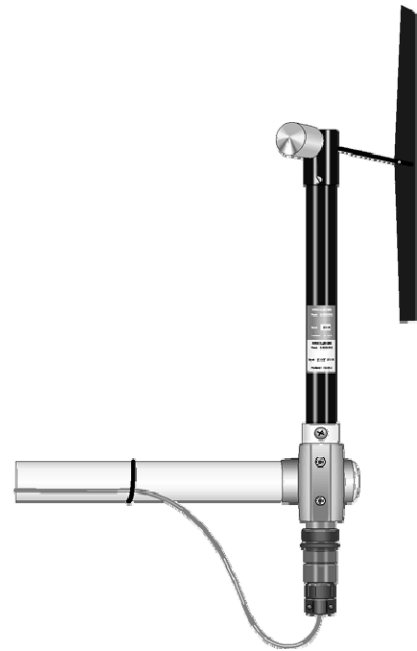


INSTRUCTION MANUAL



Model 024A Met One Wind Direction Sensor

Revision: 3/09



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PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. (CSI) primarily for the US market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area: 1 in² (square inch) = 645 mm²

Length: 1 in. (inch) = 25.4 mm
1 ft (foot) = 304.8 mm
1 yard = 0.914 m
1 mile = 1.609 km

Mass: 1 oz. (ounce) = 28.35 g
1 lb (pound weight) = 0.454 kg

Pressure: 1 psi (lb/in²) = 68.95 mb

Volume: 1 US gallon = 3.785 litres

In addition, part ordering numbers may vary. For example, the CABLE5CBL is a CSI part number and known as a FIN5COND at Campbell Scientific Canada (CSC). CSC Technical Support will be pleased to assist with any questions.

WARRANTY AND ASSISTANCE

This equipment is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. ("CSC") to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. ***** **Batteries are not warranted.** ***** CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

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Non-warranty products returned for repair should be accompanied by a purchase order to cover repair costs.



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024A Met-One Wind Direction Sensor

1. Function

The Met-One 024A Wind Vane measures wind direction from 0 to 360 degrees with a 5 degree accuracy specification. The 024A utilizes a potentiometer to vary the sensor resistance in relation to wind direction.

Lead length for the 024A is specified when the sensor is ordered. Table 1-1 gives the recommended lead length for mounting the sensor at the top of a tripod/tower via a CM202 or 019ALU crossarm.

TABLE 1-1. Recommended Lead Lengths							
CM6	CM10	CM110	CM115	CM120	UT10	UT20	UT30
11'	14'	14'	19'	24'	14'	24'	37'

2. Specifications

Range	0 to 360 degrees
Threshold	0.447 m/s (1.0 mph)
Accuracy	±5 degrees
Temperature Range	-50°C to +70°C
Delay Distance	Less than 1.5 m (5 ft.)
Damping Ratio	
Standard	0.25
Optional	0.4
Potentiometer Specifications	
Sand, Dust, and Fungus	MIL-E-5272
Salt Spray	MIL-E-12934
Resistance	0-10,000 Ohms
Weight	450 g (1 lb.)
Dimensions	
Overall height	13.3" (33.8 cm)
Overall length	17.6" (44.7 cm)
Tail height	12" (30.5 cm)
Tail Width	3" (7.6 cm)

3. Installation

3.1 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 7 for a list of references that discuss siting wind direction sensors.

3.2 Assembly and Mounting

Remove the Allen hex screw in the lower part of the sensor housing and insert the 024A in the mounting bushing (see Figure 3-1). Tighten the screw in the bushing onto the sensor housing.

Mount the crossarm to the tripod or tower. Orient the crossarm North-South, with the CM220 mount or 17953 1" x 1" NU-RAIL fitting on the North end. Insert the sensor in the CM220 or NU-RAIL fitting. Align the sensor so that the counter weight points to true South and tighten the u-bolts on the CM220 or tighten the set screws on the NU-RAIL fitting.

NOTE

Appendix A contains detailed information on determining and using a compass and the magnetic declination for the site.

Connect the cable assembly to the sensor receptacle.

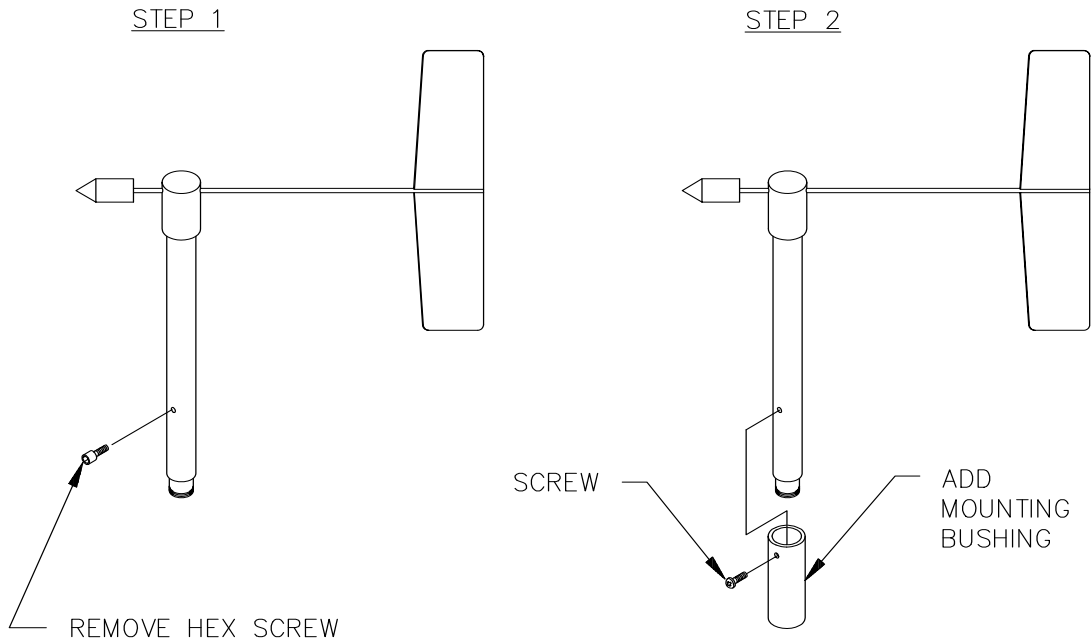


FIGURE 3-1. Bushing Installation on 024A Sensor

4. Wiring

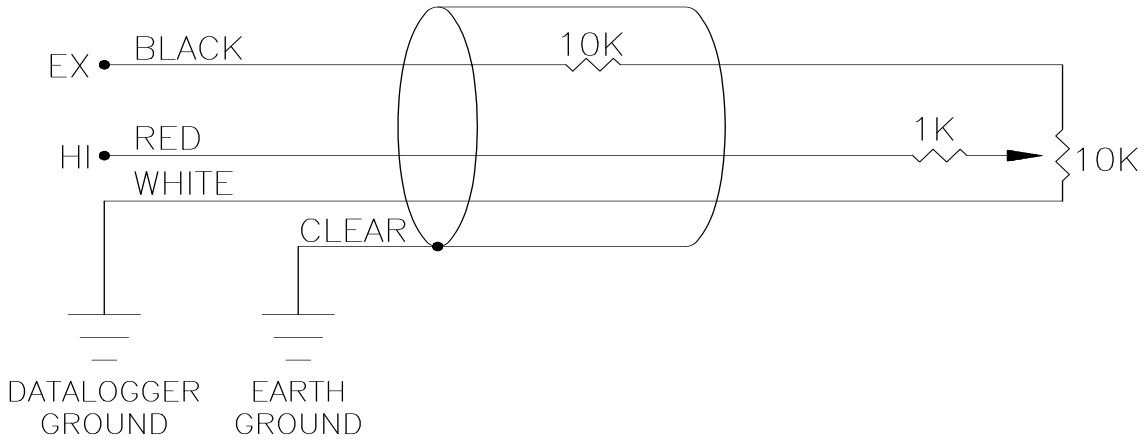


FIGURE 4-1. Schematic of 024A Wind Direction Sensor

Figure 4-1, Figure 6-1, and Table 4-1 shows wiring. 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 4-1. Connections to Campbell Scientific Dataloggers

		CR800 CR5000 CR3000 CR1000	CR510 CR500 CR10(X)	21X CR7 CR23X	CR200
Color	Description				
Red	Wind Dir. Signal	SE Analog	SE Analog	SE Analog	SE Analog
Black	Wind Dir. Excitation	Excitation	Excitation	Excitation	Excitation
White	Wind Dir. Reference	⏏	AG	⏏	⏏
Clear	Wind Dir. Shield	⏏	G	⏏	⏏

5. Programming

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

5.1 Datalogger Instruction

The datalogger instruction that measures the 024A is datalogger dependent. The BRHalf measurement instruction is used for our CR800, CR850, CR1000, CR3000, and CR5000 dataloggers. Our CR200-series dataloggers use the EX-DEL_SE. Our Edlog dataloggers (e.g., CR510, CR10(X), CR23X) use

Instruction 4 – Excite, Delay, Measure. Excitation voltages, range codes, and delays for CSI dataloggers are listed in Table 5-1. The process for determining the correct multiplier is provided in Section 5.2.

TABLE 5-1. Parameters for Wind Direction

	CR200	CR10(X), CR510	CR7, 21X, CR23X	CR800, CR850, CR1000	CR5000, CR3000
Measurement Range	2500 mV	250 mV, fast	500 mV, fast	2500 mV, 250 microsecond integration, reverse excitation	5000 mV, 250 microsecond integration, reverse excitation
Excitation Voltage	2500 mV	500 mV	1000 mV	2500 mV	5000 mV
Delay or Settling Time	2 ms	2 ms	2 ms	2 ms	2 ms
Multiplier	See Section 5.2	See Section 5.2	See Section 5.2	See Section 5.2	See Section 5.2
Offset	0	0	0	0	0

5.2 Calibration and Orientation

Conversion of the voltage output into wind direction is done by entering the proper multiplier. The proper multiplier is calculated by dividing 360 by the full scale input voltage (i.e., 360/FSIV). The full scale input voltage (FSIV) is the maximum voltage output from the wind vane. This is found by creating a datalogger program with a multiplier of 1, the default excitation, and a fast scan interval. With a multiplier of 1, the value stored in the variable or input location is simply the voltage output. Slowly turn the wind vane; the shoulder screw must first be removed. The maximum value observed is the full scale input voltage (FSIV).

NOTE

If the reading is -99999, exceeds 500 on the 21X or CR7, or exceeds 250 on the CR10, then reduce the millivolts of excitation by 5 mV.

Multiplier 360/FSIV*
 Offset 0.0

*FSIV = Full scale input voltage

Enter the calculated multiplier in the program.

Orientation of the 024A Wind Direction Sensor should be complete if the 024A counter weight was aligned due south.

5.3 Example Programs

NOTE

For these examples, the multiplier is listed as 1. The multiplier is unique to individual devices. Follow the procedure provided in Section 5.2 to acquire the correct multiplier for your sensor.

```
'CR200 Series
'Created by Short Cut (2.5)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table2,True,-1)
    DataInterval(0,1440,Min)
    Minimum(1,Batt_Volt,False,False)
EndTable

'Main Program
BeginProg
    Scan(10,Sec)
        'Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        '024A Wind Direction Sensor measurement WindDir:
        ExDeISe(WindDir,1,1,1,2500,2000,1.0,0)
        NewMult=360/WindDir
        'Call Data Tables and Store Data
        CallTable(Table2)
    NextScan
EndProg
```

```
'CR1000
'Created by Short Cut (2.5 Beta)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,60,Min,10)
    Sample(1,WindDir,FP2)
EndTable

DataTable(Table2,True,-1)
    DataInterval(0,1440,Min,10)
    Minimum(1,Batt_Volt,FP2,False,False)
EndTable

'Main Program
BeginProg
    Scan(5,Sec,1,0)
        'Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        '024A Wind Direction Sensor measurement WindDir:
        BrHalf(WindDir,1,mV2500,1,1,1,2500,True,2000,250,1.0,0)
        NewMult=360/WindDir
        'Call Data Tables and Store Data
        CallTable(Table1)
        CallTable(Table2)
    NextScan
EndProg
```

```
'CR3000
'Created by Short Cut (2.5)

'Declare Variables and Units
Public Batt_Volt
Public WindDir
Public NewMult

Units Batt_Volt=Volts
Units WindDir=degrees

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,60,Min,10)
    Sample(1,WindDir,FP2)
EndTable
```

```

DataTable(Table2,True,-1)
  DataInterval(0,1440,Min,10)
  Minimum(1,Batt_Volt,FP2,False,False)
EndTable

'Main Program
BeginProg
  Scan(5,Sec,1,0)
  'Default Datalogger Battery Voltage measurement Batt_Volt:
  Battery(Batt_Volt)
  '024A Wind Direction Sensor measurement WindDir:
  BrHalf(WindDir,1,mV5000,1,1,1,5000,True,2000,250,1.0,0)
  NewMult=360/WindDir
  'Call Data Tables and Store Data
  CallTable(Table1)
  CallTable(Table2)
  NextScan
EndProg

```

```

;{CR10X}
;
*Table 1 Program
  01: 10      Execution Interval (seconds)

;Measure sensor. Multiplier is unique to individual devices.
1: Excite-Delay (SE) (P4)
  1: 1      Reps
  2: 14     250 mV Fast Range
  3: 1      SE Channel
  4: 1      Excite all reps w/Exchan 1
  5: 2      Delay (0.01 sec units)
  6: 500    mV Excitation
  7: 1      Loc [ wind_dir ]
  8: 1.0    Multiplier
  9: 0.0    Offset

;Store measurements in final storage
2: If time is (P92)
  1: 0000   Minutes (Seconds --) into a
  2: 60     Interval (same units as above)
  3: 10     Set Output Flag High (Flag 0)

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

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

5: Sample (P70)
  1: 1      Reps
  2: 1      Loc [ wind_dir ]

```

6. General Maintenance Schedule

6.1 6 to 12 Month Periodic Service *

Inspect sensor for physical damage and verify that the vane assembly rotates freely. To verify parts and locations, refer to the parts diagram (Figure 6-2) and the parts list (Table 6-1).

6.2 24 to 36 Month Service *

A complete factory overhaul of the sensor, including the replacement of the potentiometer, is recommended. Contact Campbell Scientific and get a Return Materials number (RMA) before sending it to Campbell Scientific.

* Schedule is based on average to adverse environments.

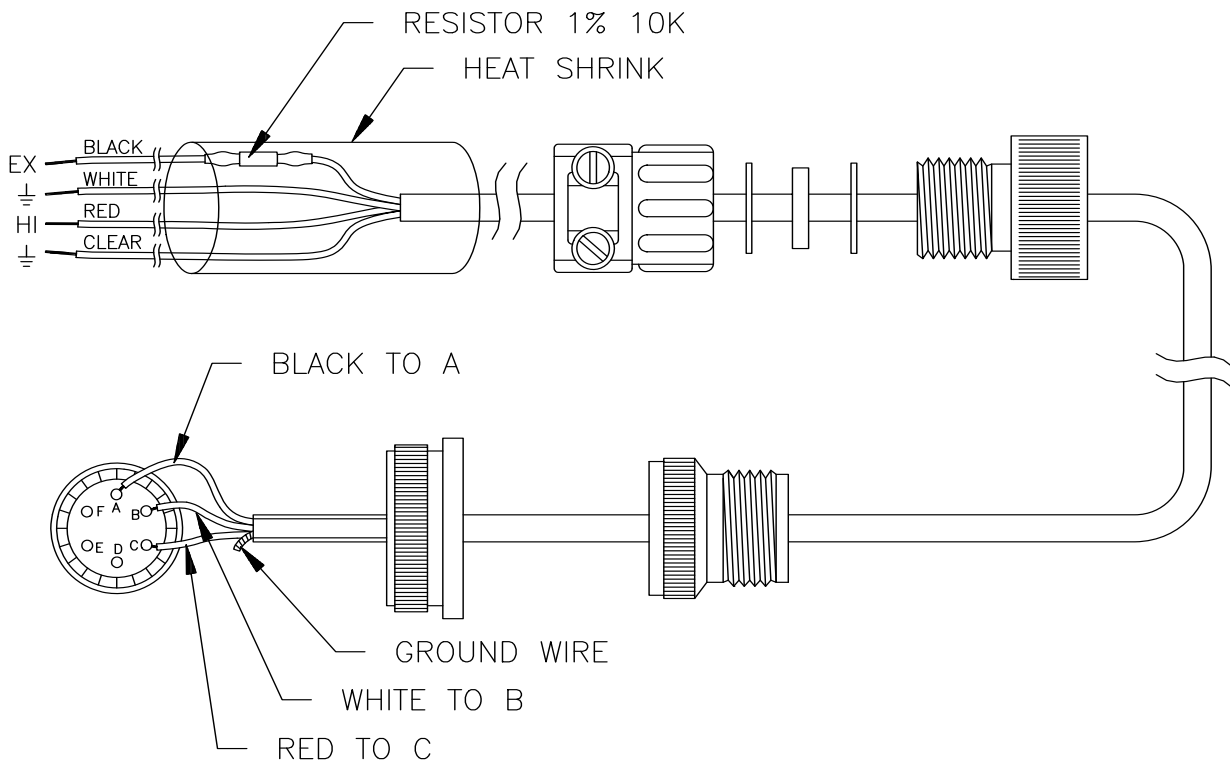


FIGURE 6-1. Cable Diagram

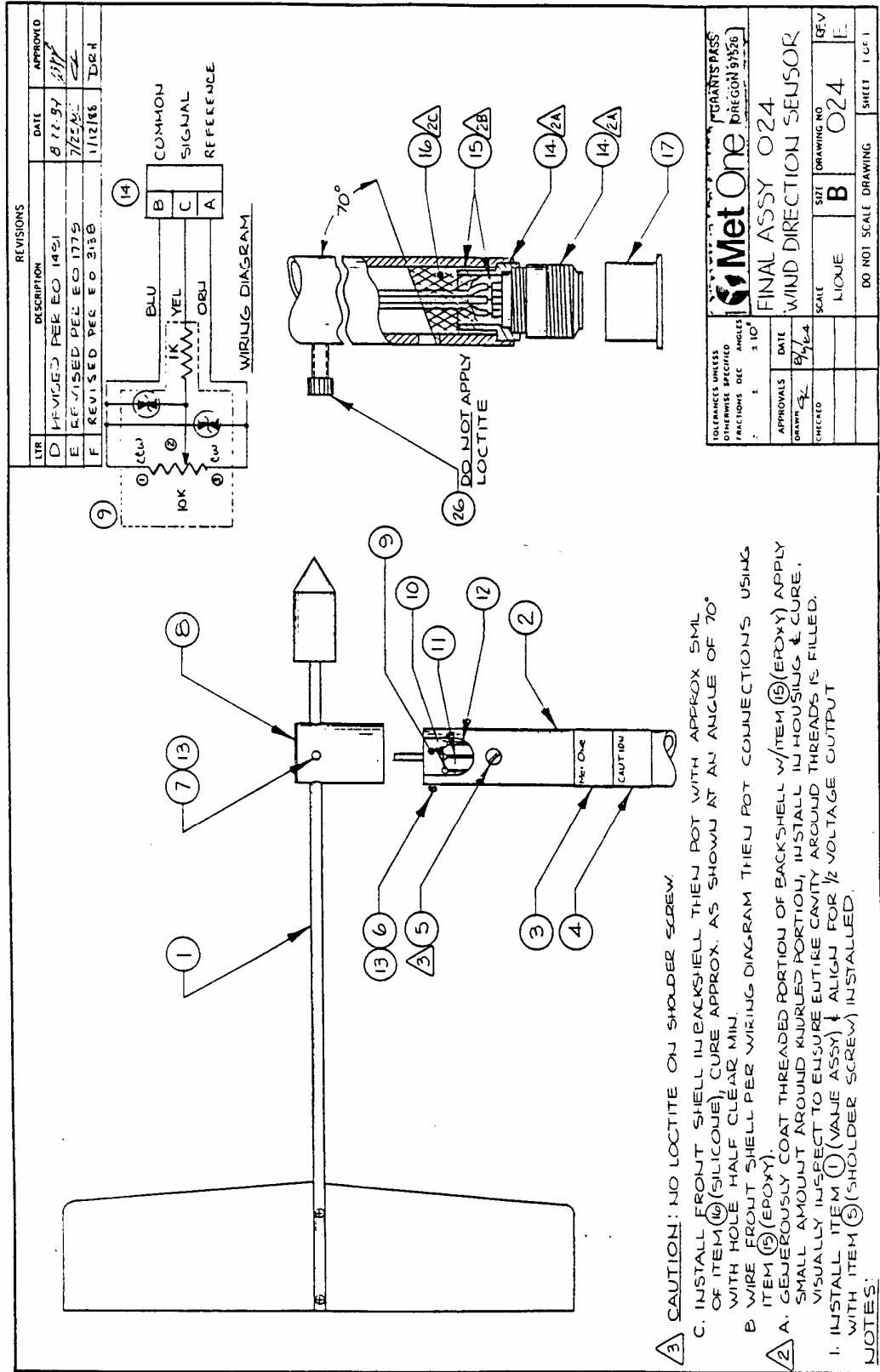


FIGURE 6-2. Parts Diagram

TABLE 6-1. Met-One Parts List Reproduced by Campbell Scientific, Inc.			
Item	Part No.	Description.	Qty./Assy
1	102105	Vane Assembly	1
2	101685-1	Wind Dir. Support	1
3	101049-2	Label, Wind Dir.	1
4	101789	Label, Caution	1
5	860015	Screw, Shoulder	1
6	601100	Screw, Pan Hd Ph, 2-56x3/16	3
7	601680	Scrw, Set A/H, 8-32x3/8	2
8	101687	Label, Met-One	1
9	102017	Assy, Potentiometer	1
10	980495	Wire, 22Ga, Yel	1
11	980450	Wire, 22Ga, Blu	1
12	980475	Wire, 22Ga, Orn	1
13	995425	Loctite 222	A/R
14	500280	Connector, 6 Pin	1
15	995100	Adhesive, Epoxy	A/R
16	995060	Adhesive, Silicone	5ml
17	510020	Cap	1
18			
19			
20			
21	101806	Assembly, Cable	Ref
22	101699	Assy Instructions	Ref
23	101706	014 & 024 Installation	Ref
24	101697	Wir. Diagram	Ref
25			
26	601850	Scrw, Cap A/H SS 10-32x5/8	1

7. 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. Magnetic declination for a specific site can be obtained from a USGS map, local airport, or through a computer service offered by the USGS at www.ngdc.noaa.gov/seg/geomag/. 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 0 degrees to get True North as shown Figure A-2. 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. For example, the declination for Logan, Utah is 14° East. True North is $360^{\circ} - 14^{\circ}$, or 346° as read on a compass.

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.

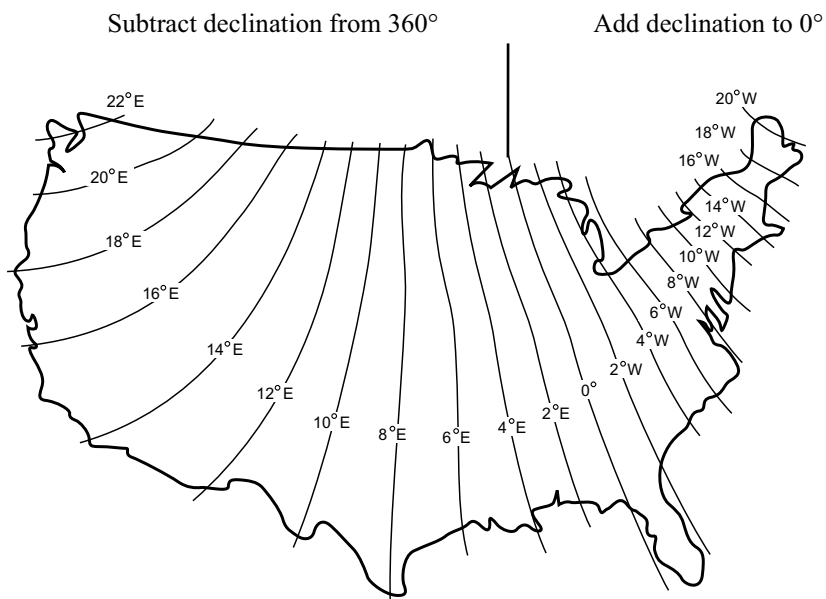


FIGURE A-1. Magnetic Declination for the Contiguous United States

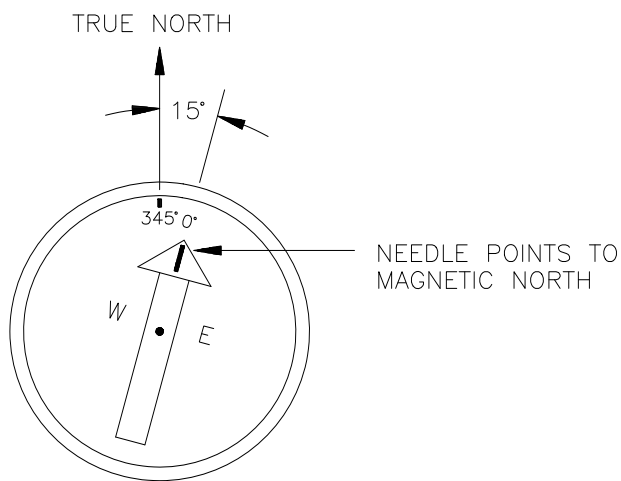


FIGURE A-2. Declination Angles East of True North Are Subtracted From 0 to Get True North

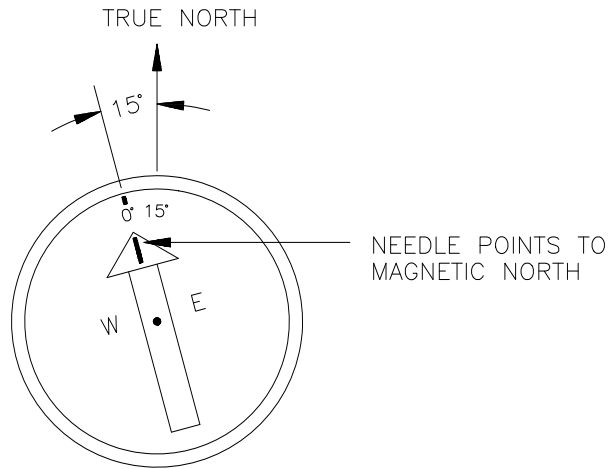


FIGURE A-3. Declination Angles West of True North Are Added to 0 to Get True North

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