Model
H-340

Tipping Bucket Rain Gauge

WATERLOG® SERIES

Owner's Manual

Version 1.1

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User Agreement/ *WATER*LOG® Warranty

1. NATURE OF THE PRODUCT

This agreement accompanies a pressure measuring system comprising micro-coded circuitry and other electronic equipment sealed in an enclosed housing, and packaged together with written instructional materials. The packaged electronic circuitry and instructional materials herein are collectively referred to as the "PRODUCT." The PRODUCT is made available from DESIGN ANALYSIS ASSOCIATES, INC., of 75 West 100 South, Logan, Utah 84321 (hereinafter referred to as "DESIGN ANALYSIS"), and contains information and embodies technology that is confidential and proprietary to DESIGN ANALYSIS, and the availability and use of the PRODUCT is extended to you, the USER, solely on the basis of the terms of agreement which follow.

2. ACKNOWLEDGMENTS BY USER

Opening the package which encloses the accompanying PRODUCT indicates your acceptance of the terms and conditions of this agreement and constitutes an acknowledgment by you of the confidential and proprietary nature of the rights of DESIGN ANALYSIS in the PRODUCT.

3. DUTIES OF YOU, THE USER

In consideration for the access to and use of the PRODUCT extended to you by DESIGN ANALYSIS and to protect the confidential and proprietary information of DESIGN ANALYSIS, USER agrees as follows:

(a) USER agrees that they will not open the sealed housing of the PRODUCT, and that they will take all necessary precautions to prevent their employees, agents, sub-contractors and resellers from doing so.

(b) USER agrees that they will not remove from the exterior of the housing of the PRODUCT any warnings against opening or notices of proprietary interest placed thereon by DESIGN ANALYSIS, and that they will take all necessary precautions to prevent their employees, agents, sub-contractors, and resellers form removing such markings therefrom.

(c) USER agrees to treat the PRODUCT with the same degree of care as USER exercises in relation to their own confidential and proprietary information.

(d) USER agrees to return the PRODUCT to DESIGN ANALYSIS if and when the PRODUCT is deemed to be no longer of use. In return therefore, USER will receive from DESIGN ANALYSIS a redemption fee of $10.00.

4. TERM

USER may enjoy these rights only as long as their possession of the PRODUCT shall continue to be rightful. These rights will cease if the PRODUCT is returned to DESIGN ANALYSIS under the terms of any redemption offer, warranty, or money-back guarantee, or if USER transfers the PRODUCT to another party on terms inconsistent with this agreement.

5. LIMITED WARRANTY

(a) What is Covered

DESIGN ANALYSIS warrants that for a period of twelve months from the time of purchase the functions to be performed by the PRODUCT will be substantially in compliance with USER documentation. DESIGN ANALYSIS also warrants that the PRODUCT will be free from defects in materials and workmanship for a period of ONE YEAR from the date of purchase.

(b) What USER Must Do

If the product fails to satisfy the above warranty, USER must notify DESIGN ANALYSIS in writing within the applicable period specified above and reasonably cooperate with the directions they received from DESIGN ANALYSIS.

(c) What DESIGN ANALYSIS Will Do

DESIGN ANALYSIS will repair the PRODUCT or will endeavor to provide a replacement of same within a reasonable period of time. In the event that DESIGN ANALYSIS is unable to make the necessary repairs or replacement within a reasonable period of time, the original purchase price will be refunded upon the return of the PRODUCT to DESIGN ANALYSIS.

(d) Limitations

(i) THIS LIMITED WARRANTY IS VOIDED WHERE THE SEALED HOUSING OF THE PRODUCT HAS BEEN OPENED.

(ii) THE ENTIRE REMEDY FOR BREACH OF THIS LIMITED WARRANTY SHALL BE LIMITED TO REPLACEMENT OF THE DEFECTIVE PRODUCT OR REFUNDING OF THE PURCHASE PRICE, AS SET FORTH ABOVE. IN NO EVENT WILL THE LIABILITY OF DESIGN ANALYSIS TO USER OR TO ANY OTHER PARTY EXCEED THE ORIGINAL PURCHASE PRICE OF THE PRODUCT, REGARDLESS OF THE FORM OF THE CLAIM.

(iii) EXCEPT FOR THE EXPRESS WARRANTIES ABOVE, DESIGN ANALYSIS SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

(iv) UNDER NO CIRCUMSTANCES WILL DESIGN ANALYSIS BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT, OR ANY OTHER DAMAGES OR CLAIMS ARISING FROM THE USE OF THIS PRODUCT, THIS INCLUDES LOSS OF PROFITS OR ANY OTHER COMMERCIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT WILL DESIGN ANALYSIS BE LIABLE FOR ANY CLAIMS, LIABILITY, OR DAMAGES ARISING FROM MODIFICATION MADE THEREIN, OTHER THAN BY DESIGN ANALYSIS.

(v) Should the exclusive remedy stated in subparagraph 6 (d) (ii) above be determined by a proper court of law to have failed of its essential purpose, the limitation of the obligations of DESIGN ANALYSIS stated in subparagraphs 6 (d) (iii) and (iv) shall remain valid.

(vi) THIS LIMITED WARRANTY GIVES USER SPECIFIC LEGAL RIGHTS. USER MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS OR THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THOSE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY.

6. BINDING AGREEMENT

This is a binding agreement, and if not understood, USER should seek competent legal advice. By paying for the PRODUCT and opening the package, USER acknowledges to have read this Agreement and have agreed to be bound by its terms and conditions.

7. GOVERNING LAW

This Agreement and its validity and interpretation shall be governed by the laws of the State of Utah, notwithstanding any choice of law rules of Utah or any other state or jurisdiction.

8. U.S. GOVERNMENT RESTRICTED RIGHTS

Use, duplication, or disclosure by the United States Government is subject to restrictions set forth in paragraph (c) (1) (ii) of the rights in Technical Data and Computer Software clause at 52.227-7013. The Contractor-manufacturer is DESIGN ANALYSIS ASSOCIATES, INC., 75 West 100 South, Logan, Utah 84321.

Chapter 1
H-340 Operation

1.1 Introduction

The ***WATER*LOG®**H-340 is a rugged, durable, Tipping Bucket Rain Gauge.

The H-340 has the following features:

- Switch closure output connects directly to a data logger
- Patented bucket tip mechanism is easy to adjust
- Removable stainless steel funnel screen
- Rustproof, powder painted aluminum enclosure and cast base
- Side windows allow inspection of mechanism without removing cover
- No plastic parts
- All internal parts anodized aluminum or stainless steel

1.2 Theory of Operation

The H-340 has an anodized aluminum tipping bucket mounted on precision stainless steel bearings. The patented bucket tip mechanism allows easy calibration. The gauge is factory calibrated to provide one tip per 0.01 inches of rainfall.

Tipping bucket rain gauges have a reputation for being inaccurate. Inaccuracies can be caused by algae in the bucket, evaporation and poor calibration. The greatest source of inaccuracy however, is the volume at which the tipping bucket mechanism tips is sensitive to rainfall rate. This occurs because the water droplets cause small waves in the bucket and high rainfall rates cause superposition or "pile up" of extra water in the bucket before it actually tips over. The following graph shows the relationship between bucket volume and rainfall rate of a typical tipping bucket. In this example the bucket volume/tip changes from .009 in/tip to .013 in/tip as the rainfall changes from 0 to 25 in/hour.

The user should be aware of this inerrant inaccuracy in all simple tipping bucket rain gauges. Realizing the non linearity of the mechanism, it is important for the user to calibrate the rain gauge for the rainfall rates most common in the geographical area to be monitored.

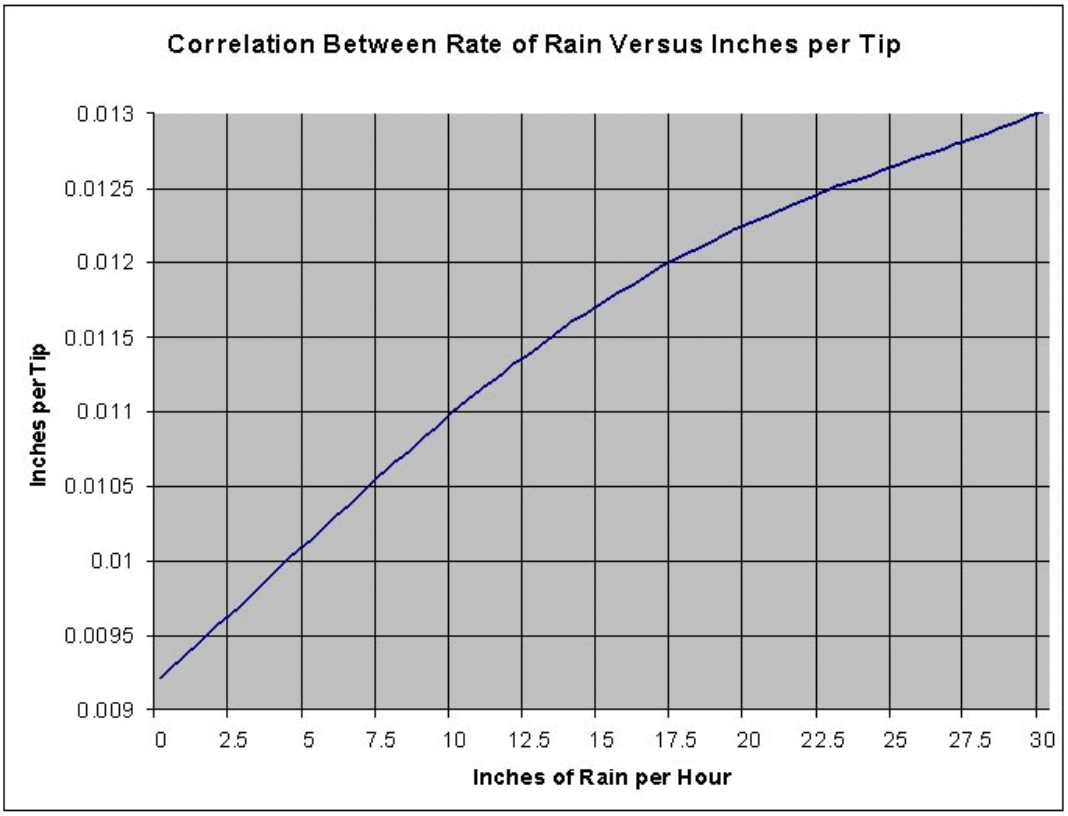

Figure 1 Bucket tip mechanism sensitivity

1.3 Installation

Install the H-340 in an open location where it will not be in the rain shadow of trees or buildings. A rooftop location helps prevent vandalism and the accumulation of leaves and debris. Bolt or screw the 3-mounting feet to the structure to prevent upset in high winds. Adjust the three self-leveling screws until the "bulls eye" level is centered.

1.4 Factory Calibration

The H-340 is calibrated in the factory with an apparatus which provides a constant 4in/hour flow rate. The water exiting from the bottom of the rain gauge is captured in a precision graduated cylinder. After 100 bucket tips or more have occurred, the flow is stopped and the volume in the graduated cylinder is measured. The procedure is as follows:

1. Empty the graduated cylinder.
2. Start the water flow into the funnel.
3. Wait until at least 100 bucket tips have occurred (1% resolution).
4. Stop the water flow.
5. Observe and record the water volume in the graduated cylinder.
6. Use the formula below to compute the actual *rainfall* in the graduated cylinder..
7. Calculate the *rainfall* measured by the rain gauge (0.01inches x number of tips).
8. Compare the difference between these two values.
9. Adjust the counterweight as needed and repeat until the two values are identical or within an acceptable difference.

The rainfall "volume" equation below converts the volume in the graduated cylinder (mL) into the equivalent rainfall (in inches) captured by an 8 inch diameter funnel.

$$RAINFALL_{inches} = \frac{NmL \times \frac{L}{1000mL} \times 61.025 \frac{in^3}{L}}{\pi(4.0in)^2} = NmL \times 1.21405x10^{-3}{}_{inches}$$

1.5 Adjusting the Tipping Bucket Mechanism

Warning: DO NOT ADJUST THE BUCKET STOPS.

Adjusting the stop posts causes a false reading of equal amounts of water in each bucket. This is due to the variation of distance the bucket center must travel after passing the bottom of the funnel. Do not adjust the bucket stops in an attempt to balance the weight of the buckets. Instead, the H-340 provides an **adjustable screw** parallel to the buckets by which the bucket weight balance can be accomplished. This eliminates the need to adjust the stops and compensates for any inequality of weight due to manufacture and assembly, and gives equal travel to each bucket as the center passes the flow of water.

The counter weight underneath the bucket mechanism can be adjusted (up or down,) to set the bucket volume (# tips/unit rainfall). See Figure 2. The up/down counter weight adjust instructions in steps 1 and 2 may seem to be intuitively backwards however, realize the center of gravity of the bucket and counterweight is above the pivot.

1. To adjust for more tips (more rainfall volume), release nut #1 and turn weight counter clockwise (down). Re-lock nut #1.

2. To adjust for less tips (less rainfall volume) release nut #1 and turn weight clockwise (up). Re-lock nut #1.

3. To adjust for equal amounts of water in each bucket, loosen set screw #2, turn adjusting screw toward the bucket with the most amount of water, then re-lock the setscrew.

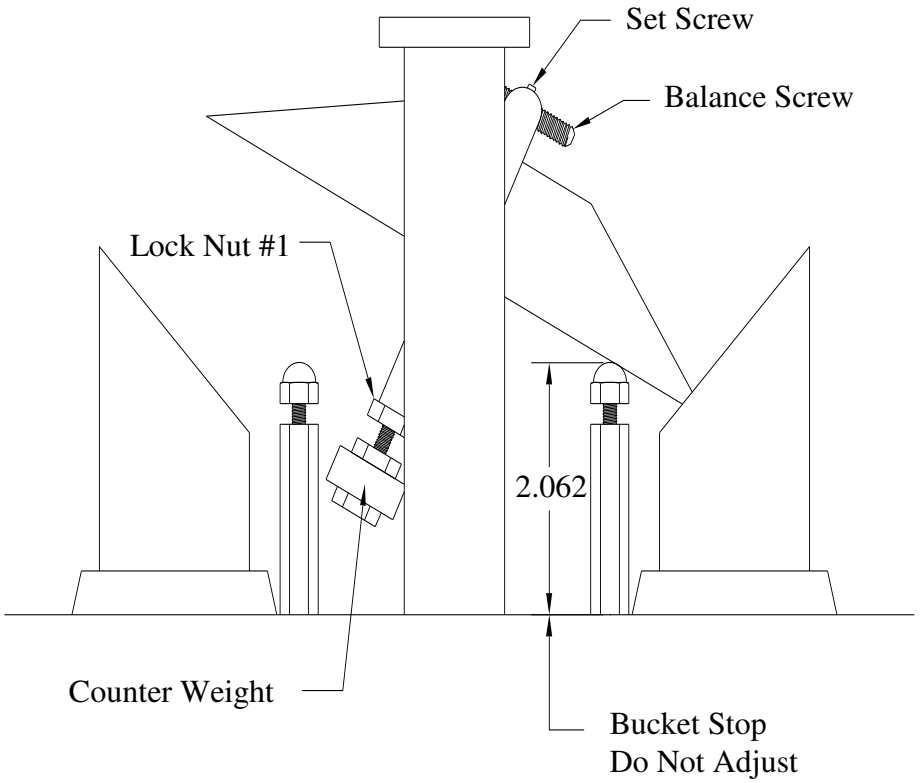

Figure 2

Appendix A
Specifications

General

Resolution:	0.01 Inches (@4in/hr)
Rate:	0 to 25 inches/hour

Calibrated @ 8.237 mL/tip = 0.01in rainfall, includes computer printout of conformance.

Magnetic Reed Switch

Type:	Normally open encapsulated reed.
Rating:	200VDC max 0.1A max
Contact Resistance:	0.2 ohms

Output Connection

2-position screw barrier strip

Environmental

Operating Temperature:	-0 to 60 °C

Mechanical

Aperture:	8 inch diameter funnel
Diameter:	8 inches
Height:	12 inches
Weight:	8 pounds

Housing:
Extruded aluminum tube. Cast aluminum base. Anodized aluminum internal parts. Stainless steel screws and fasteners. Powder painted base, funnel and housing.

Mounting:	3-stainless leveling screws with adjustable aluminum feet. Internal "bulls-eye"level.
Exit Ports:	Two screened drain tube fittings on bottom of casting.

Warranty

The ***WATER*LOG®** H-340 is warranted against defects in materials and workmanship for one year from date of shipment.