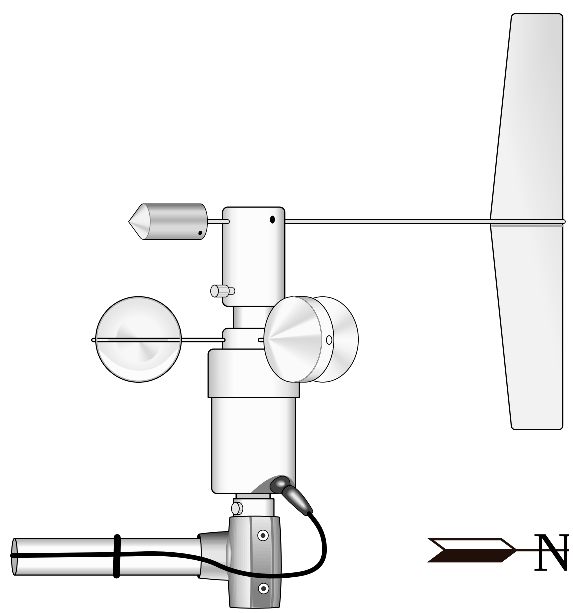
INSTRUCTION MANUAL

Met One 034B Windset

Revision: 10/12



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Met One 034B Windset

1. Introduction

The 034B combines a 3-cup anemometer and vane into a single integrated package to measure wind speed and direction. It is cabled for use with our dataloggers, and can provide measurements for a variety of applications.

Before installing the 034B, please study

- Section 2, *Cautionary Statements*
- Section 3, *Initial Inspection*
- Section 4, *Quickstart*

2. Cautionary Statements

- The 034B is a precision instrument. Please handle it with care.
- If the 034B is to be installed at heights over 6 feet, be familiar with tower safety and follow safe tower climbing procedures.
- Danger—Use extreme care when working near overhead electrical wires. Check for overhead wires before mounting the 034B or before raising a tower.
- The set screw holes must be covered with labels to prevent corrosion and assure the warranty.
- The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

3. Initial Inspection

Upon receipt of the 034B, inspect the packaging and contents for damage. File damage claims with the shipping company. Immediately check package contents against the shipping documentation (see Section 3.1, *Ships With List*). Contact Campbell Scientific about any discrepancies.

The model number and cable length are printed on a label at the connection end of the cable. Check this information against the shipping documents to ensure the expected product and cable length are received.

3.1 Ships With List

The 034B Windset ships with:

(1) 1/16” Allen wrench
(1) Bushing from Met One
(1) Calibration Sheet
(3) Direction hub stickers
(1) ResourceDVD
(1) Wind Vane
(1) Sensor cable of user-specified length

4. Quickstart

4.1 Step 1—Mount the Sensor

Tools required:

- 1/2” open end wrench (for CM220)
- 5/64” and 1/16” Allen wrenches
- compass and declination angle for the site (see Appendix A)
- small screw driver provided with datalogger
- UV resistant cable ties
- small pair of diagonal-cutting pliers
- 6 – 10” torpedo level

This quick start installs the 034B using:

- 17953 1 x 1 inch NURAIL Crossover Fitting (FIGURE 4-1), or
- CM220 Right-Angle Mounting Kit (FIGURE 4-2)

Please review Section 7, *Installation*, for siting and other guidelines.

1. Fully insert vane arm into hub (see FIGURE 4-1).

2. Align vane with center axis of sensor (see FIGURE 4-1).

3. Using the Allen wrench, tighten set screws at the top of the hub (see FIGURE 4-1).

4. Cover the set screw hole with one of the small round stickers included with the 034B. One of these labels is already installed on the hub covering the set screw that attaches the hub to the sensor. Extra labels are included with the 034B to recover the holes if the sensor has to be disassembled for maintenance.

CAUTION The set screw holes must be covered with the labels to prevent corrosion and assure the warranty.

5. Mount a CM202, CM204, or CM206 crossarm to the tripod or tower.

6. Orient the crossarm North-South, with the CM220 mount or 17953 NU-RAIL on the North end. Appendix A contains detailed information on

determining True North using a compass and the magnetic declination for the site.

7. Remove the alignment screw at the base of the 034B (FIGURE 4-1).

8. Insert the 034B into the aluminum bushing provided with the sensor (see FIGURE 4-1).

9. Align the hole in the bushing with that in the 034B base and replace the screw (see FIGURE 4-1).

10. Insert the 034B/bushing into the NU-RAIL fitting (FIGURE 4-1) or the CM220's U-bolt (FIGURE 4-2).

11. Align the sensor so that the counter weight points to true South and tighten the set screws on the NU-RAIL or U-bolts on the CM220. Final sensor orientation is done after the datalogger has been programmed to measure wind direction as described in Appendix A.

12. Remove the shoulder screw to allow the vane to rotate (see FIGURE 4-1).

13. Attach the sensor cable to the six pin male connector on the 034B. Make sure the connector is properly keyed. Finger tighten the knurled ring.

14. Route the sensor cable along the underside of the crossarm to the tripod or tower, and to the instrument enclosure.

15. Secure the cable to the crossarm and tripod or tower using cable ties.

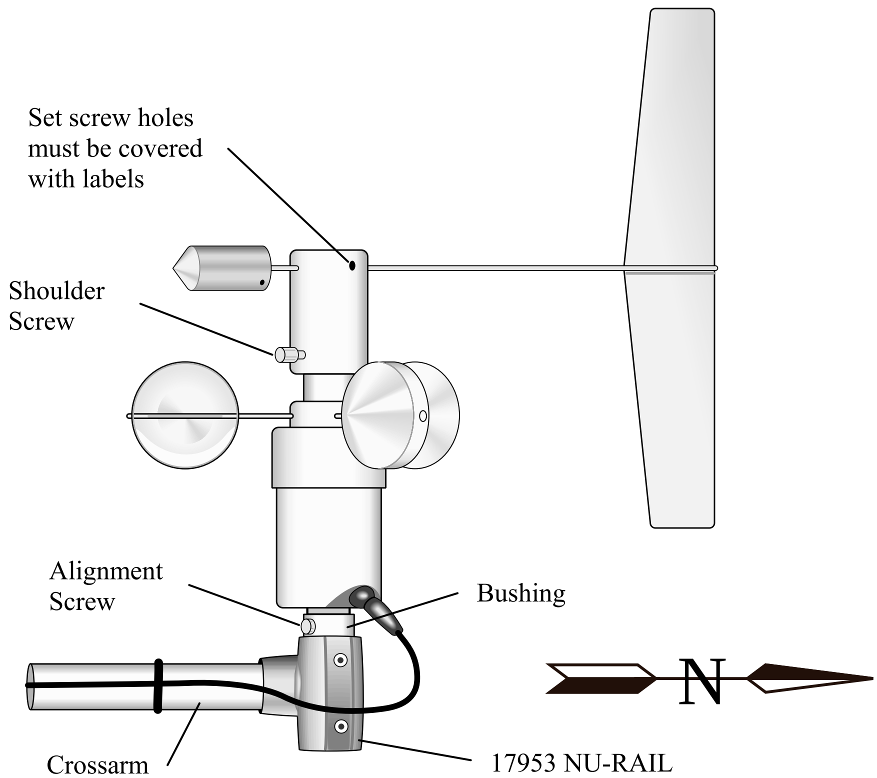


FIGURE 4-1. 034B mounted on a crossarm using a 17953 NU-RAIL crossover fitting

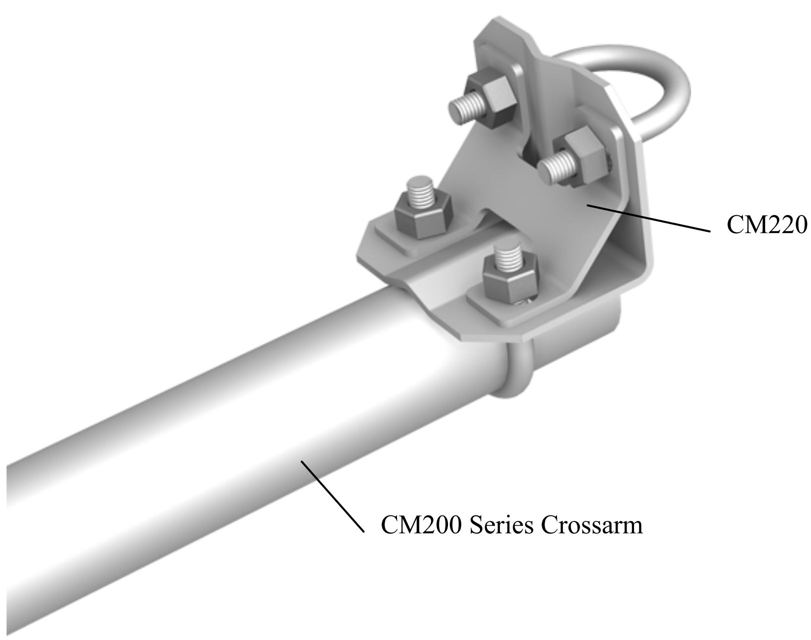
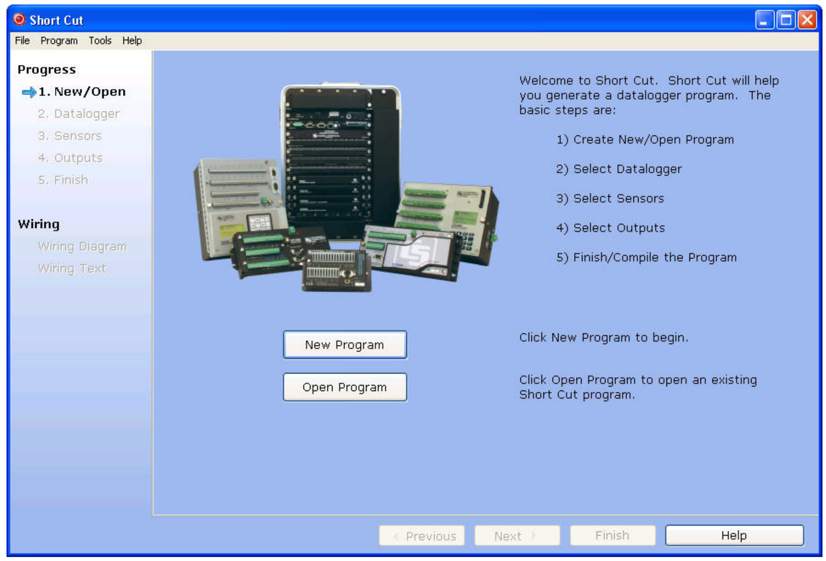


FIGURE 4-2. CM200 Series Crossarm with CM220 Right Angle Mounting Bracket

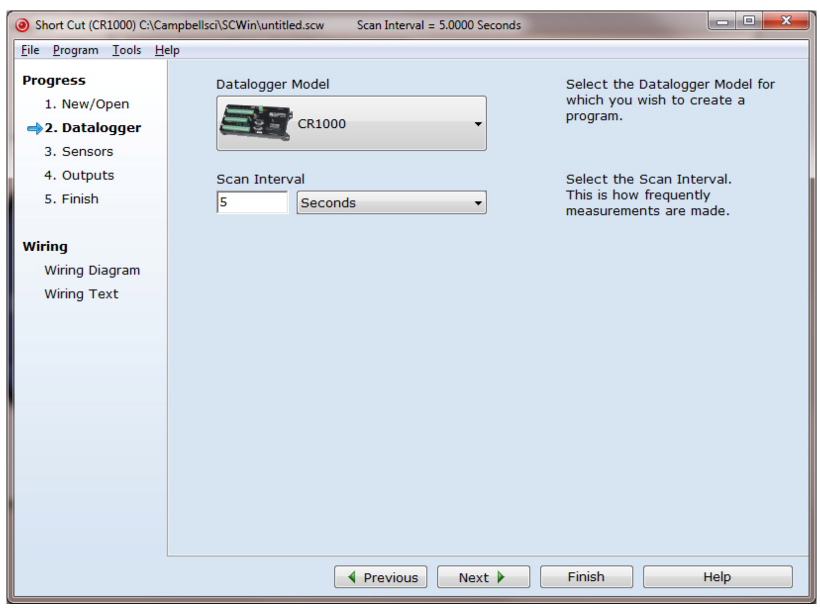
4.2 Step 2—Use SCWin ShortCut to Program Datalogger and Generate Wiring Diagram

The simplest method for programming the datalogger to measure the 034B is to use Campbell Scientific's SCWin Short Cut Program Generator.

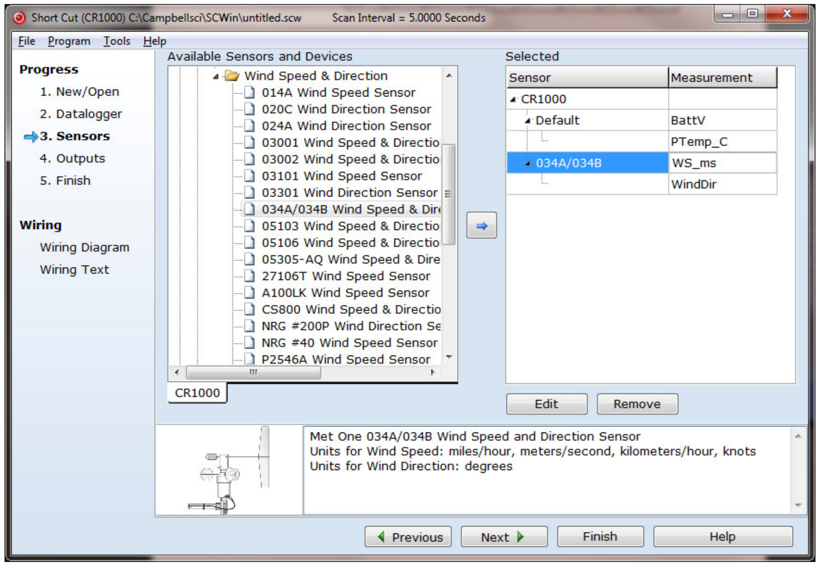
1. Open Short Cut and click on **New Program**.



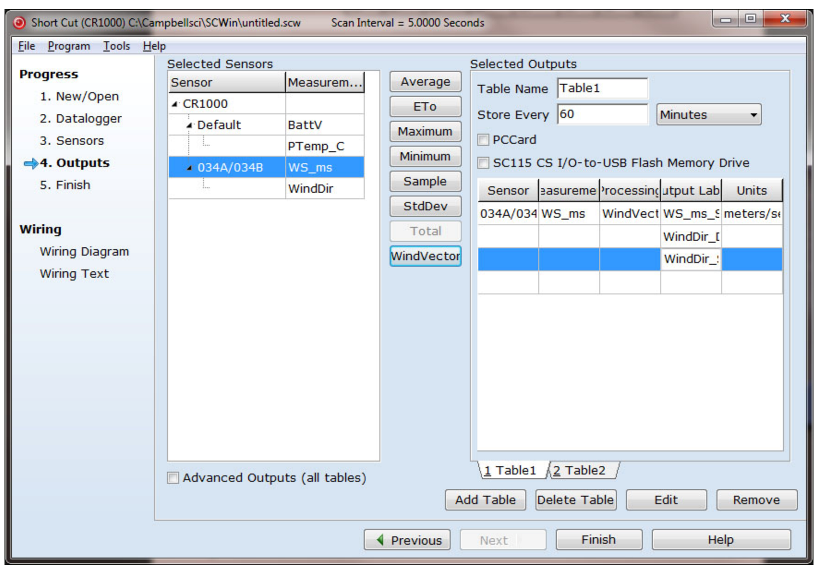
2. Select the datalogger and enter the scan interval.



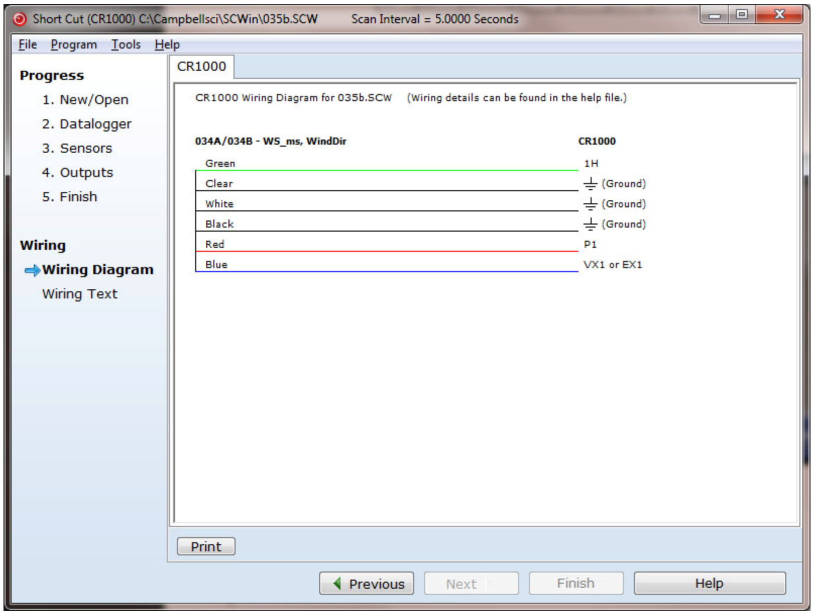
3. Select 034A/034B Wind Speed & Direction Sensor and select the right arrow (in center of screen) to add it to the list of sensors to be measured then select next.



4. Select Wind Vector for the output and then select finish.



5. Wire according to the wiring diagram generated by SCWin Short Cut.



5. Overview

The 034B Windset is used to measure horizontal wind speed and direction.

Wind speed is measured with a three cup anemometer. Rotation of the cup wheel opens and closes a reed switch at a rate proportional to wind speed.

Vane position is transmitted by a 10 kohm potentiometer. With a precision excitation voltage applied, the output voltage is proportional to wind direction.

The accompanying Met One manual contains additional information on the operating principals, installation, and maintenance of the sensor.

Cable length for the 034B is specified when the sensor is ordered. TABLE 5-1 gives the recommended cable length for mounting the sensor at the top of the tripod/tower with a CM202 crossarm.

TABLE 5-1. Recommended Cable Lengths

CM106	CM110	CM115	CM120	UT10	UT20	UT30
11 ft	14 ft	19 ft	24 ft	14 ft	24 ft	37 ft

The 034B's cable can terminate in:

- Pigtails that connect directly to a Campbell Scientific datalogger (option –PT).
- Connector that attaches to a prewired enclosure (option –PW). Refer to *www.campbellsci.com/prewired-enclosures* for more information.

- Connector that attaches to a CWS900 Wireless Sensor Interface (option –CWS). The CWS900 allows the 034B to be used in a wireless sensor network. Refer to *www.campbellsci.com/cws900* for more information.

6. Specifications

Features:

- Designed for continuous, long term, unattended operation in adverse conditions
- Constructed of light-weight aluminum
- Compatible with most Campbell Scientific dataloggers

Compatible Dataloggers: CR200(X)-series
CR800 series
CR1000
CR3000
CR5000
CR9000X
CR510
CR10(X)
CR23X
CR7
21X

6.1 Wind Speed

Operating Range: 0 to 75 m s^{-1} (0 to 167 mph)

Threshold: 0.4 m s^{-1} (0.9 mph)

Accuracy:
±0.12 m s^{-1} (±0.25 mph) for wind speed < 10.1 m s^{-1} (22.7 mph)
±1.1% of reading for wind speeds > 10.1 m s^{-1} (22.7 mph)

Output Signal: contact closure (reed switch)

Resolution: (1.789 mph) / (scan rate in seconds)
or (0.7998 m s^{-1}) / (scan rate in seconds)

Anemometer Height: 24.4 cm (9.6 in)

Anemometer Radius: 10.7 cm (4.2 in)

6.2 Wind Direction

Length: 11.4 cm (4.5 in)

Measurement Range: 0 to 360°

Threshold: 0.4 m s^{-1} (0.9 mph)

Accuracy: ±4°

Resolution: 0.5°

Potentiometer Resistance: 0 to 10 kΩ open at crossover

6.3 General Specifications

Operating Temperature Range:	-30° to +70°C
Weight:	907 g (2.0 lb)

CAUTION The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

7. Installation

7.1 Siting

Locate wind sensors away from obstructions (e.g. trees and building). As a general rule of thumb there should be a horizontal distance of at least ten times the height of the obstruction between the windset and the obstruction. If it is necessary to mount the sensors on the roof of a building, the height of the sensors, above the roof, should be at least 1.5 times the height of the building. See Section 10, *References*, for a list of references that discuss siting wind speed and direction sensors.

7.2 Mounting Options

The 034B can be attached to a CM202, CM204, or CM206 crossarm via a 17953 NU-RAIL fitting or a CM220 Right Angle Mounting Bracket. Procedure for using these mounts is provided in the quick start (Section 4.1, *Step 1—Mount the Sensor*).

Alternatively, the 034B can be attached to the top of our stainless-steel tripods via the CM216 Sensor Mounting Kit. The CM216 extends 4 in. above the mast of a stainless-steel CM110, CM115, or CM120 tripod.

FIGURE 7-1. CM216 mount

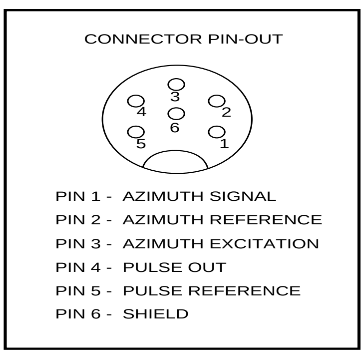
7.3 Wiring

Connections to Campbell Scientific dataloggers are given in TABLE 7-1. When Short Cut for Windows software is used to create the datalogger program, the sensor should be wired to the channels shown on the wiring diagram created by Short Cut.

TABLE 7-1. Connections to Campbell Scientific Dataloggers

Color	Wire Label	CR800 CR5000 CR3000 CR1000	CR510 CR500 CR10(X)	21X CR7 CR23X	CR200(X)
Red	WS Signal	Pulse	Pulse	Pulse	P_SW
Black	WS Signal Ref	⏚	G	⏚	⏚
Green	WD Signal	SE Analog	SE Analog	SE Analog	SE Analog
Blue	WD Volt Excite	Excitation (VX)	Excitation	Excitation	Excitation (VX)
White	WD Signal Ref	⏚	AG	⏚	⏚
Clear	Shield	⏚	G	⏚	⏚

The CR10X, CR23X, and dataloggers programmed with CRBasic can also measure wind speed on a control port. With this option the black wire is connected to the 5 V terminal.



NOTE 034B-L Windsets purchased directly from Met One Instruments have a different configuration on the 6 pin connector. In addition, they do not have the 10 kΩ resistance on the excitation line. The wiring diagram and the multiplier and offset, for wind direction, are different than the examples in this document.

7.4 Programming

This section is for users who write their own programs. A datalogger program to measure this sensor can be created using Campbell Scientifics' Short Cut Program Builder software. You do not need to read this section to use Short Cut.

7.4.1 Wind Speed

Wind speed is measured with the Pulse Count instruction, using the Switch Closure configuration and set to output frequency in Hertz (see Section 7.4.4, *Example Programs*, for examples).

The expression for wind speed (U) is:

$$U = MX + B$$

where

M = multiplier
X = number of pulses per second (Hertz)
B = offset

TABLE 7-2 lists the multipliers (M) and offsets (Off) to obtain meters/second or miles/hour when the Pulse Count instruction is configured to output the result in Hz.

TABLE 7-2. Wind Speed Multiplier*

Model	Meters/Second	Miles/Hour
034B	M = 0.7989 Off = 0.28	M = 1.787 Off = 0.63

*When configured to output counts, the multiplier above is divided by the execution interval in seconds.

7.4.2 Wind Direction

The CR200(X) dataloggers use the **ExDelSE()** instruction to measure wind direction. All other CRBasic dataloggers (e.g., CR800, CR1000, CR3000, CR5000) use the **BRHalf()** instruction (see Section 7.4.4.1, *CR1000 Example Program*, for example).

Edlog dataloggers (CR510, CR10(X), CR23(X) typically use Instruction 5 – AC Half Bridge (P5) to measure wind speed (see Section 7.4.4.2, *CR10X Example Program*, for example). When the sensor cable length is greater than 100 ft, Edlog Instruction 4 – Excite-Delay (P4) is recommended instead (see Section 7.4.5, *Long Lead Lengths*).

Excitation voltages, range codes, and multipliers for our dataloggers are listed in TABLE 7-3. The multiplier value converts the sensor's millivolt output to degrees. Appendix B has additional information on the measurement instructions.

TABLE 7-3. Parameters for Wind Direction					
	CR10(X) CR510	**CR7 21X CR23X**	**CR800 CR1000**	**CR5000 CR3000**	**CR200(X)**
Measurement Range, Integration	2500 mV, slow	5000 mV, slow/60 Hz	2500 mV, 60 Hz, reverse excitation	5000 mV, 60 Hz, reverse excitation	N/A
Excitation Voltage	2500 mV	5000 mV	2500 mV	5000 mV	2500 mV
Multiplier	720*	720*	720	720	0.288
Offset	0	0	0	0	0

*The multiplier for the Edlog dataloggers assumes Edlog Instruction 5 – AC Half Bridge is used. Refer to Section 7.4.5, *Long Lead Lengths*, if using Edlog Instruction 4 – Excite-Delay.

7.4.3 Wind Vector Processing Instruction

The Wind Vector output instruction is used to process and store mean wind speed, unit vector mean wind direction, and Standard Deviation of the wind direction (optional) from the measured wind speed and direction values.

7.4.4 Example Programs

The following programs measure the 034B every 5 seconds, and store mean wind speed, unit vector mean direction, and standard deviation of the direction every 60 minutes. Wiring for the examples is given in TABLE 7-4.

TABLE 7-4. Wiring for Example Programs			
Color	**Description**	**CR1000**	**CR10X**
Red	Wind Spd. Signal	P1	P1
Black	Wind Spd. Reference	⏚	G
Green	Wind Dir. Signal	SE 1	SE 1
Blue	Wind Dir. Excitation	EX 1	E1
White	Wind Dir. Reference	⏚	AG
Clear	Wind Dir. Shield	⏚	G

7.4.4.1 CR1000 Example Program

```
'CR1000
'Declare Variables and Units
Public Batt_Volt
Public WS_ms
Public WindDir
Units Batt_Volt=Volts
Units WS_ms=meters/second
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
  DataInterval(0,60,Min,10)
  WindVector (1,WS_ms,WindDir,FP2,False,0,0,0)
  FieldNames("WS_ms_Avg,WindDir_Avg,WindDir_StDev")
EndTable

'Main Program
BeginProg
  Scan(5,Sec,1,0)
    'Default Datalogger Battery Voltage measurement Batt_Volt:
    Battery(Batt_Volt)
    '034A/034B Wind Speed & Direction Sensor measurements WS_ms and WindDir:
    PulseCount(WS_ms,1,1,2,1,0.799,0.2811)
    If WS_ms=0.2811 Then WS_ms=0

    BrHalf(WindDir,1,mV2500,1,1,1,2500,True,0,_60Hz,720.0,0)  'Use 5000 mV
    If WindDir>=360 OR WindDir < 0 Then WindDir=0             'excitation for
    'Call Data Tables and Store Data                          'the CR3000 and
    CallTable(Table1)                                         'CR5000 dataloggers
  NextScan
EndProg
```

7.4.4.2 CR10X Example Program

```
;{CR10X}
*Table 1 Program
  01:  5.0000        Execution Interval (seconds)

1:  Pulse (P3)
  1:   1             Reps
  2:   1             Pulse Channel 1
  3:   22            Switch Closure, Output Hz
  4:   3             Loc [ WS_ms     ]
  5:   0.799         Multiplier
  6:   0.2811        Offset

2:  If (X<=>F) (P89)
  1:   3             X Loc [ WS_ms     ]
  2:   1             =
  3:   0.2811        F
  4:   30            Then Do

3:  Z=F x 10^n (P30)
  1:   0             F
  2:   0             n, Exponent of 10
  3:   3             Z Loc [ WS_ms     ]

4:  End (P95)
```

```
5:  AC Half Bridge (P5)
   1:  1           Reps
   2:  25          2500 mV 60 Hz Rejection Range   ; 5000 mV(slow/60 hz) for CR23X, 21X
   3:  1           SE Channel
   4:  1           Excite all reps w/Exchan 1
   5:  2500        mV Excitation                   ; 5000 mV for CR23X, 21X, CR7
   6:  4           Loc [ WindDir   ]
   7:  720         Multiplier
   8:  0.0         Offset

6:  If (X<=>F) (P89)
   1:  4           X Loc [ WindDir   ]
   2:  3           >=
   3:  360         F
   4:  30          Then Do

7:  Z=F x 10^n (P30)
   1:  0           F
   2:  0           n, Exponent of 10
   3:  4           Z Loc [ WindDir   ]

8:  End (P95)

9:  If time is (P92)
   1:  0           Minutes (Seconds --) into a
   2:  60          Interval (same units as above)
   3:  10          Set Output Flag High (Flag 0)

10:  Set Active Storage Area (P80)
   1:  1           Final Storage Area 1
   2:  101         Array ID

11:  Real Time (P77)
   1:  1220        Year,Day,Hour/Minute (midnight = 2400)

12:  Wind Vector (P69)
   1:  1           Reps
   2:  0           Samples per Sub-Interval
   3:  0           S, theta(1), sigma(theta(1)) with polar sensor
   4:  3           Wind Speed/East Loc [ WS_ms     ]
   5:  4           Wind Direction/North Loc [ WindDir   ]
```

7.4.5 Long Lead Lengths

When sensor lead length exceeds 100 feet, the settling time allowed for the measurement of the vane should be increased to 20 milliseconds.

For dataloggers programmed with CRBasic, increase the *Settling Time* parameter of the CRBasic instruction to 20 milliseconds (20,000 microseconds).

Dataloggers programmed with Edlog should use Instruction 4 – Excite-Delay (P4), rather than Instruction 5 – AC Half Bridge (P5). Enter a 2 in the Delay parameter for a 20 millisecond delay.

With a CR510 or CR10(X), use a 2500 mV excitation and the 2500 mV measurement range. With a 21X, CR7, or CR23X, use a 5000 mV excitation and the 5000 mV measurement range.

CAUTION The 60 Hz rejection option can not be used with the DC Half Bridge instruction, when the delay is not zero. Do not use long lead lengths in electrically noisy environments.

TABLE 7-5. Multiplier and Offset for Wind Direction when using Lead Lengths Greater than 100 Feet

Units	Datalogger Type	Instruction Number	Multiplier	Offset
degrees	CR10(X) CR510	4	0.288	0
degrees	CR23X CR7, 21X	4	0.144	0

7.4.5.1 Sample CR10(X) Program when Long Leads are Required

```
;{CR10X}
;

*Table 1 Program
  01: 10          Execution Interval (seconds)

01: Pulse (P3)
  1:  1           Reps
  2:  2*          Pulse Channel 2
  3:  22          Switch Closure, Output Hz
  4:  1*          Loc [ WndS_m_s  ]
  5:  0.7990      Mult
  6:  0.2811      Offset

;Set the wind speed to zero if the wind is not blowing.
;

02: If (X<=>F) (P89)
  1:  1*          X Loc [ WndS_m_s  ]
  2:  1           =
  3:  0.2811      F
  4:  30          Then Do

03: Z=F (P30)
  1:  0           F
  2:  0           Exponent of 10
  3:  1*          Z Loc [ WndS_m_s  ]
```

```
04:  End (P95)

05:  Excite-Delay (SE) (P4)
   1:   1              Reps
   2:   5**            ± 2500 mV Slow Range
   3:   5*             SE Channel
   4:   3*             Excite all reps w/Exchan 3
   5:   2              Delay (units 0.01 sec)
   6:   2500**         mV Excitation
   7:   2*             Loc [ WndD_deg  ]
   8:   0.288          Mult
   9:   0              Offset

06:  If time is (P92)
   1:   0              Minutes (Seconds --) into a
   2:   30             Interval (same units as above)
   3:   10             Set Output Flag High (Flag 0)

07:  Real Time (P77)
   1:   0110           Day,Hour/Minute

08:  Wind Vector (P69)
   1:   1              Reps
   2:   0              Samples per Sub-Interval
   3:   00             S, θu, & σ(θu) Polar***
   4:   1*             Wind Speed [ WndS_m_s  ]
   5:   2*             Wind Direction [ WndD_deg  ]

-Input Locations-
1 WndS_m_s
2 WndD_deg

*     Proper entries will vary with program and datalogger channel and input location assignments.
**    On the 21X use the 5000 mV input range and the a 5000 mV excitation voltage.
***   Average wind speed, average unit vector wind direction, standard deviation of unit vector wind
      direction
```

8. Sensor Maintenance

1 Month

- Do a visual/audio inspection of the anemometer at low wind speeds. Verify that the cup assembly and wind vane rotate freely. Inspect the sensor for physical damage. Verify cups and vane are tight.

6 Months

- Replace anemometer bearings if operating under harsh conditions

1 Year

- Replace anemometer bearings. Contact Campbell Scientific for a Return Materials Authorization (RMA) number at (435) 227-9000. A "Statement of Product Cleanliness and Decontamination" must also be filled out.

2 Years

- Replace the wind vane potentiometer and bearings. Contact Campbell Scientific for a Return Materials Authorization (RMA) number at (435) 227-9000. A "Statement of Product Cleanliness and Decontamination" must also be filled out.

9. Troubleshooting

9.1 Wind Direction

Symptom: NAN, -9999, or no change in direction

1. Check that the sensor is wired to the excitation and single-ended channel specified by the measurement instruction.
2. Verify that the excitation voltage and range code are correct for the datalogger type.
3. Disconnect the sensor from the datalogger and use an ohm meter to check the potentiometer. Resistance should vary from 11 to 21 kohms between the blue and green wires depending on vane position. Resistance should vary from 1 to 11 kohms between the white and green wires depending on vane position.

Symptom: Incorrect wind direction

1. Verify that the excitation voltage, range code, multiplier and offset parameters are correct for the datalogger type.
2. Check orientation of sensor as described in Section 7, *Installation*.

9.2 Wind Speed

Symptom: No wind speed

1. Check that the sensor is wired to the pulse channel specified by the pulse count instruction.
2. Disconnect the sensor from the datalogger and use an ohm meter to check the reed switch. The resistance between the red and black wires should vary from infinite (switch open) to less than 1 ohm (switch closed) as the cupwheel is slowly turned.
3. Verify that the configuration code (switch closure, Hertz), and multiplier and offset parameters for the pulse count instruction are correct for the datalogger type.

Symptom: Wind speed does not change

1. For the dataloggers that are programmed with Edlog, the input location for wind speed is not updated if the datalogger is getting "Program Table Overruns". Increase the execution interval (scan rate) to prevent overruns.

10. References

The following references give detailed information on siting wind speed and wind direction sensors.

EPA, 1989: *Quality Assurance Handbook for Air Pollution Measurements System*, Office of Research and Development, Research Triangle Park, NC, 27711.

EPA, 1987: *On-Site Meteorological Program Guidance for Regulatory Modeling Applications,* EPA-450/4-87-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711.

The State Climatologist, 1985: *Publication of the American Association of State Climatologists: Height and Exposure Standards*, for Sensors on Automated Weather Stations, vol. 9, No. 4.

WMO, 1983: *Guide to Meteorological Instruments and Methods of Observation,* World Meteorological Organization, No. 8, 5th edition, Geneva, Switzerland.

Appendix A. Wind Direction Sensor Orientation

A.1 Determining True North and Sensor Orientation

Orientation of the wind direction sensor is done after the datalogger has been programmed, and the location of True North has been determined. True North is usually found by reading a magnetic compass and applying the correction for magnetic declination; where magnetic declination is the number of degrees between True North and Magnetic North. The preferred method to obtain the magnetic declination for a specific site is to use a computer service offered by NOAA at *www.ngdc.noaa.gov/geomag*. Magnetic declination can also be obtained from a map or local airport. A general map showing magnetic declination for the contiguous United States is shown in FIGURE A-1.

Declination angles east of True North are considered negative, and are subtracted from 360 degrees to get True North as shown FIGURE A-2 (0° and 360° are the same point on a compass). For example, the declination for Logan, Utah is 14° East. True North is 360° - 14°, or 346° as read on a compass. Declination angles west of True North are considered positive, and are added to 0 degrees to get True North as shown in FIGURE A-3.

Orientation is most easily done with two people, one to aim and adjust the sensor, while the other observes the wind direction displayed by the datalogger.

1. Establish a reference point on the horizon for True North.
2. Sighting down the instrument center line, aim the nose cone, or counterweight at True North. Display the input location or variable for wind direction using a hand-held keyboard display, PC, or palm.
3. Loosen the u-bolt on the CM220 or the set screws on the Nu-Rail that secure the base of the sensor to the crossarm. While holding the vane position, slowly rotate the sensor base until the datalogger indicates 0 degrees. Tighten the set screws.

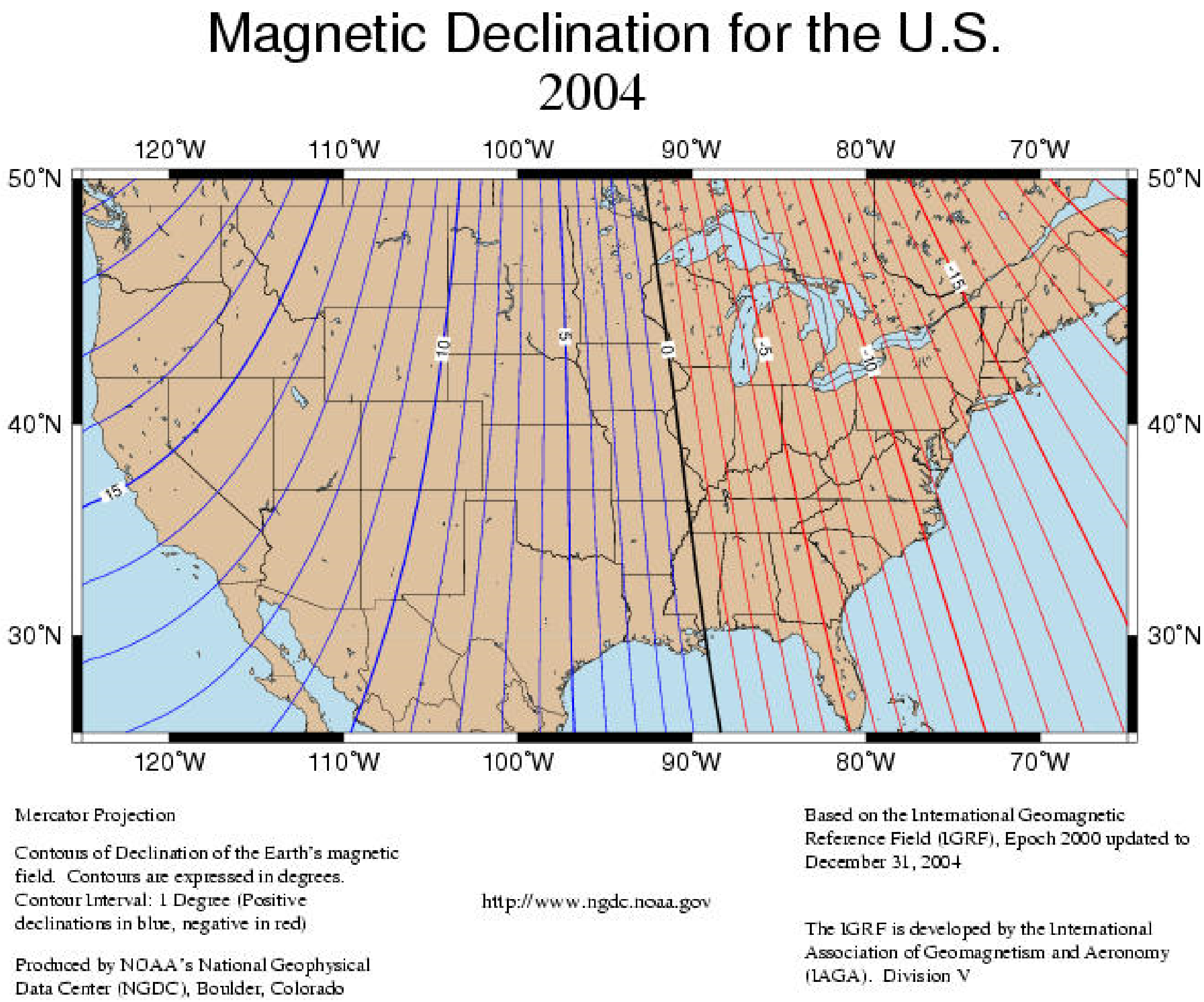


FIGURE A-1. Magnetic declination for the contiguous United States (2004)

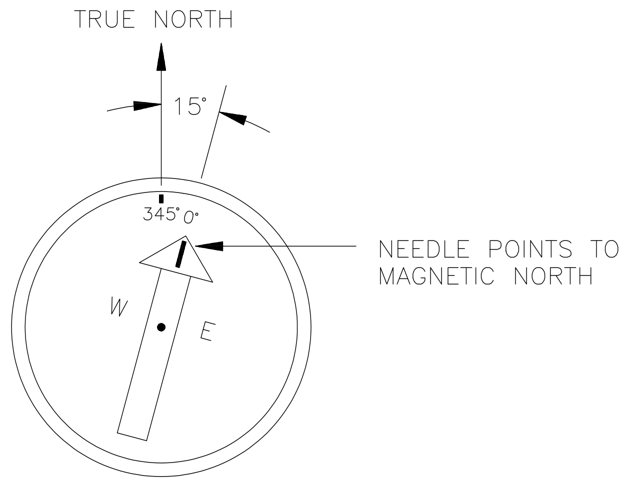


FIGURE A-2. Declination angles east of True North are subtracted from 0 to get True North

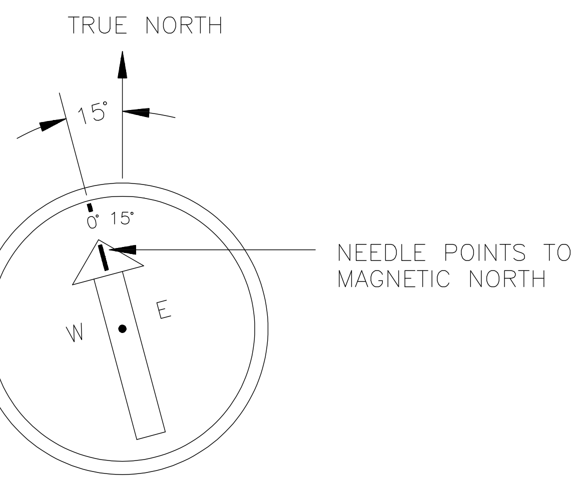


FIGURE A-3. Declination angles west of True North are added to 0 to get True North

Appendix B. Wind Direction Measurement Theory

It is not necessary to understand the concepts in this section for the general operation of the 034B Windset with Campbell Scientific's datalogger.

The 034B Windsets purchased from Campbell Scientific have a 9.53 kΩ fixed resistor and a variable resistor on the excitation line. The variable resistor is adjusted by the manufacturer so its resistance plus the 9.53 k resistor equals the resistance of the potentiometer ($R_f = R_s + R_t$).

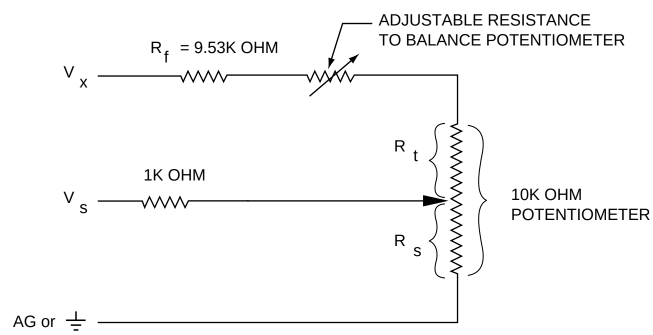


FIGURE B-4. 034B potentiometer in a half bridge circuit

The vanes are calibrated due south and then the potentiometer is adjusted until each half of the potentiometer has equal resistance.

Appendix C. Met One Instruments' 034B Operation Manual

This appendix contains a copy of Met One Instruments' 034B Operation Manual. Campbell Scientific cannot guarantee that the information contained in their manual is current. For the latest information, please refer to Met One Instruments' website (*www.metone.com*).

MODEL 034B
WIND SENSOR

OPERATION MANUAL
REV A

MET ONE INSTRUMENTS

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1.0 GENERAL INFORMATION

1.1 The Met One Instruments Model 034B Wind Sensor consists of a wind sped sensor and wind direction sensor. The wind speed sensor uses a three cup anemometer to produce a series of contact closures in a magnetic reed switch. The frequency of the closures is proportional to wind speed. The wind direction sensor uses a balanced anodized aluminum vane assembly that changes the value of a linear potentiometer as the wind direction changes. The output of the potentiometer is proportional to the wind direction. A 1K ohm resistor in series with the wiper provides protection against overload situations.

1.2 SPECIFICATIONS

Wind Speed		
	Range	0-100 MPH (0-175kph)
	Starting Threshold	0.9 mph
	Accuracy	
	Less than 22.7 mph	.25 mph
	Greater than 22.7 mph	+/-1.1% of true
Wind Direction		
	Range	Mechanical 0-360 Degrees Electrical 0-356 Degrees
	Starting Threshold	0.9 mph
	Accuracy	+/- 4 Degrees
	Damping Ratio	.25 Std. (.4 to .6 optional)
	Resolution	0.5 Degrees
Temperature Range		-30 Degrees C to +70 Degrees C
Weight		2 lb. 9 oz. With cable
Output signal		
	Wind Speed	Pulsed contact closure Maximum current 5mA
	Wind Direction	Potentiometer output (0-10K ohms) Maximum current 10mA Maximum open circuit voltage 28

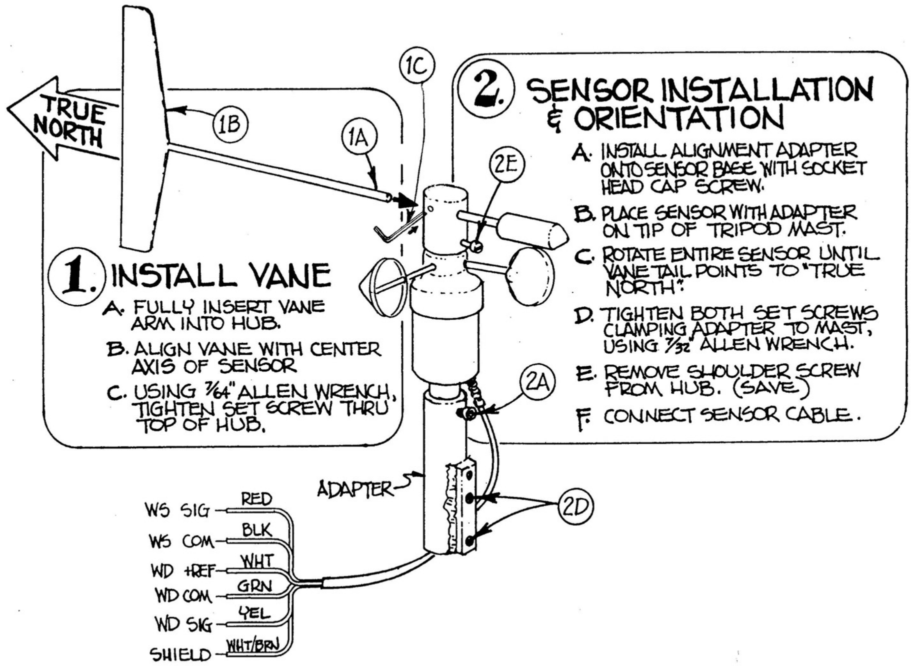

FIGURE 2-1
TYPICAL 034B WIND SENSOR INSTALLATION

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CAUTION
THE POTENTIOMETER HAS A SHORTING GAP WIPER. ANY VOLTAGE APPLIED TO THE SENSOR MUST BE CURRENT LIMITED TO 5 MILLIAMPS.

2.0 INSTALLATION (See FIGURE 2-1)

NOTE: Save all sensor packaging. During future maintenance, it will be very handy for supporting the sensor and avoiding handling damage. Also, use during shipment for recommended factory servicing.

2.1 INSTALL VANE

A. Insert the vane tail shaft into the hub. Make sure the shaft is fully seated at the bottom of its hole, which will replicate factory balance.
B. Rotate the vane so that H aligns with the axis of the sensor body.
C. Tighten the set screw using the 5/32" allen wrench (provided) to secure the vane tail in he hub.

2.2 SENSOR INSTALLATION & ORIENTATION

A. Install the sensor into the alignment adapter. The socket head screw will pass through the adapter and will tighten into the sensor housing.
B. Place the sensor with adapter onto tip of the tripod mast or in the fitting on the cross arm.
C. Rotate the entire sensor until the vane points to "TRUE NORTH". The use o f transit/compass will assure accurate alignment, when the magnetic correction to true has been established.
D. When the sensor is properly aligned, tighten the adapter ser screw using the 5/32" allen wrench. By removing the socket head screw in the adapter, the sensor may be removed and replaced without realignment.
E. Remove and retain the shoulder screw from the vane hub. Check to see that the vane assembly rotates freely.
F. Connect the cable to the sensor. Route the cable to the data recording device. Secure the cable with cable ties or tape. The cable assembly contains 5 wires. Typical wiring hookup is shown in FIGUREW 2-1.

2.3 LIGHTNING PROTECTION

Weather sensors are sensitive to direct or nearby lightning strikes. A well-grounded metal rod or frame should be placed above the sensor installation. In addition, the shield on the signal cable leading to the translator must be connected to a good earth ground at the translator end. The cable route should not be vulnerable to lightning.

3.0 OPERATIONAL CHECK-OUT AND CALIBRATION

3.1 Wind Speed and Direction Sensor Check-Out

A. Rotating the vane in a clockwise direction as viewed from above will increase the output up to the 360 Degree point and it will start over at 0 Degree.

B. Spinning the anemometer cup assembly will produce a series of pulses. To verify sensor output, monitor this signal with either a translator module, data logger or an ohmmeter. Refer to Frequency vs. Wind Speed Table 3-1. Spin slowly and monitor output signal. A wind speed calibrator may be used to check operation at different RPM points. The vane and counter weight must both removed for connection to the calibrator motor drive.

C. The 034B wind sensor should be inspected periodically for physical damage to the vane assembly and cable connections. Inspect all vane assembly parts for security and damage. Inspect the cup assembly for loose cup arms or other damage. The cup assembly cannot change calibration unless a mechanical part has loosened or has been bent or broken.

TABLE 3-1

MODEL 034B WIND SPEED SENSOR CALIBRATION

WIND VELOCITY VS
OUTPUT FREQUENCY

SPEED IN MILES/HR

V MPH	RPS	F HZ
10	2.622	5.24
20	5.42	10.84
30	8.22	16.44
40	11.02	22.03
50	13.81	27.63
60	16.61	33.22
70	19.41	38.82
80	22.21	44.42
90	25.01	50.01
100	27.80	55.61
110	30.60	61.20
120	33.40	66.80

SPEED IN METERS PER SECOND

V MPS	RPS	F HZ
2.5	1.39	2.78
5	2.95	5.91
7.5	4.52	9.04
10	6.08	12.17
12.5	7.65	15.30
15	9.21	18.43
17.5	10.78	21.56
20	12.34	24.69
22.5	13.91	27.81
25	15.47	30.94
27.5	17.04	34.07
30	18.60	37.20
32.5	20.17	40.33
35	21.73	43.46
37.5	23.30	46.59
40	24.86	49.72
42.5	26.43	52.85
45	27.99	55.98
47.5	29.55	59.11
50	31.12	62.24
52.5	32.68	65.37
55	34.25	68.50
57.5	35.81	71.63
60	37.38	74.76

RPM VS WIND SPEED

RPM VS WIND SPEED			
RPM	MPS	MPH	F HZ
100	2.94	6.58	3.33
200	5.61	12.54	6.67
300	8.27	18.50	10.00
400	10.93	24.45	13.33
500	13.60	30.41	16.67
600	16.26	36.37	20.00
700	18.92	42.32	23.33
800	21.59	48.28	26.67
900	24.25	54.24	30.00
1000	26.91	60.19	33.33
1100	29.58	66.15	36.67
1200	32.24	72.11	40.00
1300	34.90	78.06	43.33
1400	37.56	84.02	46.67
1500	40.23	89.98	50.00
1600	42.89	95.93	53.33
1700	45.55	101.89	56.67
1800	48.22	107.85	60.00

CALIBRATION EQUATIONS

$$V\ mph = \frac{RPM}{16.787} + 0.63$$

$$V\ mps = \frac{RPM}{37.547} + 0.28$$

$$V\ mph = \frac{FHZ}{0.5596} + 0.63$$

$$V\ mps = \frac{FHZ}{1.2517} + 0.28$$

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4.0 MAINTENANCE AND TROUBLESHOOTING

4.1 General Maintenance Schedule

6-12 month intervals:

A. Inspect the sensor for proper operation per Section 3.0

B. Replacement of Wind Speed Sensor bearing in extremely adverse environments.

12-24 month intervals:

A. Replacement of Wind Speed Sensor bearings.

24-36 month intervals:

A. Recommended complete factory overhaul of sensor.

*Schedule is based on average to adverse environments.

TABLE 4.1

TROUBLESHOOTING TABLE

Symptom	Probable Cause	Remedy
No WS Sensor output	Faulty bearings	Replace bearings (REF. 4.2)
No WD Sensor output	Faulty pot assy	Replace pot assy. (REF 4.3)
No WS Sensor output	Faulty reed switch	Replace reed switch (REF 4.4)
No WS or WD output	Faulty cable	Check cable and connections

Wind speed bearing replacement

A. Refer to Figure 4-1. Remove sensor housing damping screw (Item 1). Slide the sensor housing (Item 6) open 1 ½ to 2", exposing the terminal block (Item 8) .

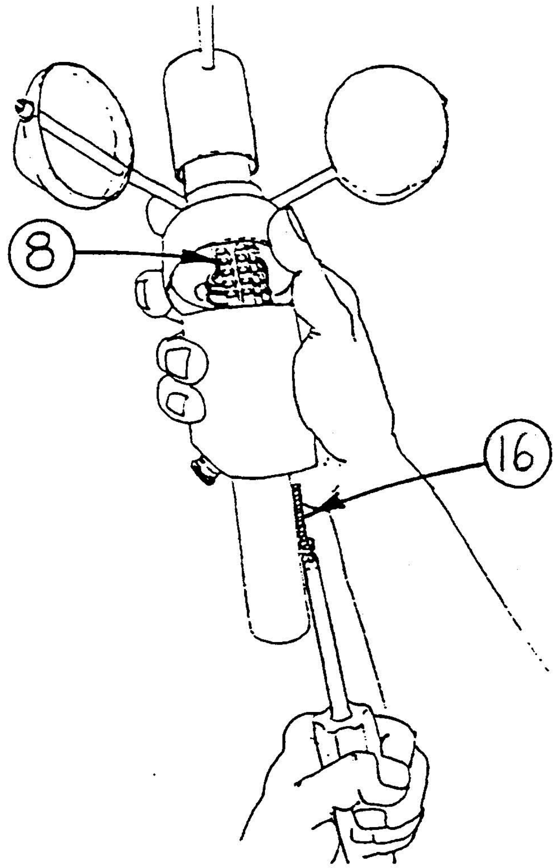


FIGURE 4-1
INTERNAL ACCESS

B. Refer to figure 4-2. With small common screw driver, loosen the three wire contacts of the white, green, & yellow wires going to Pot. Gently pull the wires free from the terminal block and straighten them enough to allow easy passage through the stem on the top of sensor.

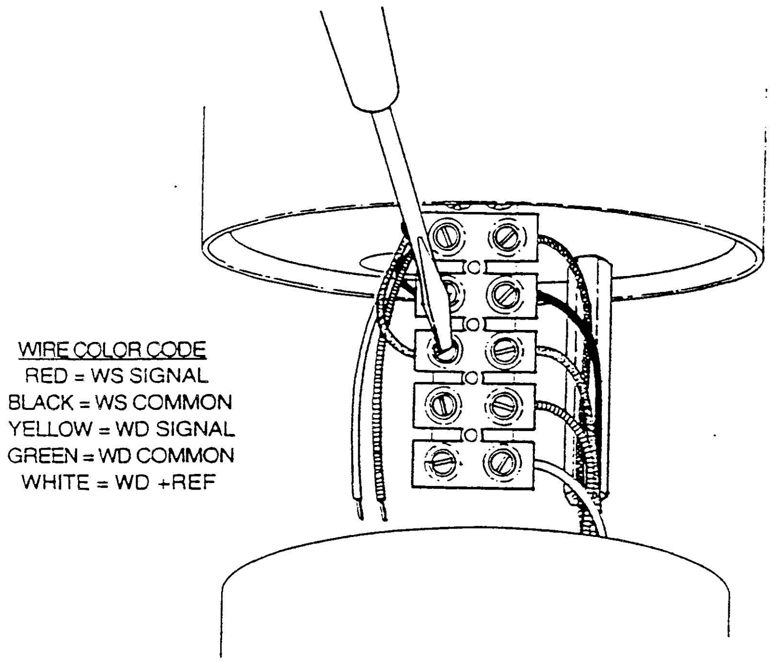


FIGURE 4-2
TERMINAL BLOCK

C. Slide sensor housing (Item 6) closed. A notch in the tip rim of the sensor housing must engage with the "South" pin located on the outer edge of the Top Plate Assembly (Item 3) to allow proper closure. Install the screw (Item 21).

D. Refer to Figure 4-3. To facilitate maintenance and to minimize the risk of damage, support the sensor upright in the foam packing as shipped or some other method.

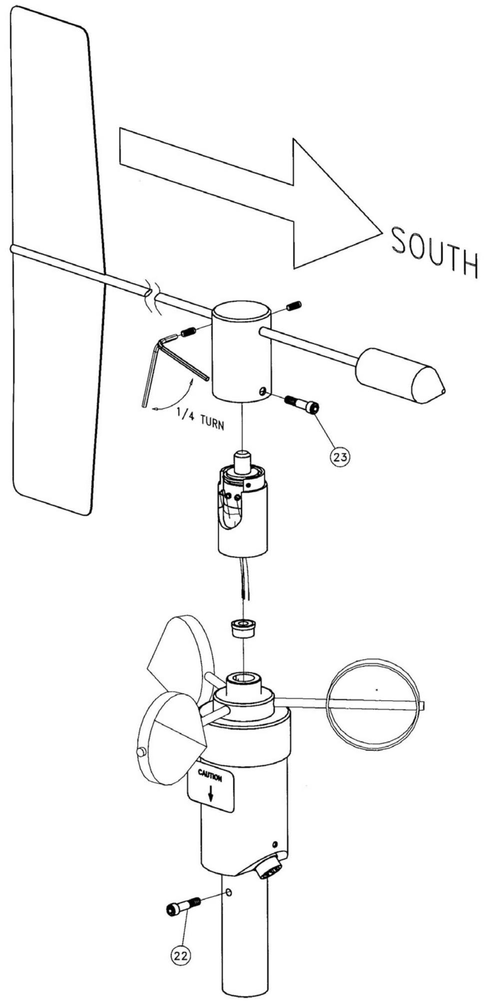


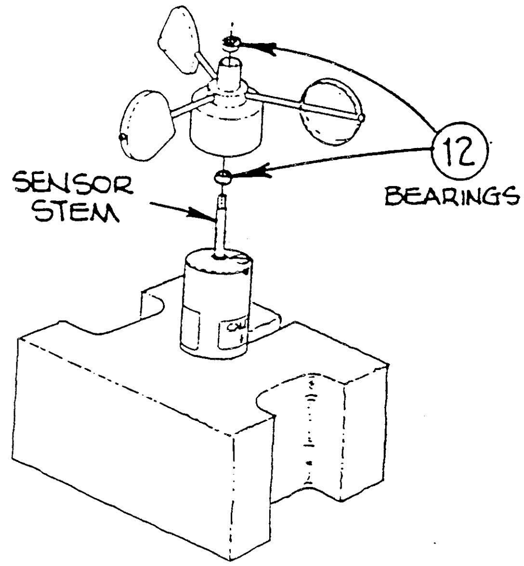
FIGURE 4-3

"SOUTH" ORIENTATION

E. Remove the shoulder screw (Item 23).
F. With the 5/64" allen wrench (Item 38). Loosen by only a ¼turn, the set screw located in the side of the wind vane hub. The ¼turn loosening will enable easier alignment of the pot/mount assembly during the re-assembly process.

G. Carefully remove entire vane/potentiometer assembly from body of sensor. Use care to avoid snags when withdrawing the wires from the top stem.

CUP ASSEMBLY AND BEARINGS



H. Refer to Figure 4-4. Remove cup assembly (Item 2). Remove the old bearings. Clean areas of bearing contact using a cotton swab and alcohol.

CAUTION: DO NOT LUBRICATE FO FORCE BEARINGS

I. Install new bearings (Item 12) and cup assembly (Item 2) onto stem.

NOTE: If potentiometer needs replacement, now refer to Section 4-3.
NOTE: If reed switch needs replacement, now refer to Section 4-4.

j. Refer to Figure 4-2. Feed Pot/Mount Assembly wires into center hold in sensor stem. Note the location of the flat on the sensor stem as re-alignment of the Pot/Mount Assembly is critical to re-establish factory calibration.

K. Seat the unit onto the sensor stem and slowly tighten the set screw as you feel that the flat alignment has been accomplished.

L. Spin the Cup Assembly (Item 2) to check for freedom of rotation. There should be a small amount of up and down play (Approximately .010").

M. Re-open sensor body, connect pot wires in terminal block, matching wire colors. Refer to Figure 4-2.

N. Prior to final closure of sensor body, inspect inside. Ensure that wires are routed as to prevent pinching or over-straining. Make sure wires do not get between spacer (Item 24) and interior of sensor body. Close sensor and secure with screw (Item 21).

O. Unit is now ready for service

Wind Direction Potentiometer Replacement

A. Follow Steps A through G in Section 4.2

B. Remove Shoulder Screw (Item 23). Loosen (1) set screw (Item 36) in upper side of vane hub.

C. Remove entire Vane Assembly (Item 1) from Pot/Mount Assembly (Item 4).

D. Follow Steps I through N in Section 4.2 to install new Pot/Mount Assembly.

E. Slip Vane Hub onto pot shaft and adaptor, aligning the flat with the set screw in the upper side of the vane hub. Tighten the set screw. Align hole in Pot Mount Assembly (Item4) with hole in skirt of vane hub. Install Shoulder Screw (Item 23).

F. Refer to Figure 4-5. Connect an ohmmeter to pins 3 and 4 of the cable connector (Item 9) mounted on the lower side of the sensor housing.

G. The resistance measured across pins 3 and 4 should be approximately equal to the resistance measured across pins 3 and 5 (approx. 6k ohms).

H. Remove shoulder screw. Rotate vane assembly clockwise ¼turn as viewed from above. Check that the resistance between pins 3 and 4 is 8.5k ohms

I. Unit is now ready for service.

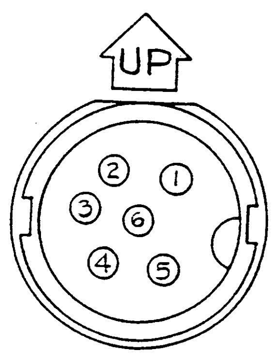


FIGURE 4-5
SENSOR CONNECTOR PIN LAYOUT

Wind Speed Reed Switch Cartridge Replacement

A. Follow Steps A through H in Section 4-2.
B. Open the sensor housing.
C. From the terminal block (Item 8), disconnect the black and red wires coming from the Reed Switch Cartridge (Item 35).
D. Push switch cartridge out of its seat. Clean off any old sealant from the Top Plate Assembly (Item 3).
E. Refer to Figure 4-6. Apply a small bead of RTV silicone sealant under cartridge flange. Noting proper orientation, push into hole.
F. Wipe away excess sealant. Allow for overnight curing before reassembly.
G. Using care to avoid stressing switch leads while routing, connect the switch wires in the terminal strip. Match wire colors with sensor connector harness. Refer to Figure 4-2.
H. Follow steps I through O in Section 4.2.

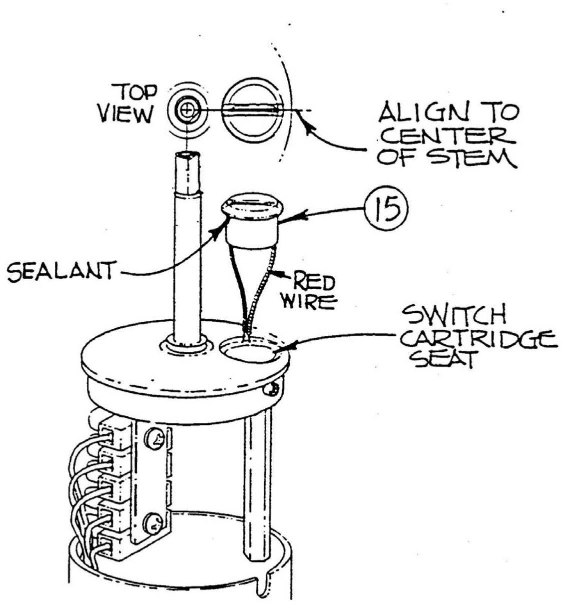
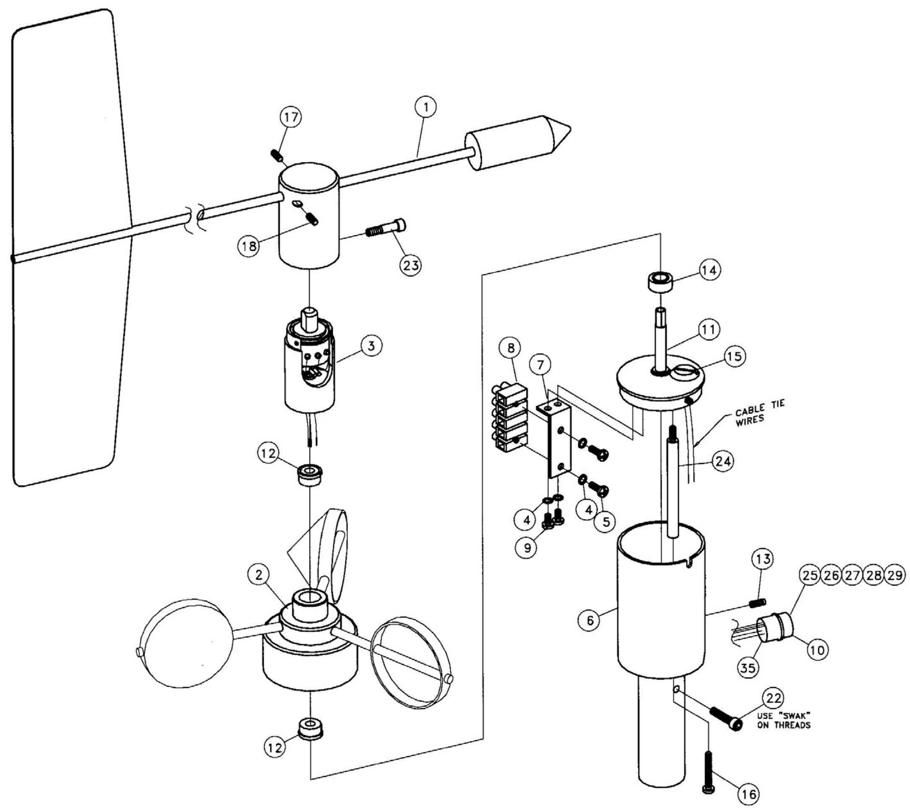


FIGURE 4-6
REED SWITCH CARTRIDGE ORIENTATION

REPLACEMENT PARTS LIST (REFER TO FIGURE 4-7)

ITEM NO.	PART NO.	DESCRIPTION
1	3387	VANE ASSEMBLY
2	3376	CUP ASSEMBLY
3	3786	POT MOUNT ASSEMBLY
4	602340	WASHER, SPLIT, #6
5	601480	SCREW,PAN HD, 6/32 X ¼
6	3019	SENSOR HOUSING MOUNT
7	3092	BRACKET, TERMINAL BLOCK
8	340021	TERMINAL STRIP 5 POSITUION
9	601550	SCREW, 6-32, x 3/8, PAN HD
10	3014	CONNECTOR, MODIFIED
11	3369	TOP PLATE STEM ASSEMBLY
12	1898	BEARING
13	601254	SET SCREW, 4-40 x 3/16, CUP PT.
14	3366	SPACER SLEEVE
15	6838	REED SWITCH ASSY
16	601580	SCREW, 6-32x5/8 PAN HD
17	601645	SET SCREW, 8-32 x 3/8, BRASS TIP
18	601650	SET SCREW, 8-32 x 3/16
19		
20		
21		
22	601850	SCREW, 10/32 x 5/8 SOC CAP
23	860015	SHOULDER SCREW
24	3368	SPACER, BRASS
25	980-445	WIRE, 22 AWG, BLACK
26	980465	WIRE, 22 AWG, GREEN
27	980480	WIRE, 22 AWG, RED
28	980490	WIRE, 22 AWG, WHITE
29	980495	WIRE, 22 AWG, YELLOW
30	993000	ALLEN WRENCH 5/64

FIGURE 4-7
EXPLODED PARTS VIEW OF 034B



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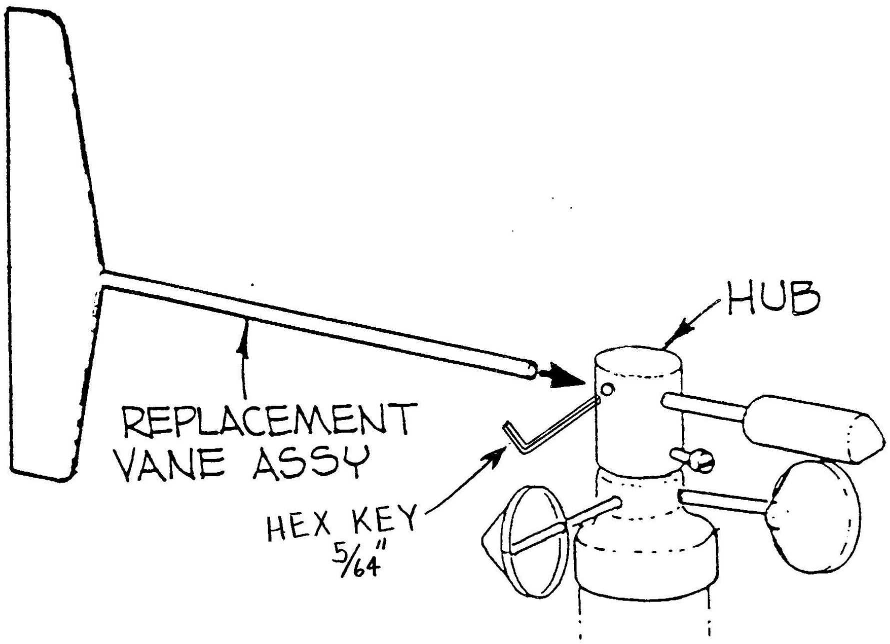
Vane Assembly Replacement and Balance Procedure

Vanes and counterweight are matched and balanced at the factory, but if customer vane replacement is preformed, the balance of the assembly must be verified prior to returning the sensor to service.

1. Install replacement vane...

   A. Insert the vane tail shaft into the hub. Make sure the shaft is fully seated at the bottom of its hole.

   B. Rotate vane to align with axis to sensor body and tighten set screw to secure vane assembly.



2. To prove proper vane assembly balance...

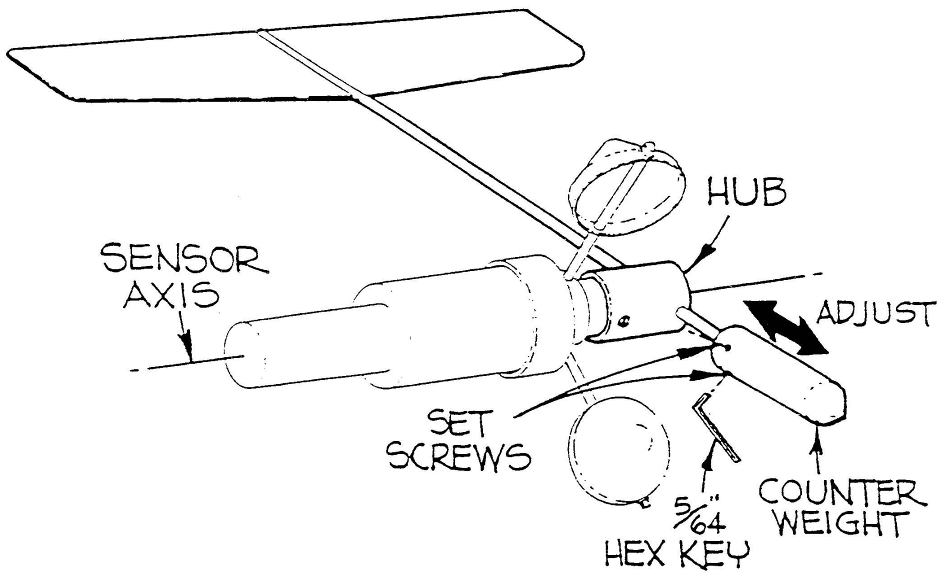
A. Hold or clamp sensor so that its axis is horizontal. Make sure the orientation shoulder is removed from the hub.

B. Rotate the vane shaft to level and gently releases. If vane and counterweight remain level, assembly is already in proper balance and no further adjustment is required.

C. If balancing is required, loosen both counterweight set screws (using a 5/64" hex key) and move the counterweight on the shaft as required to establish balance. Do NOT remove the shaft from the hub.

NOTE: Position the counterweight on the stem so that the set screw holes face towards the sensor base. This will prevent moisture from collecting in the screw holes during sensor operation.

D. Tighten the set screws and recheck balance. Readjust and required, return the sensor to service.



WARRANTY

SERVICE

Campbell Scientific Companies

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com • info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za • cleroux@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 8108
Garbutt Post Shop QLD 4814
AUSTRALIA
www.campbellsci.com.au • info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br • suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca • dataloggers@campbellsci.ca

Campbell Scientific Centro Caribe S.A. (CSCC)
300 N Cementerio, Edificio Breller
Santo Domingo, Heredia 40305
COSTA RICA
www.campbellsci.cc • info@campbellsci.cc

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk • sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
3 Avenue de la Division Leclerc
92160 ANTONY
FRANCE
www.campbellsci.fr • info@campbellsci.fr

Campbell Scientific Spain, S. L.
Avda. Pompeu Fabra 7-9, local 1
08024 Barcelona
SPAIN
www.campbellsci.es • info@campbellsci.es

Please visit www.campbellsci.com to obtain contact information for your local US or international representative.