INSTRUCTION MANUAL

27106T Gill Propeller Anemometer

Revision: 2/11

Warranty and Assistance

The **27106T GILL PROPELLER ANEMOMETER** is warranted by Campbell Scientific, Inc. 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 have no warranty. Campbell Scientific, Inc.'s obligation under this warranty is limited to repairing or replacing (at Campbell Scientific, Inc.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to Campbell Scientific, Inc. Campbell Scientific, Inc. will return such products by surface carrier prepaid. This warranty shall not apply to any Campbell Scientific, Inc. 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. Campbell Scientific, Inc. is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. The following contact information is for US and International customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit www.campbellsci.com to determine which Campbell Scientific company serves your country.

To obtain a Returned Materials Authorization (RMA), contact Campbell Scientific, Inc., phone (435) 753-2342. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. Campbell Scientific's shipping address is:

CAMPBELL SCIENTIFIC, INC.
RMA#_____
815 West 1800 North
Logan, Utah 84321-1784

For all returns, the customer must fill out a "Declaration of Hazardous Material and Decontamination" form and comply with the requirements specified in it. The form is available from our website at www.campbellsci.com/repair. A completed form must be either emailed to repair@campbellsci.com or faxed to 435-750-9579. Campbell Scientific will not process any returns until we receive this form. If the form is not received within three days of product receipt or is incomplete, the product will be returned to the customer at the customer's expense. Campbell Scientific reserves the right to refuse service on products that were exposed to contaminants that may cause health or safety concerns for our employees.

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27106T Gill Propeller Anemometer

1. General Description

The 27106T Gill Propeller Anemometer sensor is used to measure vertical wind speed. Wind speed is measured with a helicoid-shaped, four-blade propeller. Rotation of the propeller produces an analog voltage signal proportional to wind speed with polarity determined by the direction of the wind.

The R.M. Young Instruction Manual includes additional information on the operating principles, installation and maintenance of the sensor.

Lead length for the 27106T is specified when the sensor is ordered. Table 1-1 gives the recommended lead length for mounting the sensor at the top of the tripod/tower with a 019ALU or CM200 series crossarm.

TABLE 1-1. Recommended Lead Lengths

CM6	CM10	CM110	CM115	CM120	UT10	UT20	UT30
10’	13’	13’	19’	24’	13’	24’	34’

The 27106T ships with:

(1) ResourceCD
(1) 1180 Mount

2. Specifications

Range
Axial Flow: 0 to 90 mph (0 to 40 m/s)
All Angles: 0 to 80 mph (0 to 35 m/s)

Threshold Sensitivity*: 0.8 mph (0.4 m/s)

Distance Constant*: <6.9 feet (2.1 m)

Pitch: 11.8 inch (30.0 cm) air passage per revolution

Signal Output: Analog DC Voltage proportional to axial wind component. Polarity reverses with reverse rotation.

1800 rpm (500 mV) = 9.0 m/s (20.1 mph)

Operating Temperature: -50° to +50°C

Propeller Description: 4-blade helicoids propeller molded of carbon fiber thermoplastic

Dimensions

Overall Length:	17 inch (43 cm)
Propeller Diameter:	8 inch (20 cm)
Housing Diameter:	1 inch (2.5 cm)

1180 Mounting Pipe Description: 12-in. long, 3/4-in. IPS schedule 40 pipe (1.05 in. OD)

Weight: 1.2 lbs (0.5 kg)

*Threshold and Distant Constant values are for axial flows.

Manufactured by RM Young (Traverse City, MI) and cabled by Campbell Scientific for use with our dataloggers.

NOTE 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. Installation

3.1 Unpack Equipment and Assemble the 27106T

Upon receipt of your shipment, immediately open the shipping carton and ensure that you have all of the 27106T's components.

The shipping carton should include:

- 16" x 2" x 2" box labeled *Propeller Anemometer*
- 9" x 9" x 2" box labeled *Carbon Fiber Propeller*
- Cable (routed through the 1180 mounting pipe to mating connector)
- 1180 Mounting Pipe

CAUTION Make sure that you have removed everything (two boxes, cable, and mounting pipe) from the shipping carton before discarding the shipping foam and shipping carton. Foam included with the shipping carton may conceal items. If an item listed above is not initially visible, remove the foam from the shipping carton and thoroughly inspect both sides of the foam for the item. Immediately contact Campbell Scientific if any item is missing.

Once everything has been retrieved from the shipping carton, assemble the 27106T by doing the following:

1. Remove the propeller shaft from the *Propeller Anemometer* box
2. Remove the propeller from the *Carbon Fiber Propeller* box
3. Remove the nut that is on the top of the propeller shaft
4. Place the propeller onto the top of the propeller shaft
5. Replace the nut and tighten to secure the propeller to the shaft
6. Remove the dust cap from the cable's connector and attach the cable to the anemometer's connector

3.2 Mounting to Crossarm

Tools Required:

- 5/32" Allen wrench for the NU-RAIL fitting or ½" open-end wrench for CM220 Right Angle mount
- UV resistant cable ties
- small pair of diagonal-cutting pliers
- 6" to 10" torpedo level

This anemometer can be mounted to a CM200-series crossarm or a 019ALU crossarm. The 1180's pipe that ships with the 27106 mounts to a CM200 series crossarm via the CM220 (Figure 3-1) or 1049 NU-RAIL Fitting (Figures 3-2) or to the 019ALU's NU-RAIL fitting (Figure 3-2).

When mounting the sensor to the crossarm, care should be taken to ensure that there are no obstacles, or sensors, that will interfere with the vertical air flow from either the up or down direction.

Route the sensor cable along the underside of the crossarm to the tower/tripod mast, and to the instrument enclosure. Secure the sensor cable to the crossarm and mast using cable ties.

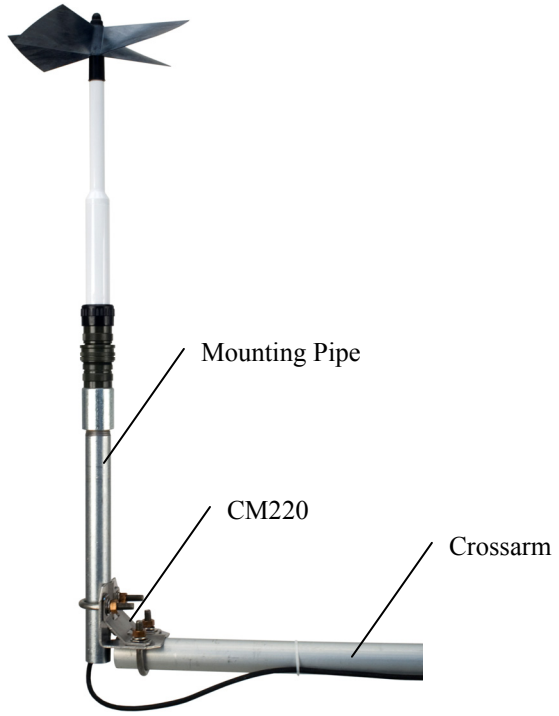

FIGURE 3-1. 27106T Mounted to a Crossarm via the CM220

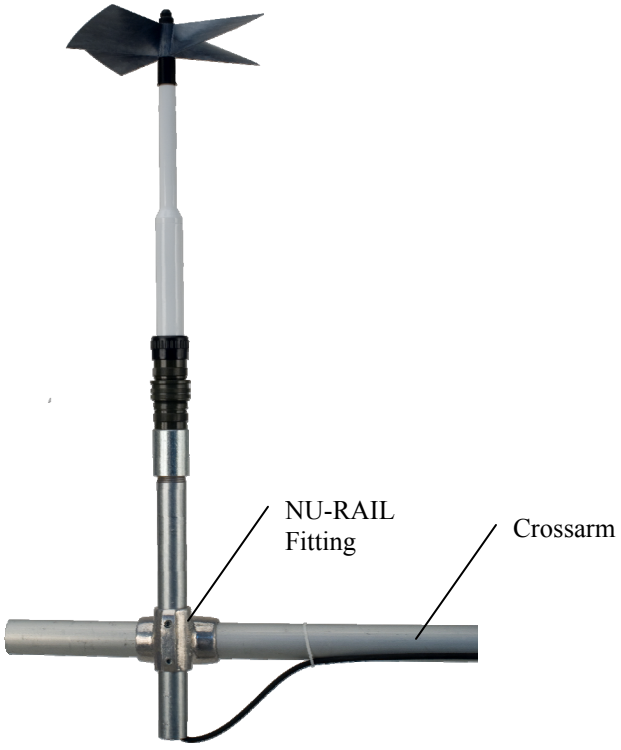

FIGURE 3-2. 27106T Mounted to a Crossarm via a NU-RAIL Fitting

4. Wiring

Connections to Campbell Scientific dataloggers are given in Table 4-1. When Short Cut for Windows software is used to create the datalogger program, the sensor should be wired to the channels shown in the wiring diagram created by Short Cut.

TABLE 4-1. Connections to Campbell Scientific Dataloggers

Color	Wire Label	CR800 CR850 CR5000 CR3000 CR1000	CR510 CR500 CR10(X)	21X, CR7 CR23X	CR200(X)
White	Signal	SE Analog	SE Analog	SE Analog	SE Analog
Black	Signal Reference	⏚	G	⏚	⏚
Clear	Shield	⏚	⏚	⏚	⏚

5. Programming

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

In CRBasic, wind speed is measured by the VoltSE instruction. Dataloggers that use CRBasic include the CR200(X) series, CR800, CR850, CR1000, CR3000, CR5000, and CR9000(X).

In Edlog, wind speed is measured by the Volt (SE) (P1) instruction. Dataloggers that use Edlog include the CR500, CR510, CR10(X), 21X, CR23X, and CR7.

5.1 Wind Speed Multiplier and Offset

The expression for wind speed (U) is:

$$U = MX + B$$

Where,

M = multiplier
X = voltage measured by the datalogger
B = offset

Table 5-1 lists the multipliers to obtain miles/hour, meters/second, km/H, and knots. The helicoid propeller has a calibration that passes through zero, so the offset is zero.

TABLE 5-1. Wind Speed Multiplier (With Configuration Code 21*)	
Unit	**Multiplier**
Miles per Hour	0.04025
Meters/Second	0.01800
Kilometers/Hour	0.06480
Knots	0.03496

*When the propeller is used for measuring the vertical wind component, users may want to apply an additional multiplier of 1.25 to the output signal. This may be done numerically in the data processing operations or electronically in the signal conditioning. Using the additional multiplier brings the anemometer output signal within ±3% of the cosine response for elevation angles between -30° and +30°. Since the standard deviation of wind elevation angle in open terrain rarely exceeds 12°, 98% (2.5 standard deviations) of observations will be within ±30°. Using the multiplier is NOT necessary when the anemometer is used in a UVW configuration with RM YOUNG model 26601UVW Translator.

5.2 Example Programs

The following programs measure the 27106T every 1 second, and store the maximum, minimum, and average wind speed every 10 minutes. Wiring for the examples is given in Table 5-2.

TABLE 5-2. Wiring for Example Programs			
Color	**Wire Label**	**CR1000**	**CR10X**
White	Signal	SE1	SE1
Black	Signal Reference	⏚	G
Clear	Shield	⏚	G

5.2.1 CR1000 Example Program

```
'CR1000 Series Datalogger
'Declare Public Variables
Public Batt_Volt
Public WS_ms

Units Batt_Volt=Volts
Units WS_ms=meters/second
```

```
'Define Data Tables
DataTable (Table1,True,-1)
    DataInterval (0,10,Min,10)
    Maximum (1,WS_ms,FP2,False,False)
    Minimum (1,WS_ms,FP2,0,False)
    Average (1,WS_ms,FP2,False)
EndTable

'Main Program
BeginProg
    Scan (1,Sec,1,0)
        Battery (Batt_Volt)
        '27106T Wind Speed Sensor measurement
        VoltSe (WS_ms,1,mV2500,1,1,0,250,0.01800,0)
        'mV5000 range code for CR3000 and CR5000 dataloggers

    'Call Output Tables
    CallTable Table1
    NextScan
EndProg
```

5.2.2 CR10X Example Program

```
;{CR10X}
;
*Table 1 Program
  01: 1.000          Execution Interval   (seconds)

;27106T Wind Speed Sensor Measurement
1: Volt (SE) (P1)
  1:  1              Reps
  2:  5              2500 mV Slow Range       ;5000mV (slow 60Hz) Range for CR23X, 21X, CR7
  3:  1              SE Channel
  4:  1              Loc [ WS_ms     ]
  5:  0.01800        Multiplier
  6:  0              Offset

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

3: Set Active Storage Area (P80)^23620
  1:  1              Final Storage Area 1
  2:  101            Array ID

4: Real Time (P77)^28329
  1:  1220           Year,Day,Hour/Minute (midnight = 2400)

5: Maximum (P73)
  1:  1              Reps
  2:  0              Value Only
  3:  1              Loc [ WS_ms     ]
```

```
6:  Minimum (P74)
   1:   1              Reps
   2:   0              Value Only
   3:   1              Loc [ WS_ms     ]

7:  Average (P71)^4771
   1:   1              Reps
   2:   1              Loc [ WS_ms     ]
```

6. Sensor Maintenance

Given proper care, the Gill Propeller Anemometer should provide years of service. Components are conservatively rated and require little maintenance. The only parts likely to need replacement due to normal wear are the precision ball bearings and the tach-generator. The replacement procedures are best performed in a service facility and only by qualified technicians.

If service facilities are not available, return the instrument to the factory. Before returning the sensor to the factory, customers must get a Returned Materials Authorization (RMA) and must fill out a Declaration of Hazardous Material and Decontamination form (for more information, refer to the Warranty and Assistance Section at the beginning of this manual).

6.1 Flange Bearing Replacement

CAUTION This replacement procedure needs to be done by a qualified technician. If a qualified technician is not available, return the sensor to Campbell Scientific and have their qualified technicians replace the bearing. Refer to the Warranty and Assistance page for more information.

NOTE This replacement procedure is from RM Young Operation manual (see Section 8).

If anemometer bearings become noisy or wind speed threshold increases above an acceptable level, bearings may need replacement. Check bearing condition using a Model 18310 Anemometer Bearing Torque Disk (available from RM Young). If, after replacing bearings, the torque is still too high, check the tach-generator.

Replace bearings as follows:

1. REMOVE OLD BEARINGS

   a) Remove propeller from anemometer.

   b) Unthread and separate shaft housing assembly from generator housing.

c) Loosen set screw on shaft collar/coupling disk and remove from propeller shaft.

d) Slide propeller shaft through both bearings and out of housing.

e) Pull front bearing dust shield off housing.

f) Using the edge of a pocket knife, gently pry front and rear bearings out of housing.

2. INSTALL NEW BEARINGS

a) Gently insert front bearing into housing.

b) Push front bearing dust shield back onto housing.

c) Carefully slide propeller shaft through front bearing and into housing.

d) Slide rear bearing over propeller shaft and gently push it into housing.

e) Place shaft collar/coupling disk on propeller shaft.

f) Allow 0.010 inch (0.25 mm) end play gap between shaft collar/coupling disk and bearing. Tighten set screw (80 oz in, 5600 gm-cm max torque).

g) Thread shaft housing assembly into generator housing. Tighten firmly.

h) Check bearing torque to confirm it is within specifications.

6.2 Tach-Generator Replacement

CAUTION This replacement procedure needs to be done by a qualified technician. If a qualified technician is not available, return the sensor to Campbell Scientific and have their qualified technicians replace the Tach-Generator. Refer to the Warranty and Assistance page for more information.

NOTE This replacement procedure is from RM Young Operation manual (see Section 8).

When the tach-generator output becomes erratic (usually due to brush failure) or begins to show signs of bearing failure (high torque), the entire generator assembly should be removed and replaced. If replacing the tach-generator due to excessive torque make certain it is indeed caused by a worn tach-generator, not the anemometer flange bearings.

Replace the tach-generator as follows:

1. REMOVE OLD GENERATOR ASSEMBLY

    a) Remove propeller from anemometer.

    b) Unthread generator housing collar. Pull generator housing away from sensor connector and generator assembly.

    c) Note position of generator wires on sensor connector pins. Unsolder wires from pins and remove old generator assembly.

2. INSTALL NEW GENERATOR ASSEMBLY

    a) Solder wires from new generator assembly onto proper sensor connector pins. Verify correct polarity: CCW rotation produces negative output voltage.

    b) Slide generator housing over generator assembly. Firmly tighten housing collar onto connector threads.

    c) Check bearing torque to confirm it is within specification.

7. Troubleshooting

Symptom: No wind speed

1. Check that the sensor is wired to the single-ended channel specified by the VoltSE instruction.

2. Disconnect the sensor from the datalogger and use an ohm meter to check the Tach-Generator. The resistance between the white and black wires should be about 32 ohms. Infinite resistance indicates an open coil; low resistance indicates a shorted coil.

3. Verify that the Voltage Range Code, and Multiplier and Offset parameters for the VoltSE 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.

8. References

References containing additional information about the Gill Propeller Anemometer are listed below in chronological order.

Holmes, R.M., Gill, G.C., and Carson, H.W., “A Propeller Type Vertical Anemometer”, Journal of Applied Meteorology, Vol 3, 1964, pp. 802-804

Drinkow, R., “A Solution to the Paired Gill-Anemometer Response Function”, Journal of Applied Meteorology, Vol 11, 1972, pp. 7-80.

Hicks, B. B., “Propeller Anemometers as Sensors of Atmospheric Turbulence”, Boundary-Layer Meteorology, Vol 3, 1972, pp. 214-228

Fichtl, G. H., and Kumar, P., “The Response of Propeller Anemometer to Turbulent Flow with the Mean Wind Vector Perpendicular to the Axis of Rotation”, Boundary-Layer Meteorology, Vol 6, 1974, pp. 363-379.

McMichael, J.M., and Klebanoff, P. S., “The Dynamic Response of Helicoid Anemometers”, NBSIR 75-772, National Bureau of Standards, 1975.

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