INSTRUCTION MANUAL

TB4 and TB4MM Rain Gage

Revision: 10/10



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TB4 and TB4MM Rain Gage

1. General Description

The TB4 and TB4MM tipping bucket rain gages are manufactured by Hydrological Services Pty. Ltd. (Model TB4) and modified for use with Campbell Scientific dataloggers.

These rain gages catch rainfall in the 7.87" (200 mm) diameter collection funnel. When a full bucket of rainfall is collected, the tipping bucket assembly tips and activates a reed switch. The switch closure is recorded by the datalogger pulse channel. When the bucket tips, the water drains out the screened fittings in the base of the gage.

Two models are available:

TB4 0.01 in. tip
TB4MM 0.2 mm tip

NOTE Throughout this manual, both models are referred to as the TB4 unless specified otherwise.

The "-L" after the model TB4 Rain Gage indicates that the cable length is specified when ordering.

The TB4 ships with:

(1) Allen Wrench from Original Mfg.
(1) Resource CD

The 260-953 Alter-Type Wind Screen can be used with the TB4 and TB4MM to minimize the effects of strong winds.

2. Specifications

Funnel:	7.87 in (200 mm)
Drain Fittings:	Accept 12 mm ID tubing
Measurement Range:	0 to 19.7 in/hr (0 to 500 mm/hr)
Accuracy:	Better than +2% @ 19.7in/hr (500 mm/hr)
Resolution:	0.01 in (0.254 mm) TB4 0.2 mm (0.008 in) TB4MM
Environmental Conditions:	
Temperature:	0° to +70°C
Humidity:	0 to 100%
Temperature Specifications:	-20 to +70°C
Siphon Capacity:	0.012 in (0.3mm)
Contact:	Dual Reed Switch

Capacity:	12 VA (0.5 amp max.)
Dimensions:	
Weight:	4.41 pounds (2 kg)
Height:	13 in (330 mm)
Diameter:	7.9 in (200 mm)

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

NOTE The 260-953 Alter-Type Wind Screen's siting information and installation procedure are provided in our 260-953 manual.

3.1 Siting

The rain gage should be mounted in a relatively level spot which is representative of the surrounding area. The ground surface around the rain gage should be natural vegetation or gravel. It should not be paved or concrete.

For accurate measurements, the rain gage must be placed away from objects that obstruct wind. The minimum distance should be 2 to 4 times the height of the obstruction.

3.2 Mounting



The rain gage is designed to mount on a flat surface. Three equally spaced mounting pads are provided. The mounting pads are pre-drilled for three 3/8" (M8) bolts on a 9.21" (234 mm) diameter bolt circle. The CM240 mounting bracket is available from Campbell Scientific for installing the TB4. 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 rain gage should be high enough to be above the average snow depth. The pole or pipe can be placed directly into a concrete foundation, or attached to a concrete foundation using J-bolts, or self-supporting with legs (see Figure 3-2). A concrete pad is recommended. A typical rain gage installation is illustrated in Figure 3-1.

Remove the TB4 funnel from the base by removing the three screws and lifting upward. Adjust the three nuts on the CM240 bracket to level the rain gage. A bubble level is mounted on the TB4 base to facilitate leveling.

Remove the rubber shipping band and cardboard packing securing the tipping bucket assembly. Tip the bucket several times to insure the tipping mechanism is moving freely. Replace the housing assembly and tighten the three screws to secure the housing to the base. Level the rain gage after mounting it.

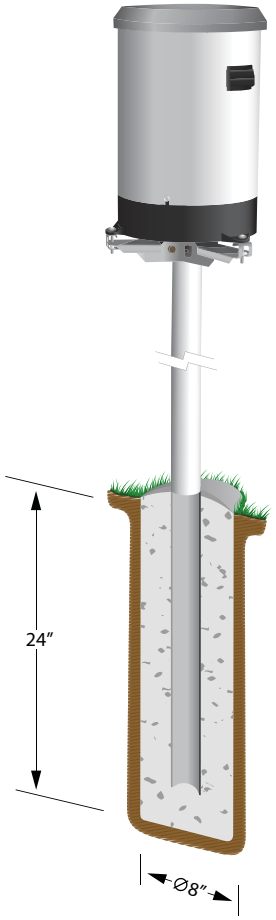


FIGURE 3-1. Typical Rain Gage Installation

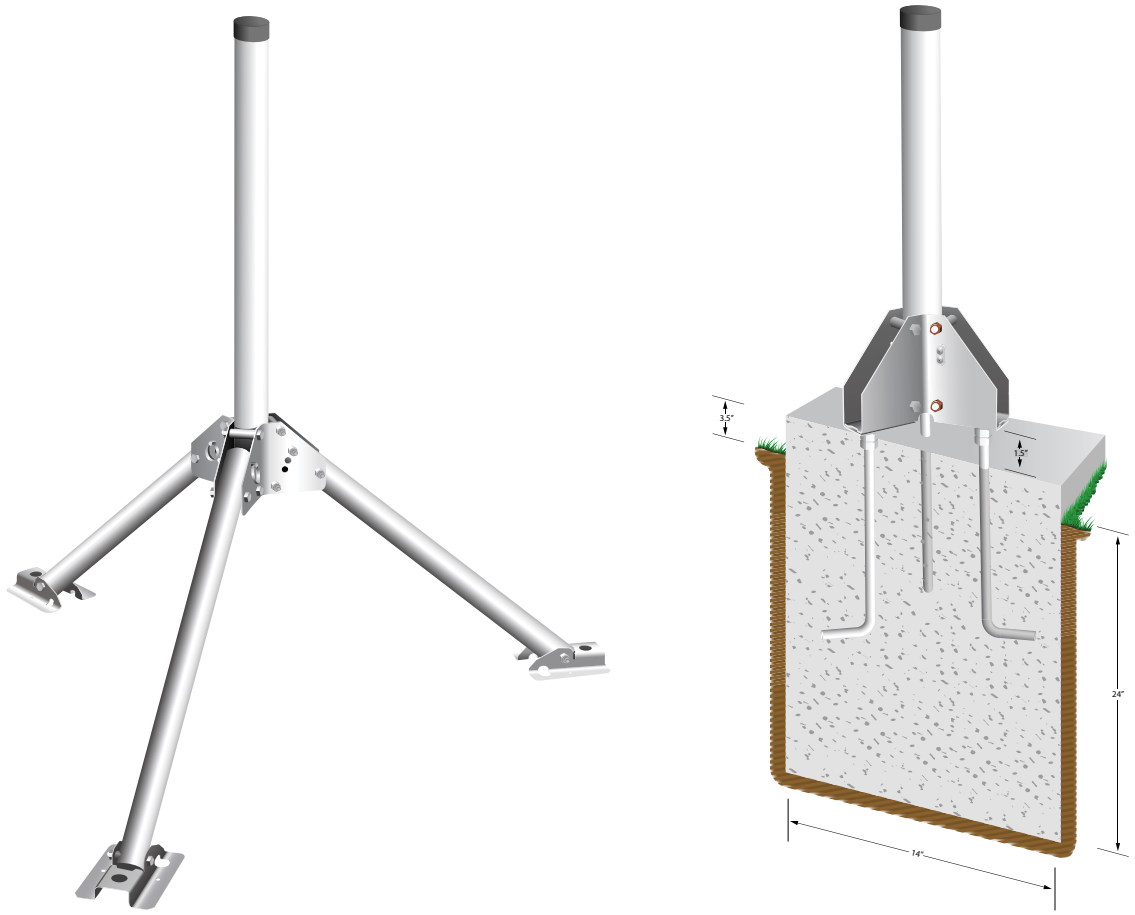


FIGURE 3-2. Pedestal Base Options

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 on the wiring diagram created by Short Cut.

TABLE 4-1. Wiring for Pulse Channel Input

Color	Description	CR800 CR1000 CR3000 CR5000	CR510 CR500 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 switch must be connected to +5 volts on the datalogger.

TABLE 4-2. Wiring for Control Port Input

Color	Description	CR800 CR1000 CR3000	CR500 CR510	CR10X	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.

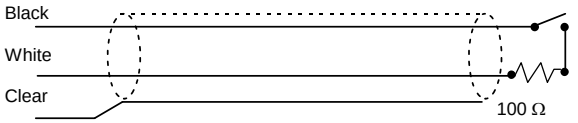


FIGURE 4-1. Rain Gage Schematic

In a long cable there is appreciable capacitance between the lines. A built up charge could cause arcing when the switch closes, shortening switch life. A 100 ohm resistor is connected in series at the switch to prevent arcing by limiting the current (Figure 4-1). This resistor is installed on all rain gages currently sold by Campbell Scientific.

5. Datalogger Programming

This section is for users who write their own datalogger 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 rain gage is measured using the Pulse Count instruction with the switch closure configuration code. The multiplier used in the Pulse Count instruction determines the units in which rainfall is reported.

TABLE 5-1. Multipliers

	TB4	TB4MM
Inches	0.01	0.007874
Millimeters	0.254	0.2

5.1 Pulse Channel Example Programs

The following example programs use a pulse channel to read the output from the rain gage.

5.1.1 CR1000 Pulse Channel Example

Although this example is for the CR1000, Campbell Scientific's CR800, CR850, CR3000, and CR5000 are programmed similarly.

```
'CR1000
'CR1000 Program for TB4

'Declare Variables and Units
Public Rain_mm

Units Rain_mm=mm

'Define Data Tables
DataTable(TB4_mm,True,-1)
    DataInterval(0,60,Min,0)
    Totalize(1,Rain_mm,IEEE4,0)
EndTable

'Main Program
BeginProg
    Scan(1,Sec,1,0)
        'TB4 Rain Gauge measurement Rain_mm:
        PulseCount(Rain_mm,1,1,2,0,0.254,0)
        'Call Data Tables and Store Data
        CallTable(TB4_mm)
    NextScan
EndProg
```

5.1.2 CR200(X) Series Pulse Channel Example

```
'CR200 Series
'TB4 program

'Declare Variables and Units
Public Rain_mm

Units Rain_mm=mm

'Define Data Tables
DataTable(TB4_mm,True,-1)
    DataInterval(0,60,Min)
    Totalize(1,Rain_mm,0)
EndTable
```

```
'Main Program
BeginProg
   Scan(10,Sec)
      'TB4 Rain Gauge measurement Rain_mm:
      PulseCount(Rain_mm,P_SW,2,0,0.254,0)
      'Call Data Tables and Store Data
      CallTable(TB4_mm)
   NextScan
EndProg
```

5.1.3 CR10(X) Pulse Channel Example

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 and 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.

```
;{CR10X}
;
;CR10X Program for TB4
;Rain (mm)
;
*Table 1 Program
  01: 1             Execution Interval (seconds)

1: Pulse (P3)
  1:  1             Reps
  2:  1             Pulse Channel 1
  3:  2             Switch Closure, All Counts
  4:  1             Loc [ Rain_mm   ]
  5:  .254          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_mm   ]

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

*Table 3 Subroutines

End Program
```

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.

5.2 Control Port Example Programs

The following examples measure a TB4 rain gage using a control port on the datalogger. Wire the sensor as shown in Table 4-2.

5.2.1 CR1000 Control Port Example

Although this example is for the CR1000 datalogger, our CR800, CR850, CR3000, and CR5000 are programmed similarly.

```
'CR1000
'CR1000 Program for TB4

'Declare Public Variables and Units
Public Rain_mm
Units Rain_mm=mm

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

'Main Program
BeginProg
    Scan (1,Sec,1,0)
        PulseCount (Rain_mm,1,18,2,0,.254,0)      ; Black wire connected to C8
        CallTable (Rain)
    NextScan
EndProg
```

5.2.2 CR200(X) Series Control Port Example

```
'CR200

' A 20 kOhm pull up resistor is require 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_mm
Units Rain_mm=mm

'Define Data Tables
DataTable (Rain,True,-1)
    DataInterval (0,60,min)
    Totalize (1,Rain_mm,0)
EndTable
```

```
'Main Program
BeginProg
      Scan (1,Sec)
            'TB4 Rain Gage measurement Rain-mm
            PulseCount (Rain_mm,C2,2,0,.254,0)          ; Black wire connected to C2
            'Call Data Tables and Store Data
            CallTable (Rain)
      NextScan
EndProg
```

5.2.3 CR10X Control Port Example

Although this program is for the CR10X datalogger, our CR500, CR510, and CR23X are programmed similarly.

```
;{CR10X}
*Table 1 Program
  01:  1.0000          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_mm   ]
   5:   .254           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:  Sample (P70)
   1:   1              Reps
   2:   1              Loc [ Rain_mm   ]

*Table 2 Program
  01:  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

During each site visit, remove any debris, insects, sediment, etc. from the collection funnel, debris screen, siphoning mechanism, or tipping bucket assembly.

Verify the tipping bucket assembly moves freely, and that the datalogger records each bucket tip.

7.1 Dismantling for Cleaning

The following items should be checked regularly for cleanliness:

- Catch filter (see Figure 7-3)
- Siphon (see Figure 7-3)
- Interior of bucket (see Figure 7-1)
- Top surface of adjusting screws (see Figure 7-1)
- Housing locking screws; lightly lubricate after cleaning (see Figure 7-1)
- All insect screens (see Figure 7-1)

To access the above components, dismantle the TB4 using the following procedure:

1. Remove the housing assembly from the base by loosening the three locking screws and lifting the housing upward.

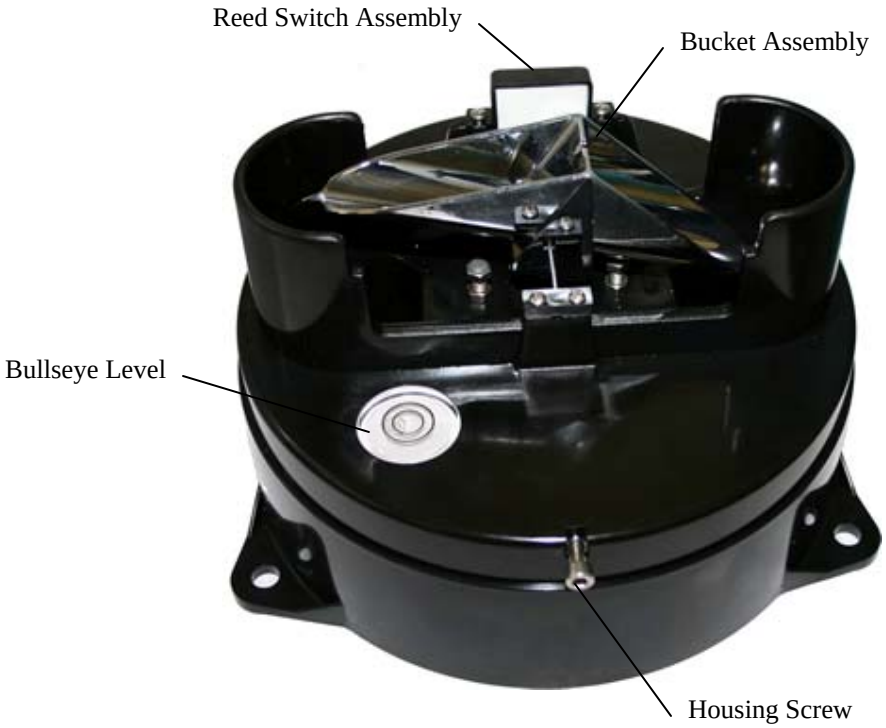


FIGURE 7-1. Components of TB4 Base

2. Separate the filter/siphon assembly from the funnel by pushing the filter while pulling the siphon (see Figure 7-2).

CAUTION Do not twist the filter/siphon assembly while pushing and pulling.

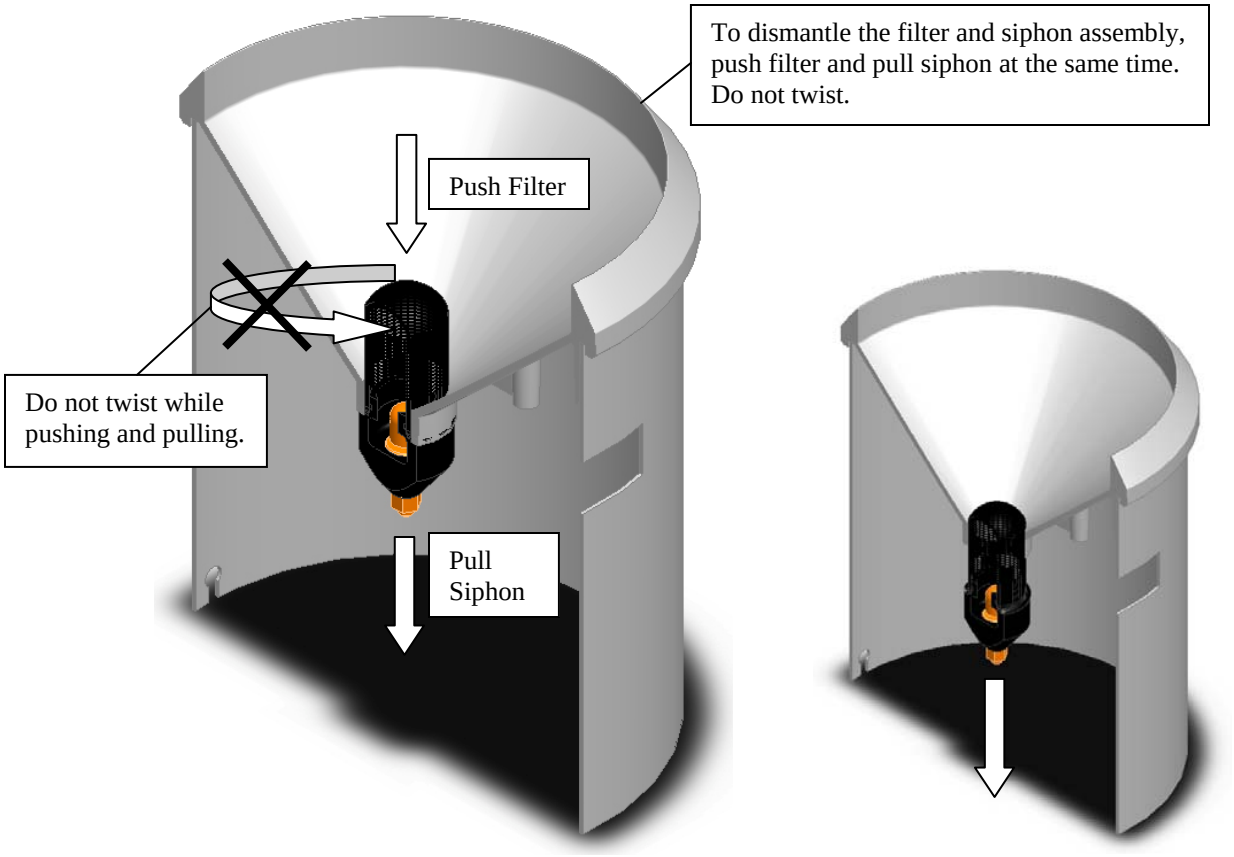


FIGURE 7-2. Dismantling the Filter/Siphon Assembly

3. Disassemble the filter/siphon assembly by doing the following (see Figure 7-3):

   (a) Unscrew nut
   (b) Lightly press stem down on surface until stem pops out of siphon body.
   (c) Remove stem from siphon body.
   (d) Unscrew cap
   (e) Clean all items

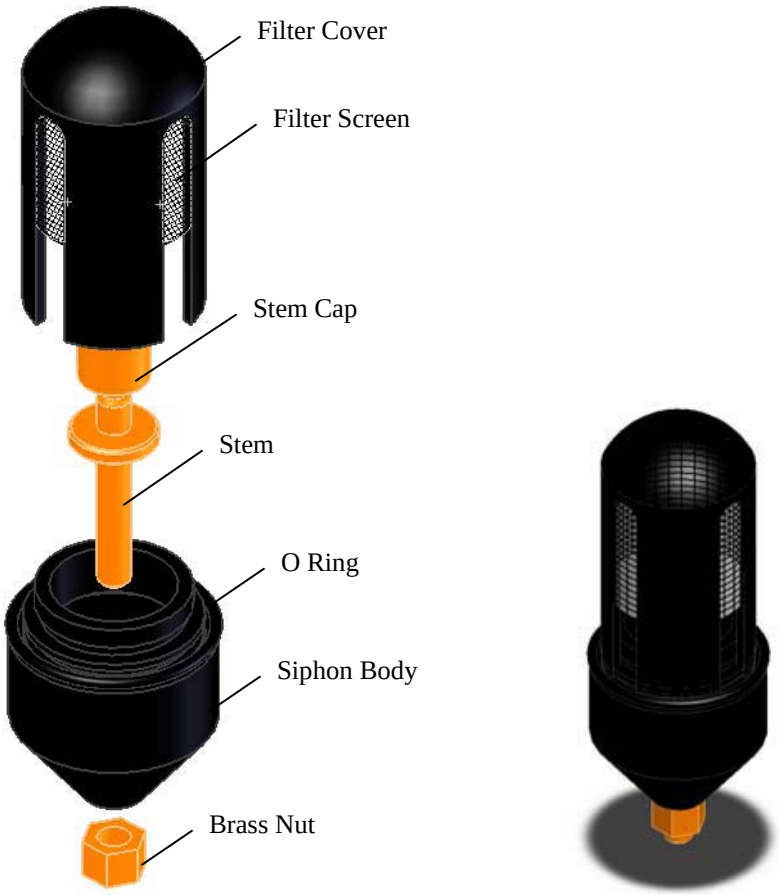


FIGURE 7-3. Filter/Siphon Assembly

7.2 Reassembling the TB4

1. Screw cap on stem, finger tighten only (see Figure 7-2).
2. Push stem into siphon body (see Figure 7-2).
3. Replace nut and tighten (see Figure 7-2).

CAUTION Do not over tighten.

4. Push filter/siphon assembly back into place (see Figure 7-4).

CAUTION Do not twist the filter/siphon assembly while putting it back into place.

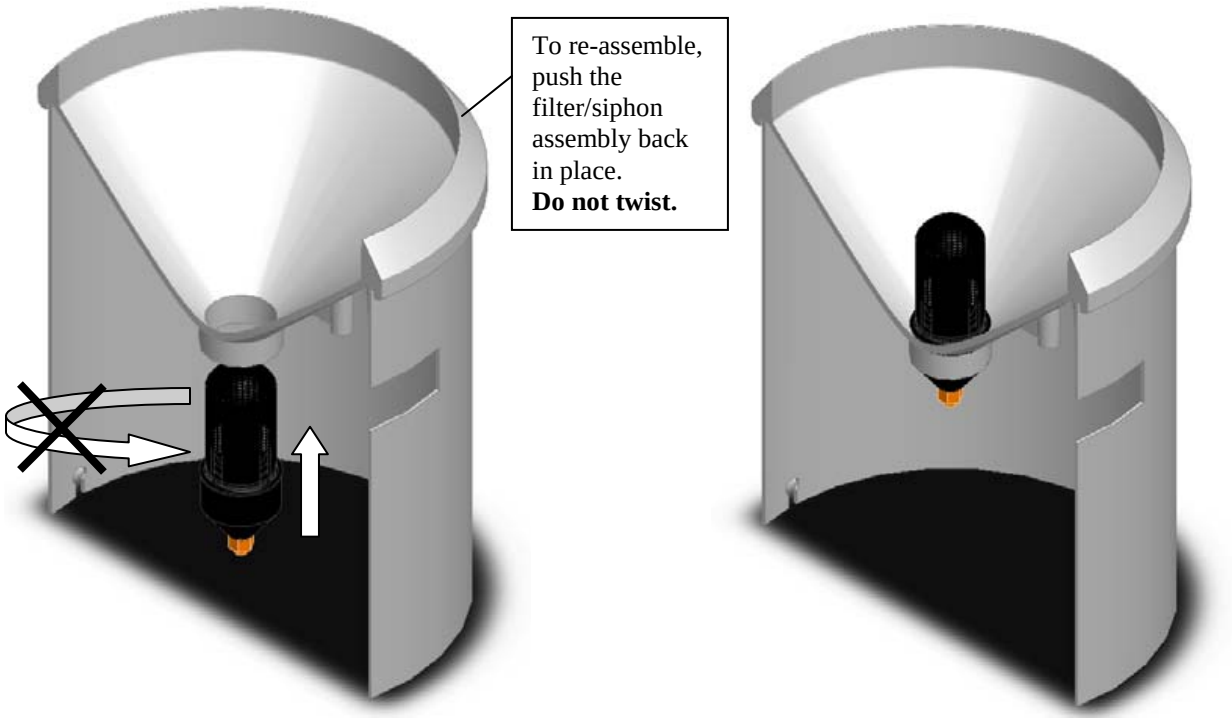


FIGURE 7-4. Reassembling the TB4

5. Place the housing assembly back onto the base and tighten the three screws that secure the housing onto the base.

8. 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:

Field Calibration Check:

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

b. Check the bubble level to verify the rain gage is level.

c. Pour water through the inner funnel to wet the two bucket surfaces. Using a graduated cylinder, slowly pour 314 cc (19.16 in^3) of water, over a 15 minute period, into the collection funnel. This volume of water is equal to .39 inches of rainfall (10 mm).

d. After the water has passed through the rain gage, the tipping bucket should have tipped 39 times for the TB4 or 50 times for the TB4MM.

e. If the rain gage fails to record the correct number of tips, return the unit to Campbell Scientific for recalibration.

Factory Calibration

If factory calibration is required, contact Campbell Scientific to obtain an RMA (see Warranty and Assistance in the front of the manual).

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