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User Manual for the

# ***Raingauge***

*type RG1*



*RG1-UM-3*

**AT**

***DELTA-T DEVICES***

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## ABOUT THIS MANUAL

This manual describes how to install and use the raingauge type RG1

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**In this Manual, all references to loggers and weather stations relate to the Delta-T Logger DL2, its software LS2, the WS01 Weather Station, and the sensor codes used with them. The references also apply to the DL2E and its derivatives.**

**For use with the DL3000 logger, you must refer to the DL3000 documentation. It contains the specific connection details and sensor type codes used by the DL3000. General information concerning the performance and installation of the sensor contained in this manual remains relevant.**

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# Raingauge

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Delta-T Serial Number :      RG1.\_\_\_\_\_

Sensor type code : RG1

Date of last calibration	Calibration Factor	Correction Factor
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## INTRODUCTION

Conventionally shaped raingauges interfere with the airflow, so that the catch is reduced. This raingauge was aerodynamically designed by the Institute of Hydrology, and is very similar to that derived theoretically and independently by the UK Meteorological Office as an "ideal" shape.

The raingauge is fabricated in UV-resistant vacuum-formed plastic. It operates in the same way as any other tipping bucket raingauge. The water collected by the funnel is passed into a double-sided container which tips when a set amount of water has been collected in one side, the process repeating indefinitely. At each tip, the bucket causes a magnet to pass a magnetic reed switch, closing its contact for a fraction of a second. This contact closure is counted by the Delta-T Logger. The gauge is calibrated to tip once for each 0.2 mm of rain. An individual calibration factor is given for each raingauge.

## SITING THE RAINGAUGE

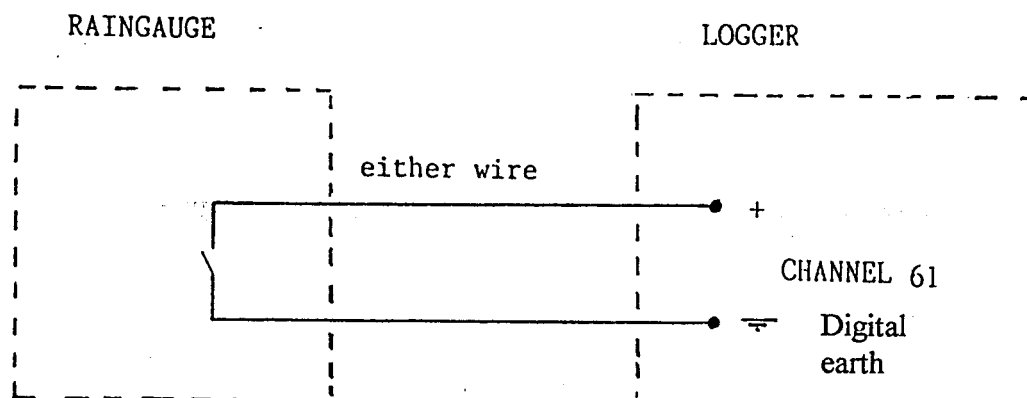
The gauge should be installed in accordance with the standard rules applicable to any raingauge, such as ensuring that it is not closer to an object by more than twice the object's height. This avoids any shielding effect. The weather station mast has quite a low wind profile, but we provide 5m of cable for mounting the raingauge at a distance from the mast. Further information on raingauge exposure is given in the publications listed at the end of this section. Research has shown that since a raingauge acts as an obstruction to the flow of wind, the flow of air speeds over the top, causing less rain to be collected by the funnel than would have fallen on the ground if the raingauge had not been there. In most cases this is ignored, but it may be corrected for arithmetically, or overcome physically by placing the gauge in a pit with the tip of its funnel level with the ground. The pit is covered by a grating to simulate the ground aerodynamically while preventing splash-in to the funnel. While excellent, this method may not always be practical. To minimise the effect of wind turbulence around the funnel, the profile of the raingauge has been designed to reduce wind effects so that the catch of the gauge is increased. Such a gauge can, therefore, be deployed successfully in more exposed sites.

An anodised aluminium base plate is provided for levelling the raingauge and to attach it firmly to the ground. This plate can either be pinned to the ground with the stakes provided, or it can be bolted to a block of concrete or wood.

Three threaded studs attached to the base plate are bolted to the plastic base of the raingauge. It can be levelled by adjusting the heights of the nuts on the studs and by observing the built-in spirit level.

It is important to ensure that the raingauge is level. Failure to do this will result in a systematic error. Many users pay only scant attention to this, yet it is one of the simplest means of improving the accuracy of rainfall measurements.

## WIRING CONNECTIONS



The screen may be connected either to the Logger digital earth, or to the raingauge frame. It should not be connected to both, otherwise there is a possibility of errors from earth loops.

## CONFIGURING THE LOGGER

Instructions on configuring the logger using the PC software are given in the *Delta-T Logger User Manual*.

The example wiring diagram assumes that the raingauge is connected to channel 61.

For highest accuracy the results should be corrected as described below - see *Use of Conversion and Correction Factors*.

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## USE OF CONVERSION AND CORRECTION FACTORS

Consider this example.

For a particular raingauge it is found that each tip corresponds to 0.198 mm of rain. This corresponds to a Conversion Factor of

$$1/0.198 = 5.051 \text{ tips per mm of rain.}$$

When you programme the logger, and are defining a raingauge sensor type, the logger will ask you what engineering units to use, to which you reply "mm". It will then ask you the number of counts per mm. The accurate Conversion Factor to use is, in this example, 5.051 counts per mm. However the logger will not accept a non-integer conversion factor for a counter input, thus losing the potential high accuracy which can be achieved with this type of calibration. This is a limitation in the software of the logger. If you tell it 5.051 it will round the conversion factor to the nearest integer value, ie 5. The only way to regain the accuracy of the measured rainfall is to multiply the logged data by a correction factor corresponding to the difference between the true conversion factor and the rounded integer value used by the logger.

For example,

Given 1000 tips during a recording interval.

The calibration for a particular raingauge is 0.198 mm per tip,  
ie 5.051 tips per mm.

The logger calculates  $1000/5 = 200$  mm of rain

The true value is  $1000/5.051$   
or  $1000 \times 0.198 = 198$  mm of rain

The correction factor to be applied is

$$198/200 = 0.99$$

This procedure acknowledges two things. Firstly that the user probably does not have the time to adjust and test, adjust and test, many times over to get the setting exactly on 0.2 mm per tip, nor to repeat such a laborious procedure on a regular (say yearly) basis. Secondly, the logger software cannot handle non-integer conversion factors for the counter input channels. The processed data printed out by the logger, or collected by your computer, should be multiplied by the appropriate correction factor.

**SPECIFICATIONS**

Sensitivity :	0.2 mm per tip ( nominal ).
Calibration :	Individual calibration factor provided.
Calibration limits :	0.195 to 0.205 mm per tip.
Accuracy :	No accepted standard for comparison.
Funnel diameter :	254 mm ( 10 inches ).
Overall height :	350 mm without baseplate and tripod.
Switch:	magnetic reed switch. 300 mA max current allowable
Output :	Contact closure at "tip".
Weight :	1.0 kg without base plate and tripod.
Levelling :	Tripod levelling mechanism with spirit level.
Mounting :	Anodised aluminium base plate pinned to the ground with 4 zinc-plated steel stakes. Alternatively the base plate can be bolted to a block of concrete or to a heavy block of wood.
Cable :	6 m PVC, screened twisted pair.



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## CALIBRATION PROCEDURES

### Static Calibration

The raingauge is calibrated during manufacture as described below. This may be repeated by the user if desired.

Install the raingauge, as illustrated in Figure 5.1, over a sink ensuring that it is level. Using a burette or pipette, adjust the two calibration screws under the tipping bucket until it tips with the correct amount of water ( 10.13 cc for a 0.2 mm sensitivity). It will not be possible to set the screws with very high precision in this way but it should be done with as much care as possible. ( This stage may be omitted if rechecking the calibration ). Only by means of a dynamic test can the exact calibration of a tipping bucket ( of any type ) be established. This test is described below. Many manufacturers and users of tipping bucket raingauges aim to adjust the bucket settings until EXACTLY the correct calibration is obtained. To achieve this, it would be necessary to repeat the dynamic test many times over, and this is very time consuming. In any case, it is almost impossible to get the adjustment absolutely correct. Therefore, it is considered better practice by the Institute of Hydrology to adjust the settings as closely as is reasonably practical and then to derive a Calibration Factor for each gauge.

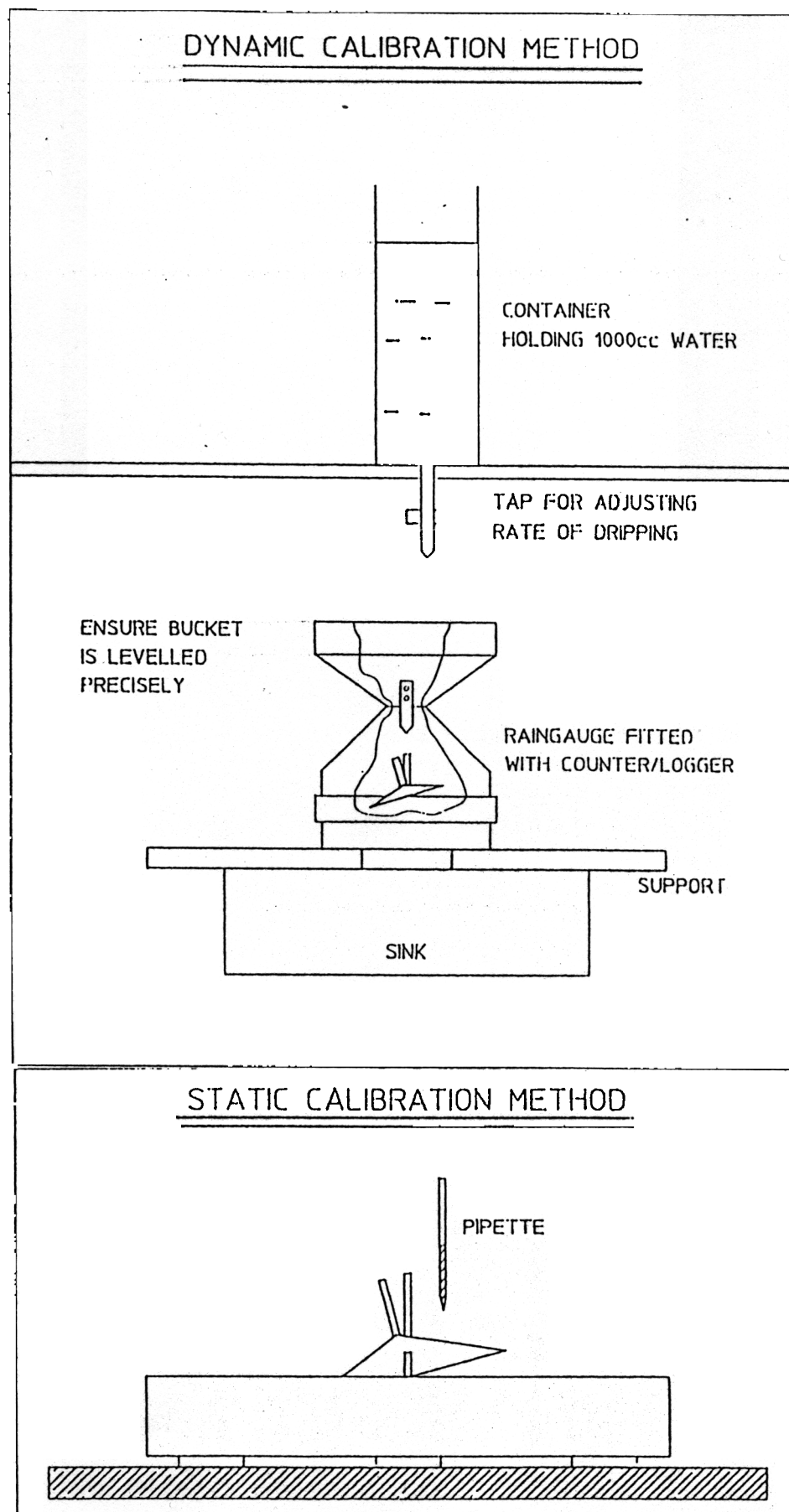
The Calibration Factor can be found using the dynamic calibration procedure described below.

### Dynamic Calibration

When the static burette test described above has been done, the calibration of the gauge should be checked as follows (most users will start from here). This procedure was carried out prior to dispatch, and the resulting Calibration Factor written inside the raingauge and at the front of this chapter.

Set up the calibration test as shown in Figure 5.1. Ensure that the gauge is level. Connect the output wires to channel 61 or 62 of the logger, or any convenient electronic or electromechanical counter. Fill the container with 810.4 cc of water. This is done most precisely by weighing the water on scales capable of measuring to 0.1 gm. If this is not practical, it should be done using a good quality graduated measuring cylinder. Allow the water to drip slowly into the gauge, taking at least 30 minutes to empty the container. At the end of this period there should have been 80 tips. It is unlikely, however, that there will be exactly this number. Note how many tips actually occurred and also estimate as precisely as possible what fraction of a tip is left in the bucket. Only if the adjustment has been very precise indeed will the bucket tip at the moment the last drop passes into it. The Calibration Factor can now be calculated.

FIGURE 5.1 : DIAGRAM OF RAINGAUGE DYNAMIC CALIBRATION SET-UP



### How to Calculate the Calibration Factor

Let N equal the number of tips. This should include an estimate of the fraction of a tip left in the bucket, eg 0.5 of a tip. The Calibration Factor is then :

$$= 0.2 \times 80/N.$$

For example, if  $N = 78.8$ , then

$$\begin{aligned} &= 0.2 \times 80/78.8 \\ &= 0.203 \text{ mm per tip.} \end{aligned}$$

Provided the Conversion Factor lies between 0.195 and 0.205 mm, or 78.0 and 82.1 tips, respectively, then it is acceptable for most purposes. The gauge is calibrated at manufacture such that each tip will lie within the above limits.

There is no reason, however, why users should not, if they so wish, aim for closer agreement with the nominal tip of 0.2 mm by repeated adjustments of the calibration screws followed by further dynamic tests. Only time limitations will set a limit to this.

Please refer to the appropriate section of the Delta Logger User Manual for general instructions.

## REFERENCES

1. Rodda, J.C.,(1967) "The rainfall measurement problem", Proc. IAHS Gen. Ass., Bern, IAHS Pub. No. 78, 215-231.
2. HMSO (1956) Handbook of Meteorological Instruments, Part 1 Met.O. 577, published by Her Majesty's Stationery Office, U.K.
3. HMSO (1982) Observers Handbook, Met. O. 933, published by Her Majesty's Stationery Office, U.K.
4. Hughes, C., Strangeways, I. & Roberts, A.M.  
Field Evaluation of two aerodynamic raingauges.  
Weather (1993) Vol 48, No 3 66-71

## GLOSSARY OF TERMS

- Calibration Factor:** Defined by the raingauge manufacturer as the number of mm of rain per tip.  
eg 0.198 mm/tip
- Conversion Factor :** The number of tips per mm of rain.  
This is the reciprocal of the calibration factor, and is the figure the logger software will ask for when defining a sensor type library.  
The logger will round this to the nearest integer - 5.
- Correction Factor :** The number by which the output of the logger must be multiplied in order to compensate for the integer conversion factor, and so calculate the true rainfall.  
= Calibration Factor x 5  
eg  $0.198 \times 5 = 0.99$

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## **GUARANTEE, REPAIRS AND SPARES**

Our Conditions of Sale ref: COND/91/11 set out Delta-T's legal obligations on these matters. For your information the following paragraphs summarise Delta-T's position but reference should always be made to our Conditions of Sale which prevail over the following explanation.

Instruments manufactured by Delta-T are guaranteed for one year against defects in manufacture or materials used. The guarantee does not cover damage through misuse or inexpert servicing, or other circumstances beyond our control.

For the U.K. this means that no charges are made for labour, materials or return carriage for guarantee repairs.

For other countries, the guarantee covers free exchange of faulty parts during the guarantee period.

Alternatively, if the equipment is returned to us for guarantee repair, we make no charge for labour or materials but we do charge for carriage and U.K. customs clearance.

We strongly prefer to have such repairs discussed with us first, and if we agree that the equipment does need to be returned, we may at our discretion waive these charges.

## **SERVICE AND SPARES**

We recognise that some users of our instruments may not have easy access to technically specialised backup.

Spare parts for our own instruments can be supplied from our works. These can normally be despatched within 1 working day of receiving an order.

Spare parts and accessories for sensors not manufactured by Delta T, but supplied as part of the weather station, may be obtained from the original manufacturer. We will endeavour to obtain parts if requested, but a certain amount of additional delay is inevitable.

Should it prove necessary, instruments may be returned to our works for servicing. We normally expect to complete repairs of our own instruments within 2 days of receiving the equipment. Other manufacturers' sensors supplied by us and returned for servicing will take longer. They will have to be returned to the original manufacturer for servicing, and may be subject to additional delays of two to four weeks.

Users in countries which have a Delta-T Agent or Technical Representative should contact them in the first instance.