, -, ×, or ÷) is entered, press the correct operation key and continue. The computer will use the last operation function entered.

ACCURACY AND ROUNDING

Each calculation produces an 11-digit result; however, these 11 digits are more than can be displayed. The result is, therefore, rounded to an eight-digit standard display. The rounding technique built into this computer adds one to the least significant digit of the display if the next nondisplayed digit is five or more. If this digit is less than five, no rounding is applied.

Groundspeed, gallons per hour, and distance values in the [T-S-D] mode, are displayed with one digit to the right of the decimal point (nearest tenth). All other values in the navigation modes (including groundspeed in the [Wind] mode) are displayed as whole numbers. Any rounded value can be converted to its full decimal display by pressing [NT = ST].

All conversion and arithmetic operations are displayed with floating decimal (full display).

ARITHMETIC OPERATIONS

Arithmetic operations are performed with the keyboard shown in figure 3.

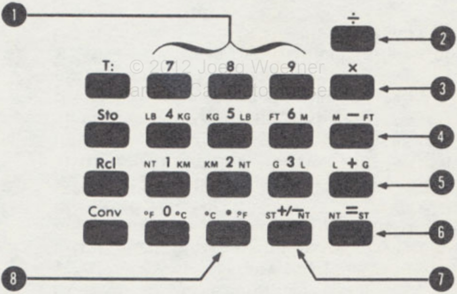


Fig. 3. Arithmetic Keyboard

The keys associated with this keyboard are:

1. Numeric Keys [°F 0 °C] thru [9] — enter numbers into display.
2. [÷] — Completes any previously-entered arithmetical function and instructs the com-

puter to divide the displayed number by the *next* entered quantity.

3. [×] — Completes any previously-entered arithmetical function and instructs the computer to multiply the displayed number by the *next* entered quantity.
4. [M − FT] — Completes any previously-entered arithmetical function and instructs the computer to subtract the *next* entered quantity from the displayed number.
5. [L + G] — Completes any previously-entered arithmetical function and instructs the computer to add the *next* entered quantity to the displayed number.
6. [NT = ST] — Completes any previously-entered arithmetical function. Following "=" with a numeric entry automatically clears the previous result. Pressing [NT = ST] also will convert the display of a rounded value to a full display (unrounded value).
7. [ST +/− NT] — Changes the arithmetical sign of the number shown in the display (adds or removes "−" sign).
8. [°C • °F] — Inserts decimal point in number in display.

ADD, SUBTRACT, MULTIPLY OR DIVIDE

To perform addition, subtraction, multiplication, or division, the computer is designed so that you can key in the problem just as it is stated.

1. Key in number.
2. Press applicable operation key: [L + G], [M − FT], [×], or [÷].
3. Key in number applicable to operation to be performed.
4. Press [NT = ST] to obtain answer.

After a result is obtained in one calculation, it may be directly used as the first number in a second calculation. There is no need to reenter the number from the keyboard; for example:
1.84 + 0.39 = 2.23; then, 2.23 ÷ 365 = .0061096.

Key In	Press	Display	Comments
1.84	[L + G]	1.84	
.39	[NT = ST]	2.23	1.84 + 0.39 = 2.23
	[÷]	2.23	
365	[NT = ST]	0.0061096	2.23 ÷ 365 = 0.0061096

MEMORY

Your flight navigation computer has a memory which can be used during all operations. The data is stored in memory until the computer is turned [Off]. Any other operations will not affect the memory.

The keys associated with memory are:

1. [Sto] — Stores the displayed quantity in memory without removing it from the display. Any previously stored value is replaced by the new value.
2. [Rcl] — Recalls stored data from memory to the display. Use of this key does not clear the memory.

Use of the memory does not affect any calculations in process; therefore, memory operations can be used whenever needed. To clear the memory, press [°F 0 °C] [Sto] or [On/C] [Sto], or [Off].

The value stored in memory is recalled in the same format it was stored (decimal or hours-minutes-seconds).

CONVERSIONS

Your electronic navigation computer incorporates the most common conversions used in aviation and can be accessed regardless of the operating mode. The conversion answers use a floating decimal value to allow full accuracy to be displayed. The conversion keyboard is located at the bottom of the computer. (See Fig. 4.)

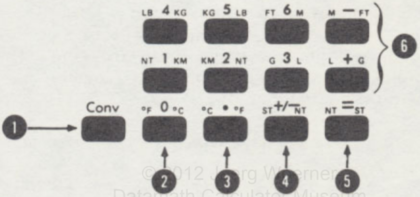


Fig. 4. Conversion Keyboard

The keys associated with conversion operations are secondary functions to some of the arithmetic keys. The identification of the conversion functions are printed in blue. Pressing the key converts the value on the left to the value shown on the right.

1. [Conv] — Pressing this key instructs the computer to perform the conversion specified for the *next* key pressed, using the data shown in the display. Pressing this key also converts the double-function keys to the *convert* function.
2. [°F 0 °C] — Pressing this key, after pressing "Conv" key, converts the displayed value degrees Fahrenheit to degrees Celsius.

3 [°C • °F] — Pressing this key, after pressing "Conv" key, converts the displayed value from degrees Celsius to degrees Fahrenheit.

4 [ST +/- NT] — Pressing this key, after pressing "Conv" key, converts the displayed value from statute to nautical equivalent value.

5 [NT = ST] — Pressing this key, after pressing "Conv" key, converts the value in the display from nautical to statute equivalent value.

6 METRIC CONVERSIONS — Pressing one of the following keys after pressing "[Conv]," converts the displayed value as noted:

[LB 4 KG] — Converts pounds to kilograms.

[KG 5 LB] — Converts kilograms to pounds.

[FT 6 M] — Converts feet to meters.

[M − FT] — Converts meters to feet.

[NT 1 KM] — Converts nautical miles to kilometers or knots to kilometers per hour.

[KM 2 NT] — Converts kilometers to nautical miles or kilometers per hour to knots.

[G 3 L] — Converts U.S. gallons to liters.

[L + G] — Converts liters to U.S. gallons.

To perform conversions:
1. Key in number.
2. Press [Conv] .
3. Press applicable conversion key.

Sample Problem — Conversion

Given: Speed — 130 m.p.h.
Find: Speed in knots

Key In	Press	Display	Comments
130	Conv	130	Convert display to value of next key pressed
	ST +/− NT	112.96691	130 m.p.h. = 113 knots

Practice Problems — Conversions
(See Appendix "A" for answers.)

	Change	To
1.	140 nautical miles	statute miles
2.	25 knots	m.p.h.
3.	77 statute miles	nautical miles
4.	176 m.p.h.	knots
5.	18°F	°C
6.	−13°C	°F
7.	36 gallons	liters
8.	246 liters	gallons
9.	36.5 pounds	kilograms
10.	432 kilograms	pounds
11.	1,380 feet	meters
12.	3,546 meters	feet
13.	346 nautical miles	kilometers
14.	73 kilometers	nautical miles
15.	148 knots	kilometers/hour
16.	216 km./hr.	knots

NOTE:

Refer to Appendix "A" for answers to all practice problems in this manual. Refer to Appendix "B" for the common conversion factors.

NAVIGATION OPERATIONS

The keys for the various navigation modes are located in the upper half on the computer's keyboard. (See Fig. 5.) These keys are grouped into three modes: altitude/airspeed [Alt/AS], wind [Wind], and time-speed-distance [T-S-D].

To help identify which keys are used with the different modes, a distinctive, colored pinstripe is used to group each mode.

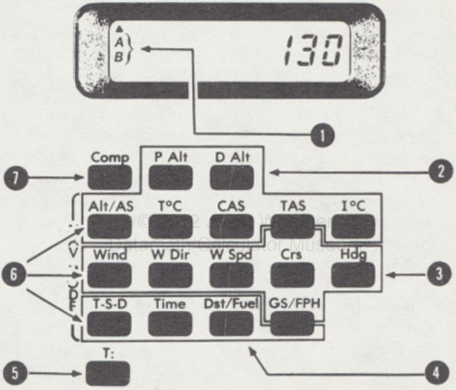


Fig. 5. Navigation Keyboard

1. MODE INDICATORS
2. ALTITUDE/AIRSPEED KEYS (within black pinstripe)
3. WIND KEYS (within red pinstripe)
4. TIME—SPEED—DISTANCE KEYS (within blue pinstripe)
5. TIME-COLON KEY (used to input time into display)
6. MODE-SELECT KEYS
7. COMPUTE KEY (used with all navigation modes)

The left key in each group is the mode-select key. When a mode-select key is pressed, the following conditions are programmed into the computer:

1. The applicable navigation mode is activated. All other navigation modes will not function.
2. All data perviously stored in the navigation mode registers are automatically *cleared*. (The Sto and Rcl memories are not affected.)
3. The arithmetical and conversion functions remain *operational*.

NAV MODE OPERATION

Each navigation mode is designed to operate as simply as 1, 2, 3.

1. *Select mode*. Press applicable mode-select key: [Alt/AS] , [Wind] , or [T-S-D] .
2. *Enter Data*. Use numeric keys to place data in display. Store it in the applicable navigation register by pressing the key which describes the data in the display. Repeat data entry for each known value of the navigation problem. The data can be entered in any sequence. When a register key is pressed in the correct navigation mode, the value in the display is the value stored in the register.
3. *Compute answer*. Press [Comp] and then the key that describes the answer you want. Pressing [Comp] instructs the computer to compute the value of the next key pressed, using the applicable information stored in the registers of the navigation mode in operation. It is used in all navigation modes.

DATA OVER-WRITE

If you want to change the data in a register, just key in the new value and press the applicable data key. This causes the old data to be replaced with the new value that appears in the display.

DISPLAY

When you press a mode-select key, such as [Alt/AS], [Wind], or [T-S-D], the display does not change. This is very handy when transferring true airspeed from [Alt/AS] to [Wind] and groundspeed from [Wind] to [T-S-D].

Mode indicator letters appear in the display as a reminder of which mode is in use. "A" will appear for the altitude/airspeed mode, "B" indicates the wind mode, and a blank display informs the user that the computer is in the time-speed-distance mode. When turned on, the computer powers up in the time-speed-distance mode.

The time of calculations in the navigation mode will vary from one to eight seconds, depending on the problem being computed. The display goes blank during calculations. While the computer is calculating, all keys except [Off] will not function.

ACCURACY LIMITATIONS

The standard-temperature lapse rate changes above 36,089 feet. This affects calculations for standard temperature, density altitude, and true airspeed. In addition, the rate of air compressibility changes for speeds in excess of Mach 1. This affects computations for true airspeed; therefore, accuracies progressively degenerate above 36,089 feet and when true airspeeds are above approximately 660 knots.

ALTITUDE/AIRSPEED MODE

The altitude/airspeed [Alt/AS] mode is used to solve true airspeed, density altitude, and standard temperature problems. The keyboard used with altitude/airspeed problems is shown in figure 6.

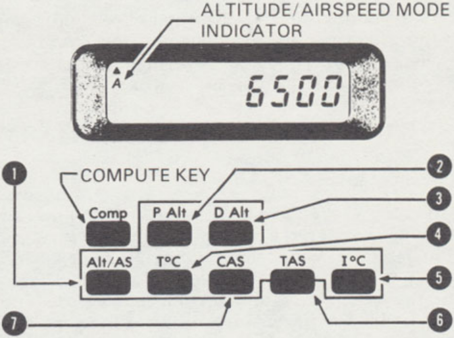


Fig. 6. Altitude/Airspeed Mode Keyboard

The keys, in addition to [Comp], used with the altitude/airspeed mode are:

1. [Alt/AS] — Pressing this key places the computer in the altitude/airspeed mode and activates all keys within the black pinstripe. (All data previously stored in the navigation mode registers are automatically cleared when this key is pressed. The display is unaffected by this clearing action.)
2. [P Alt] — Pressing this key stores the displayed value in the *pressure altitude* register. (Pressure altitude is the altitude recorded with the altimeter set at 29.92 inches of mercury, or 1013.2 millibars.)
3. [D Alt] — Pressing this key computes the density altitude. *This key cannot be used to input data.* (Density altitude is the theoretical altitude for the density of a standard atmosphere at that altitude. It is determined by pressure altitude and temperature.)
4. [T°C] — Pressing this key stores the displayed value in the *true temperature* register of the altitude/airspeed mode in degrees Cel-

sius. (True temperature is the reported, or estimated, air temperature usually available from weather reports and forecasts.) This key is used for pre-trip planning.

5 [I°C] — Pressing this key stores the displayed value, in degrees Celsius, in the *indicated temperature* register of the altitude/airspeed mode. (Indicated temperature is the outside air temperature measured by the temperature gauge in the airplane.) This key is used for in-flight calculations. It is not used for pretrip planning.

6 [TAS] — Pressing this key computes the true airspeed. *This key cannot be used to input TAS.* (True airspeed is the speed of the airplane relative to the air, not the ground.) This key also is used in the wind mode.

7 [CAS] — Pressing this key stores the displayed value in the *calibrated airspeed* register. (Calibrated airspeed is equal to the airspeed indicator reading corrected for position and instrument error.) If CAS is not available, indicated airspeed (IAS) may be used, but a slight error will exist in the final computation of true airspeed.

SOLVING FOR TRUE AIRSPEED (TAS)

The airspeed indicator is a reliable instrument, but its reading is affected by various items such as temperature, pressure, and compressibility. A fast-flying aircraft passes through the atmosphere so rapidly that the air is compressed in front of the aircraft and is heated by this compression. As a result, an outside air temperature probe "feels" a higher air temperature than really exists in the surrounding noncompressed air. Also, the rush of air over the outside air temperature probe creates friction, causing further heating and a still higher (false) reading. The amount of this higher reading of the thermometer is called "temperature rise" and must be considered when computing accurate, true airspeed. An automatic compensation for compressibility, temperature rise, and air friction is built into this computer so that correct true airspeed solutions are provided.

True airspeed calculations are affected by a temperature recovery coefficient which varies with installation and design of the temperature probe on the individual airplane. Since most modern, high-speed aircraft have a recovery coefficient equal to 1.0, this computer also uses a recovery coefficient of 1.0.

Slide-type, mechanical computers do not compensate for compressibility; therefore, the answers from this electronic computer are more accurate than those derived from slide-type computers. The difference in answers between the slide-type and electronic computers are insignificant below 200 knots and 20,000 feet; above these values, however, the differences in answers increase as speed and altitude increase.

Three values must be known to solve for true airspeed (TAS):

1. Pressure altitude.
2. Temperature (°Celsius) — Temperature can be entered as *true* air temperature (T°C) or *indicated* air temperature (I°C).
3. Calibrated airspeed (CAS).

Sample Problem — TAS

Given: Pressure altitude : 10,000 ft.
True temperature : −10°C
Calibrated airspeed : 130 knots

Find: True airspeed

Key In	Press	Display	Comments
	Alt/AS	A	Activates Alt/AS mode
10000	P Alt	10000	Pressure altitude
10	ST+/- NT	−10	True temperature (°C)
	T°C		entered
130	CAS	130	CAS entered
	Comp		
	TAS	149	TAS = 149 knots

Practice Problems — Finding TAS

	Pressure Altitude	True Air Temp.	Indicated Air Temp.	CAS	What is TAS?
1.	5,000 ft.	—	0°C	190 knots	
2.	17,000 ft.	—	-10°	350 knots	
3.	5,000 ft.	+59°F	—	125 knots	
4.	20,000 ft.	-15°C	—	276 knots	

SOLVING FOR DENSITY ALTITUDE

Two values must be known to compute density altitude:

1. Pressure altitude
2. True temperature (°C)

Sample Problem — Density Altitude

Given: Pressure altitude : 3,000 ft.
True air temperature : 25°C

Find: Density altitude

Key In	Press	Display	Comments
	Alt/AS	A	Activates Alt/AS Mode
3000	P Alt	3000	Pressure altitude entered
25	T°C	25	True temperature (°C) entered
	Comp		
	D Alt	4828	Density altitude = 4,828 feet

NOTE:

Attempting to compute a density altitude using indicated temperature (I°C) will cause "ERROR" to be displayed.

Practice Problems — Density Altitude

	Pressure Altitude	True Air Temp.	What is Density Altitude?
1.	1,500 ft.	35°C	
2.	10,000 ft.	-20°C	
3.	8,000 ft.	50°F	
4.	4,000 ft.	-25°C	

COMPUTING STANDARD TEMPERATURE

In many of today's pilot operating handbooks, it is required to know the standard temperature at a given altitude. For any given altitude below 36,089 feet, the standard temperature, in degrees Celsius, can be computed on this computer.

Sample Problem — Standard Temperature

Given: Pressure altitude — 4,000 feet

Find: Standard temperature

Key In	Press	Display	Comments
	Alt/AS	A	Activate Alt/AS Mode
4000	P Alt	4000	Pressure altitude entered
	Comp		
	T°C	7	Standard temperature = 7°C

Practice Problems — Standard Temperature

	Pressure Altitude	What is standard temperature?
1.	Sea Level	
2.	5,000 ft.	
3.	7,500 ft.	
4.	25,000 ft.	

NOTE:

If a nav mode key (Alt/AS , Wind , or T-S-D) is inadvertently pressed after the Comp key, the word "ERROR" will appear in the display to indicate an incorrect operation. Since all current information is retained in the navigation registers, simply press On/C once to clear the error indication, then press Comp and proceed with the desired computation.

WIND MODE

The wind mode is used to solve groundspeed, heading, wind direction, and wind speed problems. The keyboard used with the wind mode is shown in figure 7.

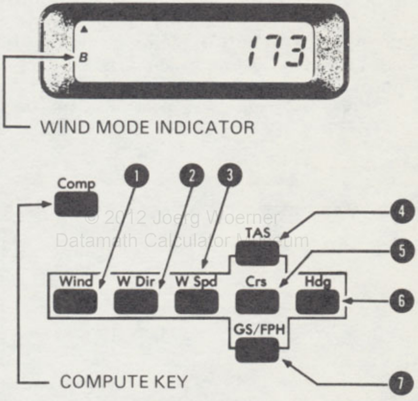


Fig. 7. Wind Mode Keyboard

The keys, in addition to [Comp], used with the wind mode are:

❶ [Wind] — Pressing this key places the computer in the wind mode and activates all keys within the red pinstripe. (All data previously stored in the navigation mode registers are automatically cleared when this key is pressed. The display is unaffected by this clearing action.)

2 [W Dir] — Pressing this key stores the displayed value in the *wind direction* register of the wind mode. (Wind direction is the direction from which the wind is blowing. It is reported on winds-aloft forecasts in degrees from true north.)

3 [WSpd] — Pressing this key stores the displayed value in the *wind speed* register. (Wind speed is the speed of the wind over the surface of the earth. It is reported in knots on winds-aloft forecasts.)

4 [TAS] — Pressing this key stores the displayed value in the *true airspeed* register of the wind mode. (True airspeed is the speed of the airplane relative to the air, not the ground.) This key also is used in the altitude/airspeed mode.

5 [Crs] — Pressing this key stores the displayed value in the *course* register. (Course is the intended direction, or path of travel, over the surface of the earth with respect to north.) (See Fig. 10.)

6 [Hdg] — Pressing this key stores the displayed value in the *heading* register. (Heading is the direction in which the longitudinal axis of the aircraft is pointed in respect to north.) (See Fig. 10.)

7 [GS/FPH] — Pressing this key stores the displayed value in the *groundspeed* register of the wind mode. (Groundspeed is the speed of the aircraft over the ground.) This key also is used in the time-speed-distance mode for both groundspeed and fuel per hour.

EFFECT OF WIND ON THE AIRPLANE

Wind is the movement of an airmass over the earth. If the airplane were a balloon, it would simply move with the air mass and drift above the terrain. However, since the airplane moves under its own power, the speed and direction it travels over the terrain is the result of combining wind direction, wind speed, aircraft speed, and aircraft heading.

If there is no wind, the airplane's true airspeed and groundspeed are the same. A headwind or tailwind, however, affects the groundspeed. For example, if an airplane has a true airspeed of 100 knots and is flying in an airmass which is moving in the same direction (tailwind) at 20 knots, the airplane's groundspeed is 120 knots. This value is determined by adding the wind speed to the true airspeed. (See Fig. 8, item A.)

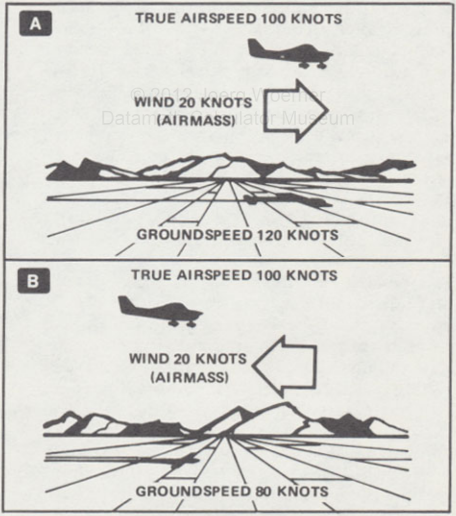


Fig. 8. Effect of Wind on Groundspeed

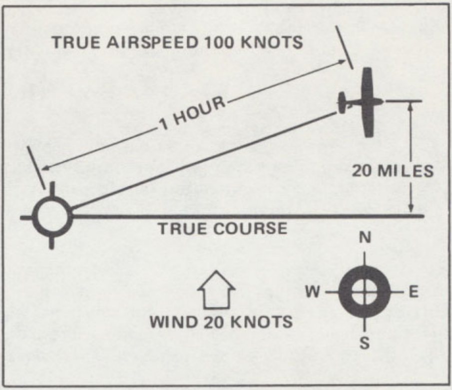


Fig. 9. Effect of Wind on Track

If this same airplane flys in an airmass which is moving in an opposite direction (headwind) at 20 knots, its progress over the ground is 80 knots. This is determined by subtracting the 20-knot airmass speed from the aircraft's 100-knot true airspeed. (See Fig. 8, item B.)

In another example of wind, the airplane in figure 9 is heading east in an airmass moving from the south at 20 knots (crosswind). At the end of one hour, the plane will have drifted 20 nautical miles north of the course line because of the airmass movement.

When you compute the effects of the wind using the electronic computer, it is best to first visualize what the wind will be doing to your airplane. For example, in figure 10, visualize the airplane's intended track to the east with the wind blowing from the southeast.

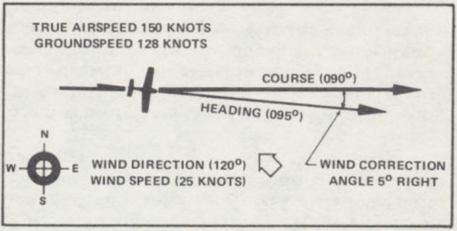


Fig. 10. Airplane Crabbed Into Wind to Maintain Course

This gives you a clue that the airplane will have to be turned into the wind and to the right of the course to counteract the affects of the wind. In the illustration, this is numerically proven by a heading of 095° compared to the lesser course of 090°. The angle between your course and heading is called the wind correction angle, which is 5° right in this example.

Also, since the wind will be from the front of the airplane, the actual speed across the ground will be less than the speed through the air. In this illustration, groundspeed is 128 knots compared to the true airspeed of 150 knots.

When computing wind problems, it is best to visualize the approximate answer as a "logic test" of the computer answers. This should be done to preclude using incorrect inputs.

TRUE VS MAGNETIC

The electronic computer allows you to work the wind problems using either true or magnetic north. All winds-aloft forecasts state the wind direction in degrees from *true* north; most flights are flown using a magnetic heading.

It is a *must* that you state your *entire* wind problem in true degrees *or* magnetic degrees and stay with the same reference throughout each problem. If you decide to stay in true degrees, remember to convert the true heading to magnetic heading for use in the airplane. If you decide to use magnetic degrees, be sure to apply the magnetic variation to the wind direction. In either case, the answers will be identical if you use only one reference system.

SOLVING FOR HEADING AND GROUNDSPEED

To determine the affect of wind on a flight, the wind direction, wind speed, course, and true airspeed must be known.

Sample Problem

Given: Wind direction * — 080°
Wind speed — 20 knots
Course * — 030°
True airspeed — 170 knots

Find: Heading *
Groundspeed

Key In	Press	Display	Comments
	Wind	B	Activates wind mode
80	W Dir	80	Wind direction entered
20	WSpd	20	Wind speed entered
30	Crs	30	Course entered
170	TAS	170	True airspeed entered
	Comp		
	Hdg	35	Heading = 035°
	Comp		
	GS/FPH	156	Groundspeed = 156 kts.

NOTES:

1. It is not necessary to input leading zeros when entering direction in degrees.
2. Items marked * must be the same (true or magnetic).

Practice Problems — Finding Heading And Groundspeed

	Wind Direction	Wind Speed	Course	TAS
1.	180°	16 knots	310°	120 knots
2.	045°	23 knots	178°	135 knots
3.	165°	18 knots	050°	155 knots
4.	265°	18 knots	270°	130 knots

What is:

Heading?	Groundspeed?
1.	
2.	
3.	
4.	

SOLVING FOR WIND DIRECTION AND SPEED

Often, the wind is not behaving as forecast at cruising altitude. Therefore, a different heading from that originally estimated must be flown. In order to compute wind direction and speed, four values must be known: true airspeed, true course, true heading, and groundspeed.

Sample Problem

Given: Course * — 175°
Heading * — 160°
TAS — 180 knots
Groundspeed — 144 knots

Find: Wind direction *
Wind speed

Key In	Press	Display	Comments
	Wind	B	Activates wind mode
175	Crs	175	Course * entered
160	Hdg	160	Heading * entered
180	TAS	180	True airspeed entered
144	GS/FPH	144	Groundspeed entered
	Comp W Dir	118	Wind direction * = 118°
	Comp WSpd	55	Wind speed = 55 knots

NOTE:

Items marked * must be the same (true or magnetic).

Practice Problem — Finding Wind Direction and Speed

	Course	Heading	TAS	Groundspeed
1.	106°	102°	240 knots	220 knots
2.	320°	309°	130 knots	142 knots
3.	323°	332°	528 knots	570 knots
4.	164°	175°	210 knots	222 knots

What is:	
Wind Direction?	Wind Speed?
1.	
2.	
3.	
4.	

SOLVING FOR WIND CORRECTION ANGLE (WCA)

Wind correction angle (WCA) is the number of degrees that the aircraft's longitudinal axis must be displaced to the right or left of the course to maintain the desired track. The wind correction angle is obtained by subtracting the course from the heading. If the answer is positive, the wind correction angle is to the right; if the answer is negative, the WCA is to the left.

If the answer is less than 180°, the computer displays the correct wind correction angle. If the answer is positive and more than 180°, 360° must be subtracted from the answer to display the wind correction angle. If the answer is negative and more than 180°, 360° must be added to the answer to obtain the wind correction angle.

Sample Problem — Wind Correction Angle

Given: Heading — 348°
Course — 005°

Find: Wind correction angle

Key In	Press	Display	Comments
348	M − FT	348	
5	NT = ST	343	This answer is more than 180°
	M − FT		
360	NT = ST	-17	WCA = 17° left

Practice Problems — Wind Correction Angle

	Heading	Course	What is wind correction angle?
1.	042°	034°	
2.	357°	010°	
3.	004°	355°	
4.	265°	276°	

TIME-SPEED-DISTANCE MODE

The time-speed-distance mode is probably the most-used mode during flight. This mode is used to solve distance, groundspeed, time, and fuel consumption problems. The keyboard, shown in figure 11, is used with the time-speed-distance mode.

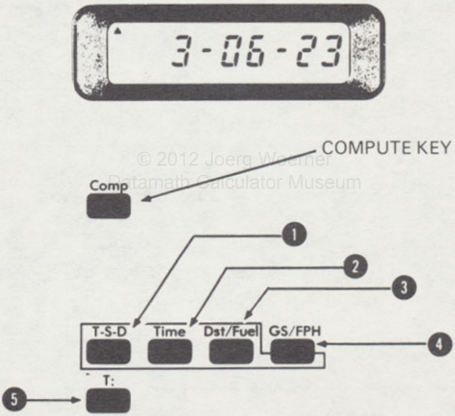


Fig. 11. Time-Speed-Distance Keyboard

The keys, in addition to [Comp], used with the T-S-D mode are:

❶ [T-S-D] — Pressing this key places the computer in the time-speed-distance mode and activates all keys within the blue pinstripe. All data previously stored in the navigation mode registers are automatically cleared when this key is pressed. The display is unaffected by this clearing action.

2 [Time] — Pressing this key stores the displayed value in the *time* register of the T-S-D mode.

3 [Dst/Fuel] — Pressing this key stores the displayed value in the *distance* or *fuel quantity* register of the T-S-D mode.

4 [GS/FPH] — Pressing this key stores the displayed value into the *groundspeed* or *fuel per hour* register of the T-S-D mode.

5 [T:] — Pushing this key once places a "–" between hours and minutes; pushing the key a second time places a "–" between minutes and seconds. This key is used with the numeric keyboard when inputting time values into the display.

ENTERING TIME

Your electronic navigation computer is designed for use of time in the hours-minutes-seconds format. This handy feature eliminates the time-consuming task of converting minutes and seconds to decimals for calculations. Mathematical computations using the time feature can be used in any mode ([Alt/AS], [Wind], and [T-S-D]) without interfering with operation of the mode. However, the computer needs to be instructed that the figure you are entering is "time" and not just another number. Normally, when writing time, you use a ":" to separate the hours from the minutes and the minutes from the seconds (11:36:03).

This is where the [T:] comes into the picture. When this key is pressed, the computer displays a "-" in place of the ":". The time-colon key enters these dashes and informs the computer that the figure in the display is "time". When this key is pushed once, it inserts a "–00" after the hours.

When the key is pushed a second time, a "−00" is inserted after the minutes.

Time is entered as follows:

1. First, key in hours. If there are no hours, skip this step.
2. Next, press [T:]. This adds "−00" after the hours. If there are no hours, the display will show "0−00."
   [T:] will be ignored by the computer (nothing happens) if:
   a. a decimal point has been entered.
   b. three or more digits are in the display.
3. Now, key in the minutes. If there are no minutes, skip this step. If there are no minutes or seconds, also omit steps 4 and 5.
4. Then, press [T:]. This adds "−00" after the minutes. If there are no seconds, steps 4 and 5 may be omitted.
5. Finally, key in the seconds.

SAMPLE TIME ENTRIES INTO DISPLAY

Given: 2 hours, 9 minutes, 3 seconds

Enter Time:

Key In	Press	Display	Comments
2	[T:]	2-00	Hours entered
9	[T:]	2-09-00	Minutes entered
3		2-09-03	Seconds entered

Given: 12 hours

Enter Time:

Key In	Press	Display	Comments
12	[T:]	*12-00*	Hours and minutes entered

Given: 13 minutes

Enter Time:

Key In	Press	Display	Comments
	[T:]	*0-00*	Hours entered
13		*0-13*	Minutes entered

Given: 23 seconds

Enter Time:

Key In	Press	Display	Comments
	[T:] [T:]	*0-00-00*	Hours and minutes entered
23		*0-00-23*	Seconds entered

ADDING, SUBTRACTING, MULTIPLYING, AND DIVIDING TIME

Your navigation computer is programmed so that time can be added, subtracted, multiplied, and divided in any mode. The display will accommodate up to 99 hours, 59 minutes, and 59 seconds in the hours-minutes-seconds configuration. When hours are 100 or greater, the display changes to the decimal format.

The results of arithmetic operations with time are:

1. (hours-minutes-seconds) +, −, ×, or ÷ (hours-minutes-seconds) = (hours-minutes-seconds)
2. (hours-minutes-seconds) + or − (decimal format) = (decimal format)

NOTE:

Hours-minutes-seconds in the display may be converted to decimal format by adding zero ([L + G], 0, [NT = ST]). Allow display to be visible before pushing "=".

3. (decimal format) + or − (hours-minutes-seconds) = (hours-minutes-seconds)

NOTE:

A decimal format in the display may be converted to hours-minutes-seconds by adding " T: " ([L + G] [T:] [NT = ST]).

4. (hours-minutes-seconds) × or ÷ (decimal) = (hours-minutes-seconds)
5. (decimal) × or ÷ (hours-minutes-seconds) = (decimal)

Sample Problem — Adding Time

Given: Departure time — 11:09 a.m.
Estimated time enroute — 1 hour, 55 minutes

Find: Estimated time of arrival

Key In	Press	Display	Comments
11	T:	11-00	Hours entered
9		11-09	Minutes entered
	L + G	11-09-00	
1	T:	1-00	Hours entered
55		1-55	Minutes entered
	NT = ST	13-04-00	Time of arrival = 1:04 p.m.

Sample Problem — Subtracting Time

Given: Departure time — 10:15 a.m.
Time of arrival — 1:13 p.m.

Find: Time enroute

Key In	Press	Display	Comments
13	T:	13-00	1:13 p.m. entered
13		13-13	
	M − FT	13-13-00	
10	T:	10-00	10:15 a.m. entered
15		10-15	
	NT = ST	2-58-00	Time enroute = 2 hours, 58 minutes

Practice Problems — Adding and Subtracting Time

Fill in the blank spaces.

	Departure Time	Time of Arrival	Time Enroute
1.	10:14:06	11:37:14	
2.	11:47:32		27 min. 12 seconds
3.		12:30:16	43 min. 37 seconds
4.	Add the following into a total: (13 minutes, 26 seconds) + (17 minutes, 14 seconds) + (54 seconds) + (2 minutes) =		

SOLVING FOR TIME, SPEED, AND DISTANCE

Problems involving time, speed, and distance are encountered in flight planning and navigation. Two of these variables must be known to solve a problem.

Time may be entered in the time-speed-distance mode in either the decimal or hours-minutes-seconds format with no effect on the results. Any time values computed in the [T-S-D] mode always are displayed in the hours-minutes-seconds format unless hours are more than 99.

Sample Problem — Finding Time

Given: Distance — 140 nautical miles
Groundspeed — 120 knots

Find: Time enroute

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
140	Dst/Fuel	140	Distance entered
120	GS/FPH	120	Groundspeed entered
	Comp		
	Time	1-10-00	Time = 1 hour, 10 min.

Practice Problems — Finding Time

	Distance	Groundspeed	What is the time?
1.	240 n.m.	180 knots	
2.	5.4 n.m.	95 knots	
3.	33 n.m.	110 knots	
4.	510 n.m.	340 knots	

Sample Problem — Finding Distance

Given: Time enroute — 1:40:00
Groundspeed — 162 knots
Find: Distance traveled

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
1	T:	1-00	Time entered
40		1-40	Time entered
	Time	1-40-00	Time entered
162	GS/FPH	162	Groundspeed entered
	Comp		
	Dst/Fuel	270.0	Distance = 270 n.m.

Practice Problems — Finding Distance

	Time	Groundspeed	How far will the aircraft fly?
1.	2:05:00	126 knots	
2.	0:04:16	135 knots	
3.	3:32:00	133 knots	
4.	0:32:00	480 knots	

Sample Problem — Finding Speed

Given: Time — 1:30:00
Distance — 210 nautical miles

Find: Groundspeed

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
1	T:	*1-00*	Time entered
30		*1-30*	
	Time	*1-30-00*	
210	Dst/Fuel	*210*	Distance entered
	Comp		
	GS/FPH	*140.0*	Groundspeed = 140 knots

Practice Problems — Finding Speed

	Time	Distance	What is the speed?
1.	0:43:00	90 n.m.	
2.	0:36:00	160 n.m.	
3.	1:54:00	182 n.m.	
4.	0:01:30	2.5 n.m.	

SOLVING FOR FUEL CONSUMPTION

Fuel consumption problems are solved in the same manner as time and distance problems, except that fuel consumption per hour and fuel quantity are used in lieu of speed and distance.

Sample Problem — Finding Time (Fuel)

Given: Usuable fuel — 45 gallons
Fuel consumption rate — 9 g.p.h.

Find: How long the aircraft can fly.

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
45	Dst/Fuel	45	Fuel quantity stored
9	GS/FPH	9	Fuel consumption rate stored
	Comp		
	Time	*5-00-00*	Time = 5 hours

Practice Problems — Finding Time (Fuel)

	Usable Fuel	Fuel Consumption	How long will the aircraft fly?
1.	30 gallons	12 g.p.h.	
2.	68 gallons	18 g.p.h.	
3.	130 liters	56 l.p.h.	
4.	500 pounds	120 lbs/hr.	

Sample Problem — Finding Fuel Consumed

Given: Fuel consumption rate — 8.5 g.p.h.
Time — 2:32:15

Find: Quantity of fuel consumed

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
2	T:	2-00	Time entered
32	T:	2-32-00	
15	Time	2-32-15	
8.5	GS/FPH	8.5	Fuel consumption rate entered
	Comp		
	Dst/Fuel	21.6	Fuel = 21.6 gallons

Practice Problems — Finding Fuel Consumed

	Time	Fuel Consumption	How much fuel was used?
1.	0:15:00	14 g.p.h.	
2.	2:40:00	21 g.p.h.	
3.	3:24:15	48 l.p.h.	
4.	4:16:43	168 lbs/hr.	

Sample Problems — Finding Fuel Comsumption

Given: Time — 2:30:00
Fuel consumed — 80 gallons
Find: Fuel consumption rate

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
2	T:	2-00	Time entered
30		2-30	
	Time	2-30-00	
80	Dst/Fuel	80	Consumed fuel entered
	Comp		
	GS/FPH	32.0	Fuel consumption rate = 32 g.p.h.

Practice Problems — Fuel Consumption Rate

	Time	Fuel Consumed	What is the fuel consumption rate?
1.	0:40:00	7 gallons	
2.	2:10:00	47 gallons	
3.	3:23:18	173 liters	
4.	4:17:53	825 pounds	

MULTI-PART PROBLEMS

Often, a series of interrelated problems leading to a final solution may be considered a multi-part problem. A good example of a multi-part problem is finding fuel consumption for an anticipated flight.

The following multi-part problem is provided to emphasize the order of information required to determine the total fuel consumption. In each case, the true airspeed is determined first; next, the groundspeed; then, the time enroute; and finally, the fuel consumed.

When computations are performed in the [Wind] and [T-S-D] modes, the computed answers are placed into the appropriate register for future use. As an example, wind direction and speed computed on one leg can be used to compute the heading and groundspeed on the next leg. This is done automatically without the necessity for reentering the computed wind direction and speed. This capability is used in the following problem when the computed time is used to determine the fuel required for the trip.

Sample Problem — Multi-Part (Fuel Consumption)

Given:
Pressure altitude — 7,500 ft.
Temperature — 15°C (True)
Calibrated airspeed — 105 knots
Wind direction — 035°
Wind speed — 12 knots
Course — 270°
Distance — 256 nautical miles
Fuel consumption rate — 11.5 g.p.h.

Find: Fuel needed for trip.

Solution —
1. First, find true airspeed.

Key In	Press	Display	Comments
	Alt/AS	A	Activates Alt/AS mode
7500	P Alt	7500	Pressure altitude entered
15	T°C	15	True temperature (C°) entered
105	CAS	105	CAS entered
	Comp		
	TAS	121	TAS = 121 knots

2. Next, find groundspeed.

Key In	Press	Display	Comments
	Wind	B 120.5534	Activates wind mode
	TAS	120.5534	TAS entered from display
35	W Dir	35	Wind direction entered
12	W Spd	12	Wind speed entered
270	Crs	270	Course entered
	Comp		
	GS/FPH	127	Groundspeed = 127 knots

3. Now, find time enroute and fuel consumed.

Key In	Press	Display	Comments
	T-S-D	127.03484	Activates T-S-D mode
	GS/FPH	127.03484	Groundspeed entered from display
256	Dst/Fuel	256	Distance entered
	Comp Time	2-00-55	Time enroute = 2:00:55
11.5	GS/FPH	11.5	Fuel consumption rate entered
	Comp Dst/Fuel	23.2	Fuel consumed = 23.2 gallons

Practice Problems — Multi-Part (Fuel Consumption)

Distance	Time Enroute	Fuel Rate	Fuel Required
320 n.m.		9 g.p.h.	
670 n.m.		1353 lbs/hr	
146 s.m.		8 g.p.h.	
420 n.m.		53 l.p.h.	

Fill in the blank spaces.

	Altitude	True Temp.	CAS	TAS	Wind		Course	Heading	Groundspeed
					Dir.	Speed			
1.	3,500	21°C	120 kts.		095°	16 kts.	032°		
2.	30,000	-50°C	310 kts.		355°	46 kts.	127°		
3.	6,500	61°F	115 m.p.h.		180°	12 kts.	243°		
4.	10,000	-10°C	165 kts.		210°	30 kts.	010°		

WEIGHT AND BALANCE

Weight and balance computations involve the addition of weights, and the computation and addition of moments. Your electronic navigation computer can make your computations easier.

Sample Problem — Weight & Balance

Given:

ITEM	WEIGHT	ARM	MOMENT
Basic empty weight	1647.5		56537.5
Front seat occupants	285	+36	
Rear seat occupants	290	+70	
Fuel (40 gal. av-gas)		+48	
Baggage	90	+95	
TOTALS			
CG =		Inches	

Find: Gross weight
Total moment
CG arm

This problem is solved in three steps:

1. First, multiply weights by arms to get moments, and add moments. As the moments are added, accumulate them in memory with final entry resulting in the total moment.

Key In	Press	Display	Comments
56537.5	Sto	*56537.5*	Stored basic empty weight moment
285	×	*285*	Determine front seat moment
36	NT = ST	*10260*	
	L + G		
	Rcl	*56537.5*	Add to value in memory
	NT = ST	*66797.5*	
	Sto	*66797.5*	Store new subtotal
290	×	*290*	
70	NT = ST	*20300*	Determine rear seat moment, add to value in memory, and store new subtotal
	L + G		
	Rcl	*66797.5*	
	NT = ST	*87097.5*	
	Sto	*87097.5*	
40	×	*40*	Multiply fuel quantity times 6 pounds to determine fuel weight
6	NT = ST	*240*	
	×	*240*	
48	NT = ST	*11520*	
	L + G		Determine fuel moment, add to value in memory, and store new subtotal
	Rcl	*87097.5*	
	NT = ST	*98617.5*	
	Sto	*98617.5*	
90	×	*90*	Determine baggage moment
95	NT = ST	*8550*	
			continued

Key In	Press	Display	Comments
	[L + G]		
	[Rcl]	*98617.5*	Add to value in memory
	[NT = ST]	*107167.5*	Total moment = 107,167.5
	[Sto]	*107167.5*	Store total moment

2. Now, record the total moment and add up weights to get gross weight.

Key In	Press	Display	Comments
1647.5	[L + G]	*1647.5*	Enter basic empty weight
285	[L + G]	*1932.5*	Add front seat weight
290	[L + G]	*2222.5*	Add rear seat weight
240	[L + G]	*2462.5*	Add fuel weight
90	[NT = ST]	*2552.5*	Add baggage weight to get gross weight

3. Then, record gross weight and determine CG arm.

Key In	Press	Display	Comments
	[Rcl]	*107167.5*	Recall total moments from memory
	[÷]	*107167.5*	Divide by next entry (gross weight)
2552.5	[NT = ST]	*41.985309*	CG arm = 41.99 inches

Practice Problem — Weight and Balance

Given:

ITEM	WEIGHT	ARM	MOMENT
Basic empty weight	1349.4		114,332.5
Front seat occupants	340.0	85.5	
Rear seat occupants	—	117.0	
Fuel	300.0	94.3	
Baggage	100.0	117.0	

Find: Gross weight
Total moment
CG arm

RATES OF CLIMB

When looking at IFR departures and standard instrument departures (SIDs) the minimum climb rates are frequently expressed in feet per nautical mile. And where can that performance be measured on most aircraft instrument panels? Nowhere!

With just a little mathematics on your computer, the climb rate in the more usuable feet per minute can be computed assuming you know your groundspeed while climbing out. A division factor of 60 is always used. (At 60 knots, 500 feet per nautical mile equals 500 feet per minute.)

Sample Problem

Given: Minimum climb gradient — 350 feet per nautical mile
Groundspeed — 135 knots

Find: Climb rate in feet per minute

Key In	Press	Display	Comments
350	÷	350	Enter climb gradient; Divide by next entry
60	NT = ST	5.8333333	Enter constant; Compute factor
	×	5.8333333	Multiply by next entry
135	NT = ST	787.5	Enter groundspeed; Climb rate = 788 f.p.m.

Practice Problems — Finding Climb Rate in Feet Per Minute

	Climb Gradient	Groundspeed	What is climb rate in f.p.m.?
1.	152 feet per n.m.	75 knots	
2.	250 feet per n.m.	135 knots	
3.	425 feet per n.m.	250 knots	
4.	550 feet per n.m.	195 knots	

RATES OF DESCENT

With your electronic computer, it is easy to compute the time and rate of descent to the airport. One method of solving this is with the T-S-D mode, as shown in the sample problem.

Sample Problem

Given: Groundspeed — 150 knots
Distance — 50 nautical miles
Cruise altitude — 10,500 feet
Airport elevation— 620 feet

Find: Time and rate of descent

Key In	Press	Display	Comments
150	GS/FPH	150	Enter groundspeed
50	Dst/Fuel	50	Enter distance
	Comp	50	
	Time	0-20-00	Time to airport

continued

Key In	Press	Display	Comments
10,500	M – FT	10,500	Cruise altitude
620	NT = ST	9,880	Altitude to lose
	Dst/Fuel	9,880	Enter altitude loss
	Comp		
	GS/FPH	29640.0	Descent rate (feet per hour)
	÷	29640	
60	NT = ST	494	Feet per minute

POINT OF DESCENT

In many aircraft, engine power requirements or other considerations may limit the rate of descent. Again, your electronic computer provides an easy method for determining the descent point. The sample problem illustrates a typical transition from cruise altitude to point of touchdown.

This particular computation uses the T-S-D mode, but in an unusual manner. Since descent rates are expressed as feet per *minute* and not per *hour*, the display answers are expressed in the format of minutes-seconds-parts of seconds. Therefore, the time must be re-entered in the proper format (hours-minutes-seconds) so that distance can be computed. The part of seconds are rounded to the nearest second.

Sample Problem

Given: Cruise altitude — 12,500 ft.
Airport elevation — 548 ft.
Descent rate — 500 feet per minute
Average descent groundspeed — 145 knots

Find: Time and distance from airport to start of descent.

Key In	Press	Display	Comments
	T-S-D		Activates T-S-D mode
12500	M − FT	12500	Enter cruise altitude; Subtract next entry
548	NT = ST	11952	Enter airport elevation; Compute altitude loss to airport
	Dst/Fuel	11952	Enter altitude loss
500	×	500	Descent rate in feet per minute
60	NT = ST	30000	Compute descent rate in feet per hour
	GS/FPH	30000	Enters descent rate in T-S-D register
	Comp		
	Time	0-23-54	Time to descend
145	GS/FPH	145	Enter groundspeed
	Comp		
	Dst/Fuel	57.8	Distance from airport for descent = 57.8 n.m.

Practice Problems — Finding Time and Distance From Airport to Start Descent

	Cruise Altitude	Airport Elevation	Descent Rate	What is Time?	Groundspeed	What is distance from airport?
1.	7,500 ft.	487 ft.	500 f.p.m.		137 knots	
2.	13,000 ft.	4458 ft.	550 f.p.m.		185 knots	
3.	6,500 ft.	38 ft.	350 f.p.m.		124 m.p.h.	
4.	28,000 ft.	2846 ft.	1500 f.p.m.		260 knots	

APPENDIX A — ANSWERS TO PRACTICE PROBLEMS

Practice Problems —
Conversions (P. 10)

1.	161.10912 s.m.	9.	16.556122 kg.
2.	28.769486 m.p.h.	10.	952.39697 lbs.
3.	66.911171 n.m.	11.	420.624 meters
4.	152.93982 knots	12.	11633.858 ft.
5.	-7.7777778°	13.	640.792 km.
6.	8.6°F.	14.	39.416847 n.m.
7.	136.27102 liters	15.	274.096 km./hr.
8.	64.988141 gallons	16.	116.63067 knots

Practice Problems —
Finding TAS (P. 17)

1.	200 knots	3.	137 knots
2.	430 knots	4.	377 knots

Practice Problems —
Finding Density Altitude (P. 18)

1.	4,097 ft.	3.	9,256 ft.
2.	8,133 ft.	4.	-98 ft.

Practice Problems —
Finding Std. Temperature (P. 19)

1.	15°C	3.	0°C
2.	5°C	4.	-35°C

Practice Problems — Finding
Heading and Groundspeed (P. 26)

1.	304°; 130 knots	3.	056°; 162 knots
2.	171°; 150 knots	4.	269°; 112 knots

Practice Problems — Finding Wind
Direction and Speed (P. 28)

1.	065° @ 26 knots	3.	083° @ 96 knots
2.	200° @ 29 knots	4.	276° @ 43 knots

Practice Problems —
Wind-Correction Angle (P. 29)

1. 8° right
2. 13° left
3. 9° right
4. 11° left

Practice Problems —
Adding and Subtracting Time (P. 36)

1. 1:23:08 Time enroute
2. 12:14:44 Time of arrival
3. 11:46:39 Departure time
4. 0:33:34

Practice Problems —
Finding Time (P. 37)

1. 1:20:00
2. 0:03:25
3. 0:18:00
4. 1:30:00

Practice Problems —
Finding Distance (P. 38)

1. 262.5 n.m.
2. 9.6 n.m.
3. 469.9 n.m.
4. 256.0 n.m.

Practice Problems —
Finding Speed (P. 38)

1. 125.6 knots
2. 266.7 knots
3. 95.8 knots
4. 100.0 knots

Practice Problems —
Finding Time (Fuel) (P. 39)

1. 2:30:00
2. 3:46:40
3. 2:19:17
4. 4:10:00

Practice Problems —
Finding Fuel Consumed (P. 40)

1. 3.5 gallons
2. 56.0 gallons
3. 163.4 liters
4. 718.8 pounds

Practice Problems — Finding
Fuel Consumption Rate (P. 41)

1. 10.5 g.p.h.
2. 21.7 g.p.h.
3. 51.1 l.p.h.
4. 191.9 lbs/hr.

Practice Problems — Multi-Part
Fuel Consumption (P. 44 and 45)

1. TAS = 129 knots; Heading = 038°; GS = 121 knots; Time = 2:38:30; Fuel = 23.8 gal.
2. TAS = 474 knots; Heading = 123°; GS = 504 knots; Time = 1:19:48; Fuel = 1799.6 lbs.
3. TAS = 113 knots; Heading =; 238° GS = 107 knots; Time = 1:11:14; Fuel = 9.5 gal.
   (Did you remember to convert temperature to °C; speed and distance to nautical?)
4. TAS = 189 knots; Heading = 007°; GS = 217 knots; Time = 1:55:55; Fuel = 102.4 liters.

Practice Problem —
Weight and Balance (P. 49)

Gross weight = 2089.4 pounds
Total moment = 183,392.5 pound/inches
CG arm = 87.77 inches

Practice Problems —
Finding Climb Rate (P. 51)

1. 190 ft./min.
2. 563 ft./min.
3. 1771 ft./min.
4. 1788 ft./min.

Practice Problems — Finding
Time and Distance From Airport To Start Descent
(P. 54)

1. Time — 0:14:02
   Distance —
   32.0 n.m.
2. Time — 0:15:32
   Distance —
   47.9 n.m.
3. Time — 0:18:28
   Distance —
   38.2 s.m.
4. Time — 0:16:46
   Distance —
   72.7 n.m.

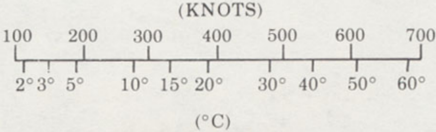
APPENDIX B

CONVERSIONS

UNIT	EQUIVALENT
Centimeter	.3937 Inches
Gallon (Imp.)	1.201 U.S. Gallons
Gallon (Imp.)	4.546 Liters
Gallon (U.S.)	.83267 Imperial Gallons
Gallon (U.S.)(av gas)	***6.0 Pounds
Gallon (U.S.)(oil)	***7.5 Pounds
Gallon (U.S.) (turbine fuel)	**6.7 Pounds
Inch	*2.54 Centimeters
Inch of Mercury	33.863 Millibars
Kilometer	.62137 Statute Miles
Liter	.21997 Imperial Gallons
Liter (av gas)	1.58 Pounds
Liter (av gas)	.719 Kilograms
Liter (oil)	1.9813 Pounds
Liter (oil)	.89871 Kilograms
Liter (turbine fuel)	**1.8 Pounds
Liter (turbine fuel)	**.8 Kilograms
Mile (nautical)	6076.115 Feet
Mile (statute)	*5,280 Feet
Mile (statute)	1.6093 Kilometers
Millibar	.02953 Inches of Mercury

* = Exact equivalent ** = Varies with temperature *** = Accepted standard

Temperature Rise ($C_T = 1.0$) versus True Airspeed (knots)



APPENDIX C
SERVICE INFORMATION

IN CASE OF DIFFICULTY:

1. If the battery indicator fails to appear on the display, check for improperly inserted or discharged batteries. See battery replacement instructions.

2. Review operating instructions to be certain that calculations were performed correctly.

3. When batteries are inserted into the computer and the display does not reset, pressing [Off] then [On/C] should reset the display and prepare the computer for use.

If none of the above procedures corrects the difficulty, return the computer PREPAID and INSURED to:

Jeppesen Sanderson, Inc.
55 Inverness Drive East
Englewood, Colorado 80112

For your protection, the computer must be sent insured. Jeppesen Sanderson cannot assume any responsibility for loss of, or damage to, uninsured shipments.

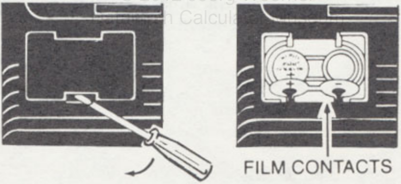
Please include information on the difficulty experienced with the computer, as well as return address information including name, address, city, state, and zip code. The shipment should be carefully packaged and adequately protected against shock and rough handling.

BATTERY REPLACEMENT

There are now two types of batteries that can be used with your computer. For up to 1000 hours operation, you can use two Union Carbide (Eveready) 186, Panasonic LR-43 or Ray-O-Vac RW-84 alkaline batteries (equivalent supplied with computer). You can also use two Mallory 10L124, Union Carbide (Eveready) 386, or Panasonic WL-11 silver-oxide batteries for up to 2500 hours operation.

To replace batteries:

1. Turn the computer off. Place a small screwdriver, paper clip, or other similar instrument into the slot and gently lift the battery cover.



2. Remove the discharged batteries and install new ones as shown. Be careful not to crease the film contacts while installing the new batteries. Be sure the film contacts are positioned to lay on top of the batteries after the batteries are installed.

3. Replace the cover top edge first, then gently press until the bottom of the cover snaps into place.

SIX–MONTH LIMITED WARRANTY

This electronic computer warranty extends to the original purchase of the computer.

Warranty Duration

This electronic computer is warranted to the original purchase for a period of six months from the original purchase date.

Warranty Coverage

This electronic computer is warranted against defective materials or workmanship. THIS WARRANTY DOES NOT COVER BATTERIES AND IS VOID IF:

1. THE COMPUTER HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, NEGLECT, IMPROPER SERVICE, OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIAL OR WORKMANSHIP.

2. THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.

Warranty Performance

During the above six month warranty period, your computer will either be repaired or replaced with a reconditioned model of an equivalent quality (at Jeppesen Sanderson's option) when the computer is returned, postage prepaid and insured, to Jeppesen Sanderson. In the event of replacement with a reconditioned model, the replacement unit will continue the warranty of the original computer. Other than the postage and insurance requirement, no charge will be made for such repair adjustment and/or replacement.

Warranty Disclaimers

Any implied warranties arising 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. Jeppesen Sanderson 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.

Legal Remedies

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

Jeppesen Sanderson, Inc.
55 Inverness Drive
Englewood, Colorado 80112

IMPORTANT

Record the serial number (from back of unit) and purchase date in the space below. Always reference this information in any correspondence.

MODEL NO.	SERIAL NO.	PURCHASE DATE
________	________	____________

CAUTION

This electronic computer is a training and information aid and is not an avionics instrument.

NOTE:

This computer is designed to operate accurately within a wide range of atmospheric conditions. However, if exposed to extreme temperatures or direct sunlight for an extended period of time, the display may go blank. If this occurs, remove the computer from the heat or sunlight and it will display properly within several minutes.