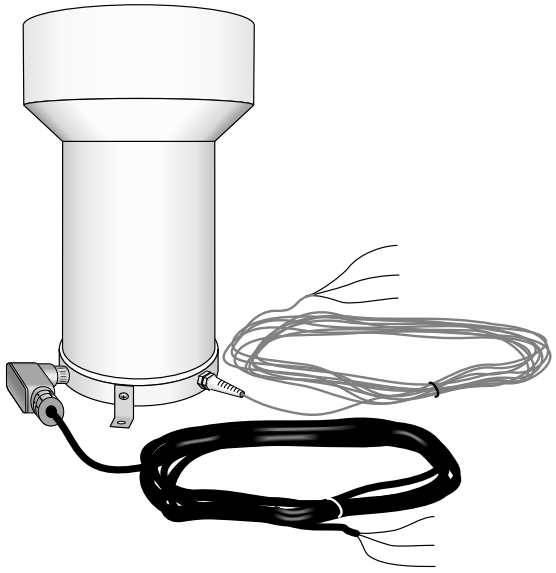
INSTRUCTION MANUAL

Met One Rain Gage Models 380 and 385

Revision: 2/08



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Warranty and Assistance

The **MET ONE RAIN GAGE MODELS 380 AND 385** are 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.

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Met One Rain Gage Models 380 and 385

1. Introduction

Met One's tipping bucket rain or snow gage is used to measure rain or snow water equivalent on a continuous basis. The Model 380 rain gage is intended to measure rainfall during above freezing conditions. The Model 385 AC heated rain gage provides year round measurement of either rain or snow. In the standard versions Model 380/385, precipitation is measured in increments of 0.01 inches.

The Model 380 rain gage works by collecting rainfall in the 12 inch collection funnel and metering the rain into the tipping bucket assembly. When 0.01 inches of rainfall are collected, the tipping bucket assembly tips and activates a mercury switch. The switch closure is recorded by the datalogger pulse channel. When the bucket tips, the water drains out the screened base of the gage. In the case of the Model 385 heated rain gage, snowfall is captured in the collection funnel and melted by the heater element. After melting, the snow water is metered into the tipping bucket assembly for measurement of the snow water equivalent.

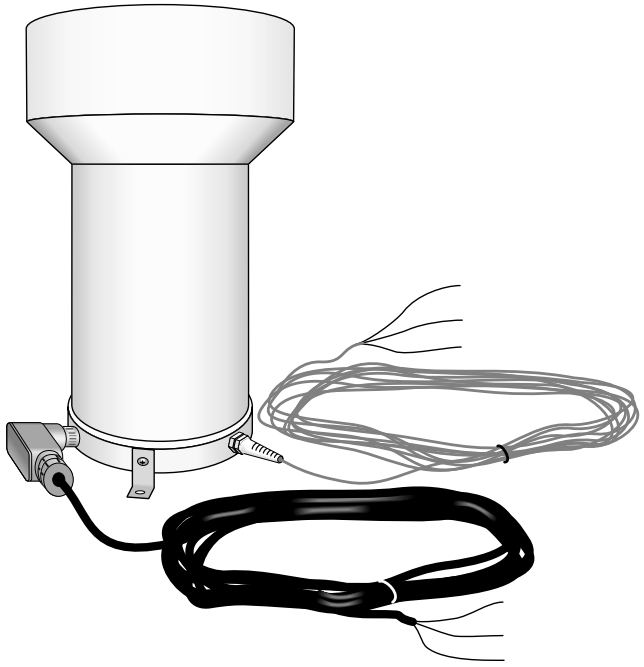


FIGURE 1-1. 385 Met One Rain and Snow Gage

The 385 ships with:

(1) Calibration Sheet
(1) Instruction Manual

2. Specifications

MODEL 380/385 RAIN GAGE

Funnel:	12 inch (30.5 cm)
Accuracy:	±0.5% < 0.5"(1.27 cm)/hr rate ±2.0% < 3.0"(7.62 cm)/hr rate
Resolution:	
380/385	0.01 inch
Environmental Conditions:	
Temperature:	0 °C to +50 °C
Humidity:	0 to 100%
Dimensions:	
Weight:	7 pounds (3.2 kg) w/ 50 ft. signal cable
Height:	14" (35.5 cm)
Diameter:	12" (30.5 cm)

MODEL 385

Specifications same as Model 380 unless listed below.

Environmental Conditions:	
Temperature:	-20°C to +50°C
Humidity:	0 to 100%
Weight:	12.2 pounds (5.57 kg) w/ 50' power/signal cable
Heater Power Specification:	
Voltage:	115 VAC (50/60 Hz)
Current:	5 amps maximum
Heater:	300 W Cartridge Element

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 Siting

The rain or snow gage should be mounted in a relatively level spot which is representative of the surrounding area. The lip of the funnel should be horizontal and at least 30 inches above the ground. Install the snow gage high enough to prevent burial by snow during the winter months. The ground surface around the rain gage should be natural vegetation or gravel. The gage should not be installed over a paved or concrete surface. Refer to Figure 3-1 for an illustration of gage installation.

The rain or snow gage should be placed away from objects that obstruct wind. The minimum distance should be 2 times the height of the obstruction or more.

3.2 Mounting

The rain or snow gage is designed to mount on a flat surface. Three equally spaced adjustable mounting legs are provided. The mounting legs are pre-drilled for 1/4" bolts on a 9.66" diameter bolt circle. A mounting bracket is available from Campbell Scientific (CM240) to install either the rain or snow gage. The mounting bracket provides additional adjustment for leveling the rain or snow gage. The CM240 base helps level the rain gage, ensuring a more accurate measurement. The base may be attached to a CM300-Series Mounting Pole or to a user-supplied 1.5 IPS (1.9” OD, unthreaded) pipe. The pipe should be long enough to place the gage's orifice at a one-meter height. The pole or pipe can be placed directly into a concrete foundation, attached to a concrete foundation using J-bolts, or self-supporting with legs (see Figure 3-2). A concrete pad is recommended. A typical snow gage installation is illustrated in Figure 3-1.

Loosen the three screws and lift the housing assembly from the base. Adjust the three slotted feet on the base of the rain gage and/or the three nuts on the CM240 to level the gage.

Remove the rubber shipping band securing the stainless steel tipping bucket assembly. Verify the bucket tips freely and that all the adjusting screws are tight. Replace the housing assembly and tighten the three screws to secure the housing to the base. Level the rain gage after mounting it.

3.3 Screen Removal

If snowfall is anticipated, remove the primary screen from funnel, as shown in Figure 3-3.

NOTE Remember to replace primary screen after a snowfall event.

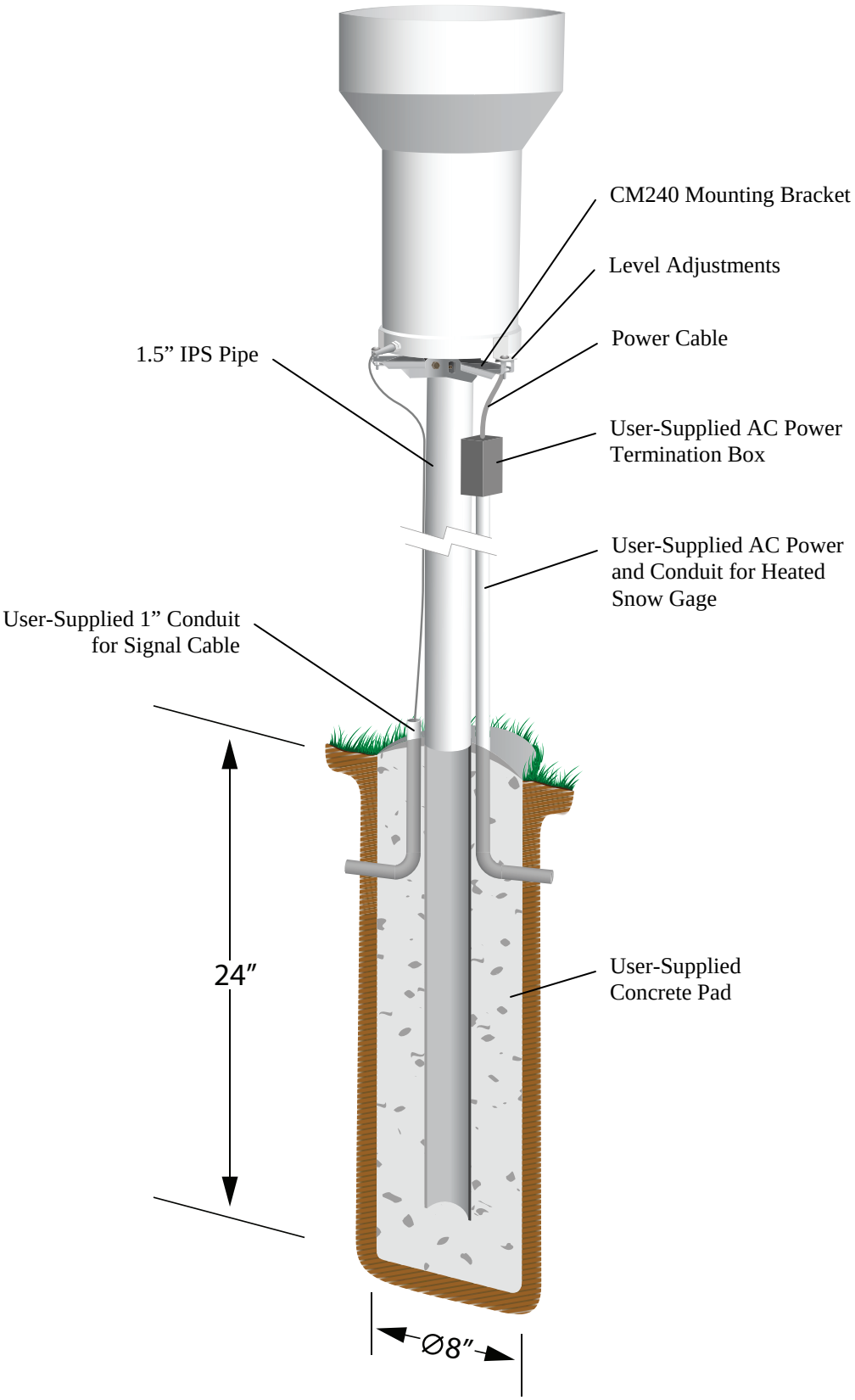


FIGURE 3-1. Typical Snow Gage Installation

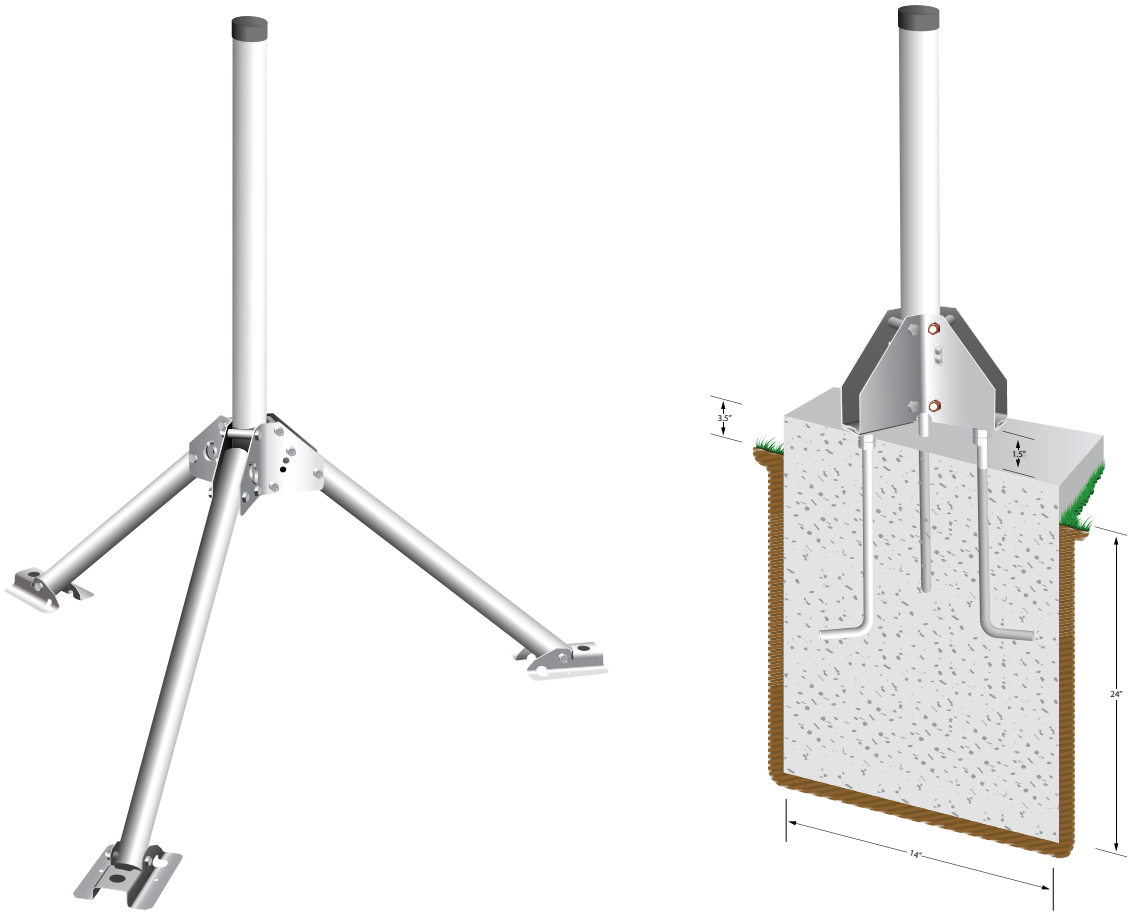
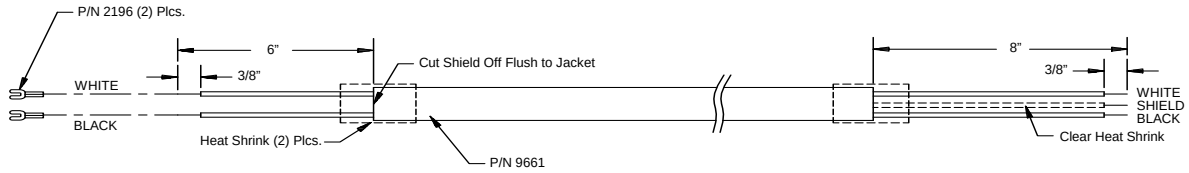
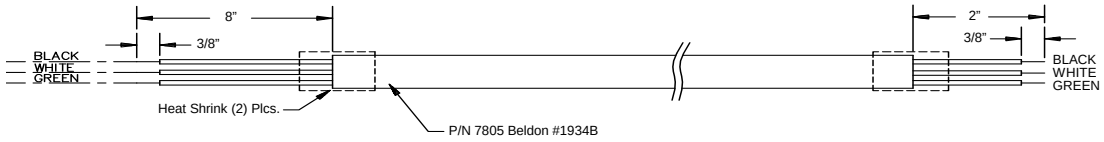


FIGURE 3-2. Pedestal Base Options



SIGNAL CABLE



POWER CABLE

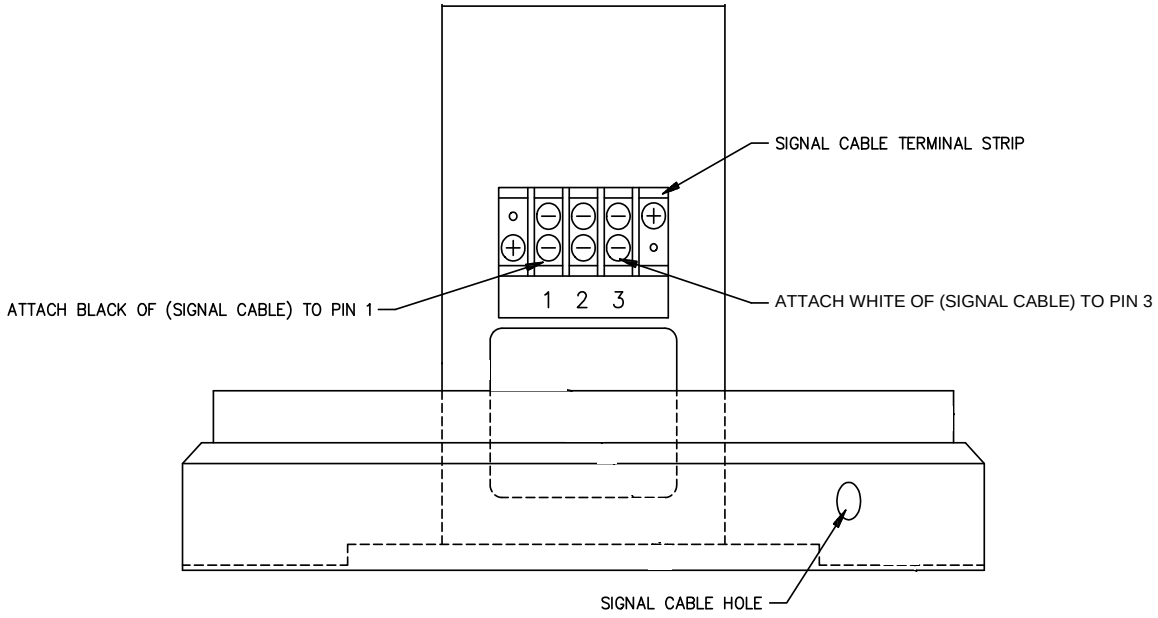


FIGURE 3-3. Connecting Signal Cable Leads

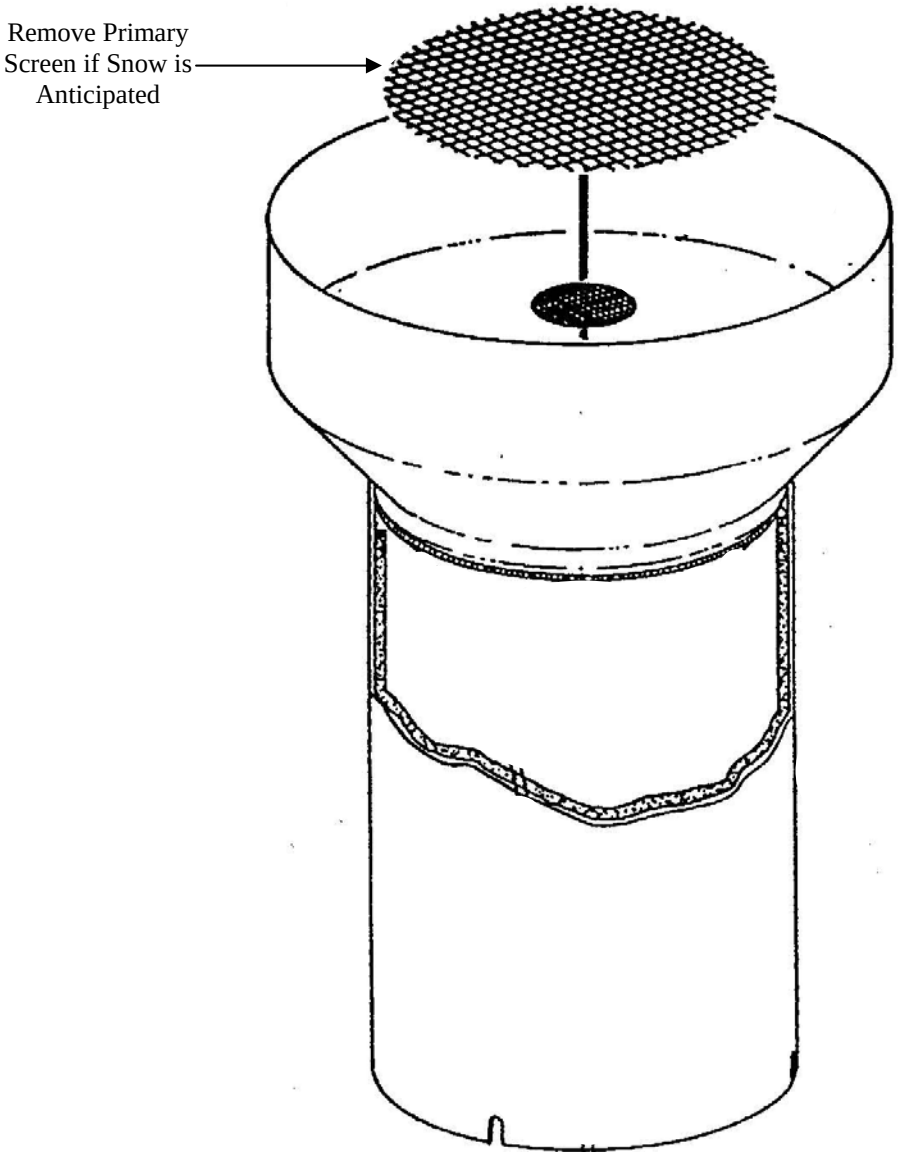


FIGURE 3-4. Remove Screen if Snow is Anticipated

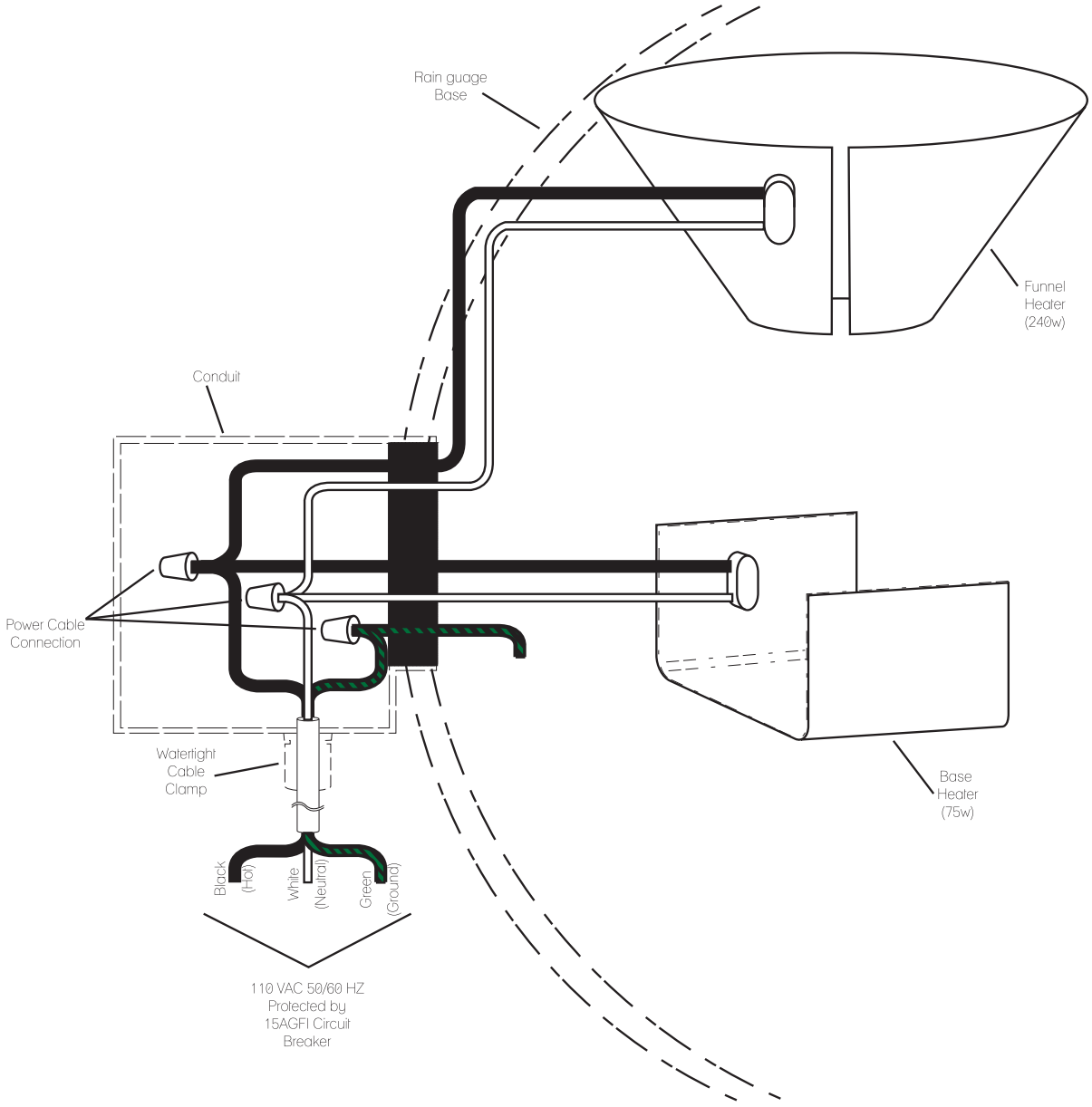


FIGURE 3-5. Connecting Heater Wires

4. Wiring

WARNING

Disconnect heater power before attempting to service or repair this equipment. Failure to do so may result in personal injury or death due to electrocution.

The BLACK (Signal) lead connects to a pulse channel. The WHITE (Power Ground) connects to ground channel. The CLEAR (shield) lead connects to ground channel. Refer to Table 4-1 for the wiring of your datalogger. The purpose of the shield wire is to drain any charges built up in the cable due to transients etc.

4.1 Heater Wiring

Attach the power plug supplied with the Model 385 by following the instructions supplied with the plug. The electric heated snow gage requires 115VAC (50/60hz), 5 amps maximum, to operate the heater. (If supplying your own signal or power cable, refer to Figure 3-4 for an illustration of cable installation.) The heater should be unplugged during warmer months to prevent evaporation during low rainfall and to minimize wear and tear on the heater element.

NOTE The heater thermostat is factory set and requires no field adjustment.

4.2 Wiring for Pulse Channel Input

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 on the wiring diagram created by Short Cut.

TABLE 4-1. Wiring for Pulse Channel Input

Color	Description	CR800 CR1000 CR3000 CR5000	CR500 CR510, CR10(X),	21X, CR7, CR23X	CR200 Series
Black	Signal	Pulse Channel	Pulse Channel	Pulse Channel	P_SW
White	Signal Return	⏚	G	⏚	⏚
Clear	Shield	⏚	G	⏚	⏚

Dataloggers listed in Table 4-2 have the capability of counting switch closures on some of their control ports. When a control port is used, the return from the rain gage must be connected to +5 volts on the datalogger.

4.3 Wiring for Control Port Input

TABLE 4-2. Wiring for Control Port Input

Color	Description	CR800 CR1000 CR3000	CR500, CR510	CR10(X)	CR23X
Black	Signal	Control Port	C2/P3	Control Port	Control Port
White	Signal Return	5 V	5 V	5 V	5 V
Clear	Shield	⏚	⏚	G	⏚

The CR10 does not support the use of control port inputs with the Pulse Count instruction; use Short Cut or see Example 8.5 in the CR10 operator's manual.

5. Datalogger Programming

5.1 CR10X Programming

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.

The Model 385 rain gage is measured using the Pulse Count instruction configured for a switch closure. In all dataloggers, a multiplier of 0.01 converts the output to inches and a multiplier of 0.254 converts the output to millimeters.

The following example program uses a pulse channel to read the output from the rain gage and will work with CR500, CR510, CR10(X), 21X or CR23X. The CR7 is similar but has an additional parameter in the Pulse Count instruction to specify the slot that the Pulse Card is in.

```
Input Location Labels:
1.  Rain  (in)

*Table 1 Program
  01:  10            Sec. Execution Interval

1:  Pulse (P3)
  1:   1             Rep
  2:   1             Pulse Input Channel
  3:   2             Switch Closure
  4:   1             Loc [:Rain (in)]
  5:   0.01          Mult
  6:   0             Offset

2:  If time is (P92)
  1:   0             minutes into a
  2:   60            minute interval
  3:   10            Set high Flag 0

3:  Real Time (P77)
  1:   110           Day,Hour-Minute

4:  Totalize (P72)
  1:   1             Repetitions
  2:   1             Starting Input Location

5:  End Table 1
```

Output Instruction 72, Totalize, is used in the output section of the program to output the total rainfall over the output interval. This section should be executed every scan and not placed in a subroutine or conditional statement.

5.1.1 CR200 Series Programming

```
'CR200 Series
'Example program showing measurement of a 380/385 sensor every 10 seconds.

'Declare Public Variables and Units
Public Rain_in

Units Rain_in=inch

'Define Data Tables
DataTable(Table1,True,-1)                    'As an example store the data every 60 minutes.
    DataInterval(0,60,Min)
    Totalize(1,Rain_in,False)
EndTable

'Main Program
BeginProg
    Scan(10,Sec)
        'MetOne 380/385 Rain Gauge measurement Rain_in:
        PulseCount(Rain_in,P_SW,2,0,0.01,0)
        'Call Data Tables and Store Data
        CallTable(Table1)
    NextScan
EndProg
```

5.1.2 CR1000 Programming

```
‘CR1000
‘Example program showing measurement of a 380/385 sensor every 10 seconds.

‘Declare Variables and Units
Public Rain_in

Units Rain_in=inch

 ‘Define Data Tables
DataTable (Table1,True,-1)
    DataInterval (0,60,Min,10)               ‘As an example store the data every 60 minutes.
    Totalize (1,Rain_in,FP2,False)
EndTable

‘Main Program
Begin Prog
    Scan (10,Sec,1,0)
        ‘MetOne 380/385 Rain Gauge measurement Rain_in:
        PulseCount (Rain_in,1,1,2,0,0.01,0)
        ‘Call Data Tables and Store Data
        CallTable (Table1)
    NextScan
End Prog
```

```
‘Main Program
BeginProg
    Scan(10,Sec,1,0)
        ‘Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        ‘MetOne 380/385 Rain Gauge measurement Rain_in:
        PulseCount(Rain_in,1,1,2,0,0.01,0)
        ‘Call Data Tables and Store Data
        CallTable(Table1)
        CallTable(Table2)
    NextScan
EndProg
```

5.2 Control Port Programming

The following examples measure a 380 and 385 rain gage using a control port on a datalogger. Wire the sensor as shown in Table 4-2.

5.2.1 CR1000 Programming

```
'CR1000
'Declare Public Variables and Units
Public Rain_in
Units Rain_in=inch

DataTable (Rain,True,-1)
    DataInterval (0,60,Min,0)
    Totalize (1,Rain_in,FP2,0)
EndTable

'Main Program
BeginProg
    Scan (1,Sec,1,0)
            PulseCount (Rain_in,1,18,2,0,.01,0)      ; Black wire connect to C8
        CallTable (Rain)
    NextScan
EndProg
```

5.2.2 CR200 Series Programming

```
'CR200

'A 20 kOhm pull up resistor is required to read a switch closure on C1 or C2
'as a Pulse Counter. The 20 kOhm resistor uses the battery voltage.

'Declare Public Variables and Units
Public Rain_in

Units Rain_in=inch
```

```
'Define Data Tables
DataTable(Table1,True,-1)                    'As an example store the data every 60 minutes.
    DataInterval(0,60,Min)
    Totalize(1,Rain_in,False)
EndTable

'Main Program
BeginProg
    Scan(10,Sec)
        'MetOne 380/385 Rain Gauge measurement Rain_in:
        PulseCount(Rain_in,C2,2,0,0.01,0)        ; Black wire connect to C2
        'Call Data Tables and Store Data
        CallTable(Table1)
    NextScan
EndProg
```

5.2.3 CR10X Programming

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

1: Pulse (P3)
  1:  1             Reps
  2:  8             Control Port 8 (switch closure only)   ; Black wire connect to C8
  3:  2             Switch Closure, All Counts
  4:  1             Loc [ Rain_inch ]
  5:  .01           Multiplier
  6:  0             Offset

2: 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)

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: Totalize (P72)
  1:  1             Reps
  2:  1             Loc [ Rain_inch ]

*Table 2 Program
  02: 0.0000        Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

6. Troubleshooting

6.1 Precipitation

Symptom: No precipitation

1. Check that the sensor is wired to the Pulse Channel specified by the Pulse Count instruction.

2. Verify that the Configuration Code (Switch Closure), and Multiplier and Offset parameters for the Pulse Count instruction are correct for the datalogger type.

3. Disconnect the sensor from the datalogger and use an ohm meter to do a continuity check of the switch. The resistance measured at the terminal block on the inside of the bucket between the black and white leads should vary from infinite (switch open) when the bucket is tipped, to less than an ohm when the bucket is balanced.

7. Maintenance and Calibration

During each site visit, check for and remove any debris, insects, sediment, etc. from the collection funnel, debris screens, or tipping bucket assembly. Verify the tipping bucket assembly moves freely, and that the datalogger records 0.01 in for each bucket tip.

7.1 Customer Calibration

The sensor is factory calibrated; recalibration is not required unless damage has occurred or the adjustment screws have loosened. Nevertheless, the following calibration check is recommended once every 12 months:

a. Remove the housing assembly from the base by loosening the three screws and lifting upward on the housing.

b. Check bubble level to verify sensor is level.

c. Pour water through the inner funnel to wet the two bucket surfaces. Using a graduated cylinder, slowly pour the appropriate amount of water (refer to Table 7-1) through the inner funnel to the tipping bucket, which should tip once. Repeat for the other bucket. If both buckets tip when filled with the appropriate amount of water (refer to Table 7-1), the sensor is properly calibrated and no additional adjustment is needed. If either bucket fails to tip, recalibrate as follows:

1. Release the lock nuts on the cup adjustments.

2. Move the adjustment screws down to a position that would place the bucket far out of calibration.

3. Pour the appropriate amount of water (see Table 7-1) into the inner funnel (i.e. 18.52 ml for 0.01 inches of rain / tip):

   Conversion Factors:
   Tip to in^3: 113.04 in^2 (catch orifice area) x increment in inches.
   in^3 to ml: multiply by 16.3881.
   ml to ounces: multiply by 0.03382.

4. Turn the cup adjustment screw, opposite the full bucket, up until the bucket assembly tips. Tighten the lock nut.

5. Repeat steps 3 and 4 for the opposite bucket.

6. Repeat steps 1-5 to ensure proper calibration.

7. Reinstall the housing assembly and tighten the three screws.

TABLE 7-1. Volume of Water for Recalibration

Tip Increment	in^3	ml	ounces
0.01 in	1.130	18.52	0.63

7.2 Factory Recalibration

Factory recalibration is available from either Campbell Scientific Incorporated or Met One Instruments. Please call and request an RMA number prior to returning any equipment to Campbell Scientific Incorporated

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