Rickly
Measuring the World's Water

# TIPPING BUCKET RAIN GAUGE
# Operations & Maintenance Manual

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# 1. Introduction

## 1.1 Overview

This Tipping Bucket Rain Gage is used to measure rainfall volume and/or rate. Rain entering through a funnel assembly with an 8.08 inch (205mm) orifice passes through a debris filtering screen and is funneled into a siphon that regulates flow and into one side of the tipping bucket assembly inside the gage. The bucket tips when a given amount of water, determined by gage calibration, has been collected. As the bucket tips it causes a magnet to pass by a ruggedized reed switch, momentarily closing the switch. The tipping of the bucket brings a second bucket into position under the funnel, ready for filling. After the rain water is measured, it is directed into drain tubes that allow it to exit out holes in the base of the gage; the exit holes are 3/8 NPT to allow for tubing or screen fittings.

Materials used in construction of the instrument are corrosion resistant. All external openings of the gage are protected from insects and foreign material by mesh screen.

# 2. Specifications

| Type | Tipping Bucket |
|---|---|
| **Sensitivity/Resolution** | 1 tip per 0.1mm<br>1 tip per 0.2mm<br>1 tip per 0.5mm<br>1 tip per 1.0mm<br>1 tip per 0.01 inch |
| **Orifice size** | 8.08" dia. (205mm) |
| **Accuracy** | ±2% from 25-500mm/hr |
| **Bearings** | Sapphire jeweled bearings with hard stainless steel shaft |
| **Insect protection** | Mesh screens |
| **Capacity** | 27.5"/Hr with ±5% |
| **Output** | 0.1 second switch closure |
| **Switch type** | Single reed switch |
| **Size**<br>**Diameter**<br>**Height** | <br>9" dia. (228mm)<br>19" (482mm) |
| **Weight** | 6.6 lbs (3kg) |
| **Temperature range, operating** | 0° to 60°C |

# 3. Installation

## 3.1 Setup & Wiring

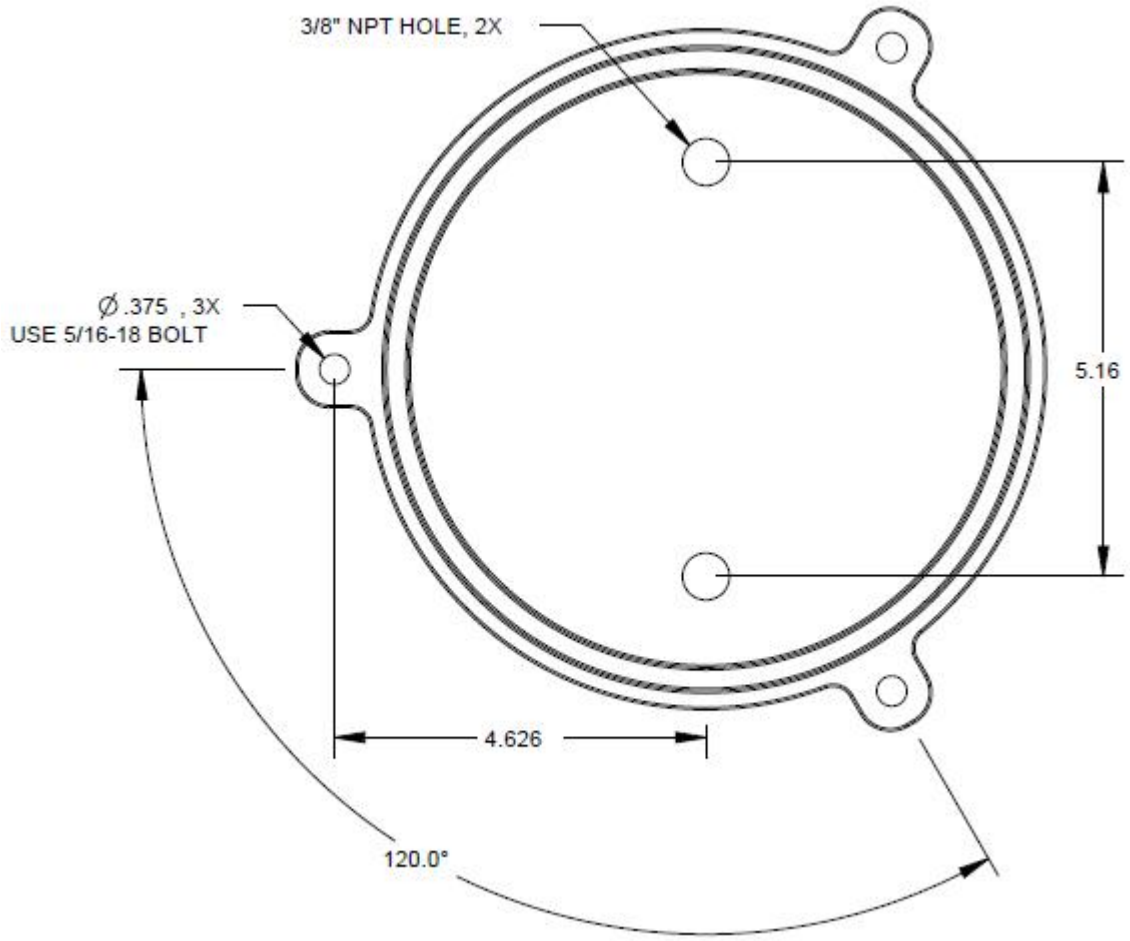
1. This instrument is thoroughly tested and fully calibrated at the factory and is ready for installation. If return to the factory is necessary please contact Rickly Hydrological Co., Inc. Customer Service department at (614) 297-9877800 for a Return Material Authorization Number.
2. The gage must be mounted level and adequately protected from high winds. Errors of greater than 5% can occur due to rainfall blowing over the lip of the orifice.
3. Install the rain gage at a distance away from surrounding obstructions two to four times the obstacle's height. Such obstacles may block the normal rainfall path into the gage or rainfall may blow off the obstructions and into the gage.
4. The gage should be securely mounted by using the mounting holes provided by the mounting feet. A recommended method of mounting the gage is to secure the gage pour a small (12" square) concrete pad at the site with three anchor bolts set for the hole pattern of the mounting feet.
5. Loosen the 3 screws attaching the outer housing of the rain gage to the tipping bucket mechanism. Rotate the top half clockwise and lift up to remove outer housing of rain gage.
6. Using the bulls-eye level on the tipping bucket mechanism, level and securely mount the gage.
7. Fish a two conductor cable through the PG gland in the base and connect the two conductor cables between the Switch thumb screw and the screw on the housing to the right of the switch. Do this by unscrewing both screws from housing to create a gap about the thickness of the wire, stripping 1/2" of insulation off of both wires, wrap the stripped part around each screw clockwise between the gap, tighten down both screws to clamp the wire in place.

**Figure 1: Tipping Bucket Output**

8. Pull extra cable back out the PG gland and tighten the gland to secure the cable in place.
9. Place the cover back on making sure to align with the screws in the base. Make a slight count-clockwise rotation once the cover is on the base and secure it in place by tightening all three screws in the base.
10. Be sure to remove any packing material and the bucket retainers from the instrument.

Mounting Hole Pattern

- Use three 5/16-18 bolts to secure tipping bucket to installation platform.
- Drain holes are 3/8” NPT tapped for optional outlet filters or drainage tubing.


3/8" NPT HOLE, 2X
Ø.375 , 3X
USE 5/16-18 BOLT
5.16
4.626
120.0°

# 4. Theory of Operation

The 8.08 inch diameter orifice was chosen from a trade-off between the sampling area and the size of the tipping bucket mechanism. The large funnel at the orifice helps prevent evaporation inside the instrument.

Precipitation enters the funnel inside the instrument and remains there until there is sufficient accumulation to trigger the siphon. This is about equal to 6mL worth of precipitation. Once the siphon is triggered, it releases all the water in the funnel at a constant rate and is directed to one of two tipping buckets. When one bucket fills, its weight tips the next bucket into position, and empties the first. At the same time, a .1 second momentary contact closure occurs. This closure initiates an event accumulating device. The water drains through the bottom of the instrument.

# 5. Calibration

## 5.1 Laboratory Calibration

| Model Number | Calibration | Grams per Tip |
|---|---|---|
| 1001-001, 1001-011, 1001-201, 1001-211 | 0.2 mm of rain | 6.62 grams |
| 1001-102, 1001-012, 1001-202, 1001-212 | 0.5 mm of rain | 16.54 grams |
| 1001-104, 1001-014, 1001-204, 1001-214 | 0.01 inch of rain | 8.40 grams |

1. To calibrate the tipping bucket rain gage, remove the outer cover by first loosening the three screws at the base. BE SURE THE GAGE IS LEVEL, using the built-in bulls-eye level as an indicator.

2. To make the first rough adjustment, draw water into a B-D 20cc syringe and weigh out to grams indicated in the table above for the required model number on an ACCULAB (or equal) Model 121 precision weighing gage. Be sure to zero out the weight of the empty syringe before weighing the water. With the bucket adjustment screws located on the bottom of tipping bucket, adjusted all the way counter-clockwise, transfer the water from the syringe into one side of the bucket. Rotate the opposite side adjusting screw clockwise until the bucket tips. Repeat these steps for the second bucket.

3. To make the final calibration adjustments, reassembly the cover to the tipping bucket and devise a source of water (Calibration Drip Setup, page 8) with a uniform flow rate of approximately 2" per hour. Direct this flow onto the wall of the small funnel. After the gage has tipped several times and the buckets are wet, collect the water in two containers, one under each drain tube. (Styrofoam cups work well) Carefully insert the collection containers between tips and collect exactly 5 tips of each bucket. Remove the containers. Measure the amount of water in each container by weight using the ACCULAB weighing gage described above. (Be sure to zero out the weight of the empty collection containers) The total weight of both containers should be from 82.32 grams to 85.68 grams, or $\pm$ 2% of 84 grams if calibrating for a -6 unit.

4. Adjustments may be made to the stops located under the buckets. Raising the stop of the bucket will reduce the catch for that bucket and consequently lowering the stop will reduce the catch for that bucket and consequently lowering the stop will increase the catch. NOTE: The stop for a bucket is located under the opposite bucket. Make only small corrections at a time (1/4 turn per test). Repeat the calibration procedure until the gage is within specifications.

5. The above procedure is for a rate of 2"/hour. The gage may be calibrated at other rates of interest.

6. After calibration, note date and place of calibration and reinstall the outer cover and screws. Be sure the cover is correctly lined up.

7. If the gage has been removed from a field location for calibration be sure the gage is installed and leveled properly.

Field Calibration

To check for calibration in the field, use a Qualimetrics, or equal, Rain Gauge Field Calibrator Model 10603.

Bring at least 3 liters of water to the gage site for this test.

8. For a calibration check at 2"/hr rate, fill the bottle with water until the meniscus level reaches the center of the reference line.
9. Screw the orifice assembly onto the bottle and slip the holder over with the feet pointing upward.
10. While holding the calibrator over the gage, flip the calibrator assembly so that water begins flowing out into the rain gage funnel. Do not allow any water to drip outside the funnel.
11. Set the calibrator in the funnel shown in the diagram. The feet of the holder should position themselves firmly in the funnel, supporting the bottle nearly vertical above the funnel opening.
12. In about half an hour the water stream should cease. Tap or shake the bottle slightly to make sure all the water is out.
13. Repeat the above test about three times, recording the number of tips after each test. (Note: The number of tips during each test can vary by a count or so because of the residual water left in one bucket at the end of the preceding test.
14. For 2"/hr rain rate the number of tips should be from 198 to 202 for -6 model. If the values fall below or above, remove the gage from the field and recalibrate using the Laboratory Calibration Check. Note that the siphon will prevent some water from going through the system so your tip count may reduce by 1 depending on whether you start with the unit completely dry or not.

## 5.2 Maintenance

Maintenance is limited to cleaning debris out of the input orifice and output drains.

## 5.3 Calibration Drip Setup

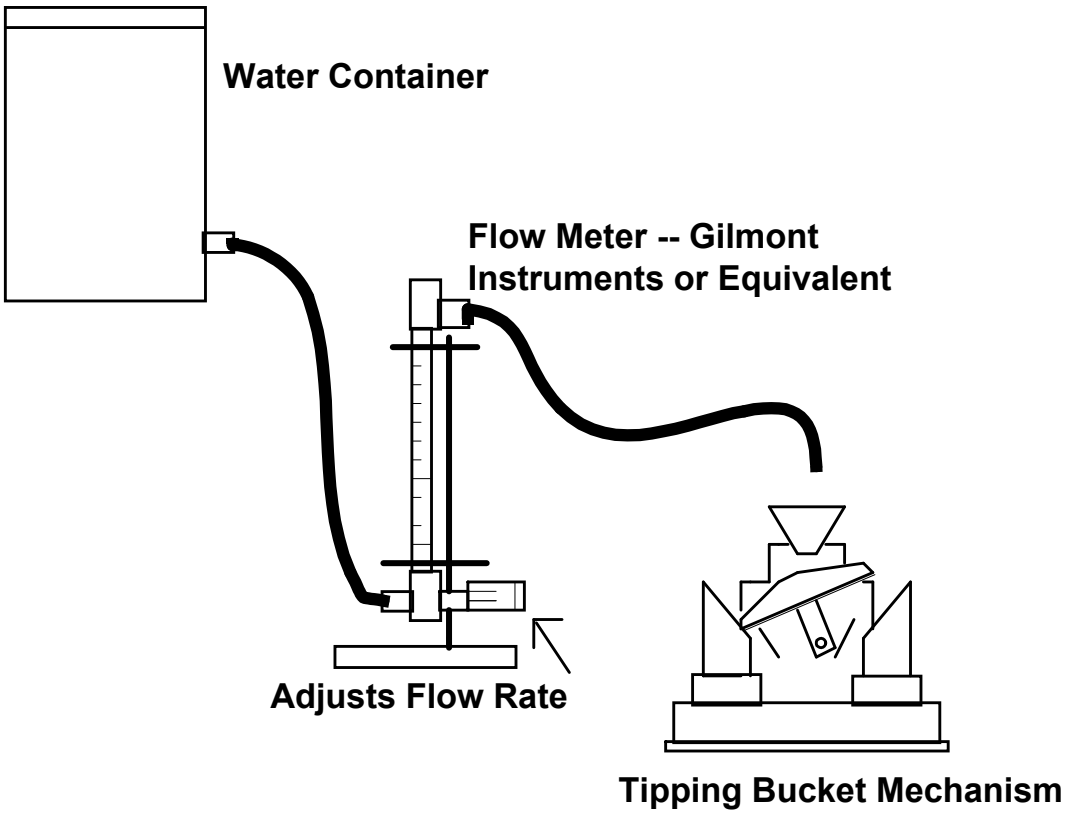



**Fig.2**

# 6. Training & Warranty

## Dear Customer:

Thank you for making the important decision to purchase Rickly equipment. All Rickly equipment is manufactured and tested to the highest quality standards as set by Rickly's Quality Assurance Department. Our Customer Service Representatives have years of experience with equipment, systems and services. We have electronic technicians with field and applications experience, not limited to technical school training.

## Rickly Equipment Repairs

Rickly maintains a Repair Department at the Ohio factory (1700 Joyce Ave, Columbus, OH 43219).

- Average turn-around time for repairs ranges from ten to thirty days after Rickly receives equipment for repair.
- Prior to returning any equipment for repair, please call Customer Service at (614) 297-9877 for a Return Material Authorization (RMA) number. Then send the faulty equipment back to the Ohio factory.
- Rickly Customer Service will repair Rickly-manufactured equipment sent to us for repair within 30 days.
- Please provide our Customer Service Representative with your email address when receiving the RMA number so that we can email you when your equipment is received at Rickly and again when it is shipped back to you.
- Expedited repairs can be completed within one (1) week for an additional expedite fee of $200.00.
- Repaired equipment is warranted for a period of 180 days after the repair shipment date.
- We appreciate your cooperation in achieving a quick turn-around by promptly providing cost approval decisions, Purchase Order and credit card information once we have supplied you with a repair estimate.

## Customer Phone Support: 8:00 am to 5:00 pm EST, Monday through Friday

Customer Service Representatives routinely handle a wide variety of questions every day. When equipment questions arise, please feel free to contact me or one of Rickly's Customer Service Representatives. We are available from 8:00 am to 5:00 pm EST Monday through Friday and are happy to take your calls. The main Customer Service number is (614) 297-9877.