No of Tips	C.F.
96.7 to 96.9	0.204 mm/Tip
97.0 to 97.4	0.203 mm/Tip
97.5 to 97.9	0.202 mm/Tip
98.0 to 98.4	0.201 mm/Tip
98.5 to 98.9	0.200 mm/Tip
99.0 to 99.4	0.199 mm/Tip
99.5 to 99.9	0.198 mm/Tip
100 to 100.4	0.197 mm/Tip

TABLE 1 TIPS / CALIBRATION FACTORS.

6. REFERENCES.

Rodda, J.C., (1967) “The rainfall measurement problem”. Proc. IAHS Gen Ass. Bern, IAHS Pub. No. 78,215-231.

HMSO (1956) Handbook of Meteorological Instruments, Part 1, Met.0. 577.

HMSO (1982) Observers Handbook, Met. 0.933.

Parkin, D.A., King, W.D. and Shaw, D.E. (1982) An automatic raingauge network for cloud seeding experiment J.Appl. Meteorol.

Painter ,R.D. (1976) in Methods of plant ecology pp 369-410. Ed. by S.b. Chapman, Blackwell Scientific Press, Oxford.

7. SERIAL NUMBER AND CALIBRATION FACTOR.

Please enter the serial number and calibration factor for this gauge below, (both are affixed to the raingauge).

Serial Number:

Calibration Factor:

Date of Purchase:

FUTURE CALIBRATION TEST RESULTS.

Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip
Date	mm/tip

MANUAL

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Warning EMC Compatibility.

The installation of the following equipment must be installed in accordance with the following instructions detailed in this manual or EMC may be violated.
The WRG 100 Raingauge is manufactured under licence from the Institute of Hydrology.

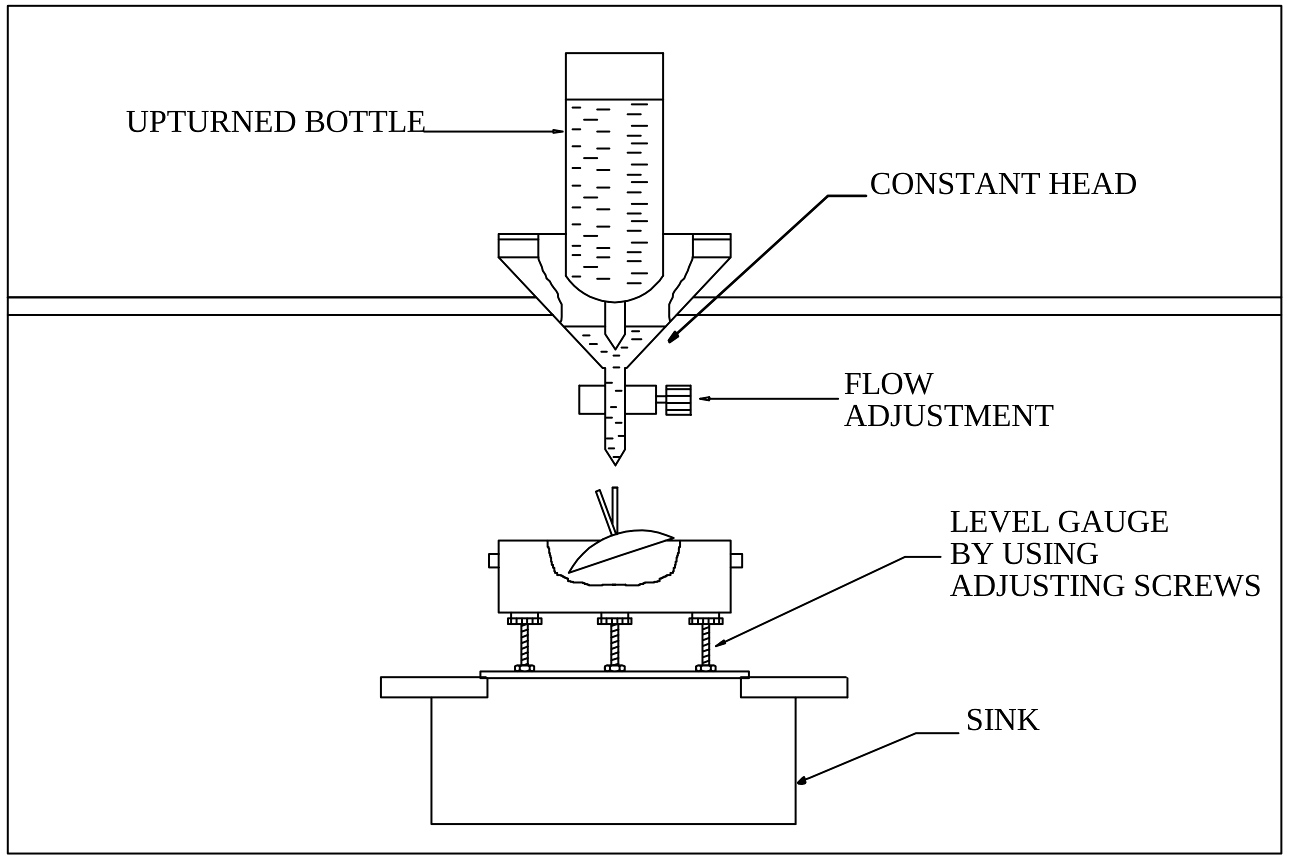

FIGURE 6 (b) DYNAMIC CALIBRATION (Constant Head)

5.3 Calculating the calibration factor.

Using the figures from the dynamic calibration the calibration factor can know be read from table 1, or you may wish to calculate the calibration factor using the following formula.

The nominal amount of tips for a 0.2 mm bucket is 98.7167 tips. Let N = the number of tips (together with the fractional part left in one bucket), the calibration factor (C.F.) is then calculated as follows (in our example we will use 99.3 tips as N).

C.F. = Gauge size x Nominal / N.

C.F. = 0.2 mm x 98.7167 / 99.3 TIPS

C.F. = 0.1988 mm / tip

C.F. = 0.199 mm / (tip rounded off)

In other words, each tip corresponds to 0.199 mm of rainfall. Provided the C.F. falls between 0.197 mm and 0.204 mm it is acceptable for most purposes. If the C.F. lies outside these limits, repeat the static and dynamic calibration procedures.

It is not possible to set the screws very precisely using this method, but it should be done with as much care as possible. It is obviously very important that both buckets tip in response to the same amount of water. Many manufactures and user of tipping bucket raingauges aim to adjust the buckets settings until exactly the correct calibration is achieved. However, a dynamic test is required to check this calibration precisely after each readjustment and the process becomes very time-consuming. In any case, it is virtually impossible to get the adjustments absolutely correct, and it is generally preferable to adjust the settings as closely as is reasonably practical, and then derive a calibration factor for each raingauge individually after a dynamic calibration.

5.2 Dynamic calibration.

1. Configure the gauge as in Figure 6 (a) or 6 (b) (the latter setup will give a preferable constant flow rate) , ensure gauge is levelled and connected to a data logger or counter.

2. Fill a container with 1000 cm^3 of water for 0.2 mm/tip calibration. this is usually achieved most precisely and consistently by weighing the water on a balance capable of measuring to 0.1g (0.1 cm^3). An alternative is to use a good quality graduated measuring cylinder.

3. Allow the water to drip slowly into the gauge, taking at least 60 minutes to empty (approximately 40 seconds for each tip). At the end of this period approximately 98 tips will have occurred. the exact number is obtained from the data logger or counter. To this add on an accurate estimation of what fraction of a tip is left in the bucket when the water stops flowing (a graduated syringe is ideal for this).

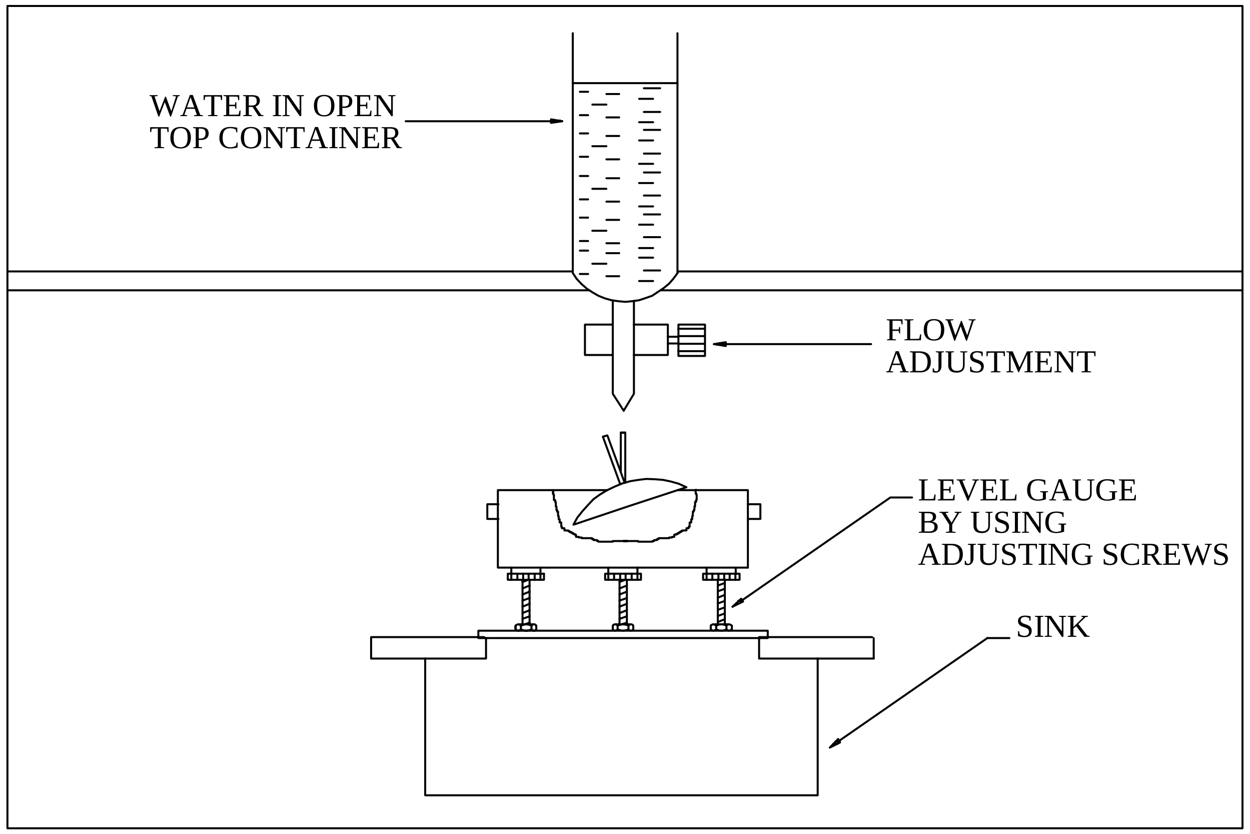

FIGURE 6 (a) DYNAMIC CALIBRATION

1. GENERAL DESCRIPTION.

Research has shown that a conventionally shaped raingauge interferes with the airflow and that the flow accelerates and turbulence increases over the top of the funnel than otherwise would have fallen on the ground. In most cases this is ignored, but it may be corrected arithmetically or overcome physically by placing the gauge in a pit so that the rim of the funnel is level with the ground. the pit is covered by a grating to simulate the aerodynamic roughness of the ground surface while preventing any splash into the funnel.
There are obvious advantages with this method, but it is not always practical. The body of the WRG 100 has a profile which has been designed to reduce drag and turbulence and therefor be sited conventionally on exposed sites with some confidence.

Raingauges which operate on the tipping bucket principle provide a switch closure output, which may be connection to a digital data logger. The pulses returned during rainfall may be counted over any time interval desired allowing accurate determination of the rainfall rate (this variable some times called intensity, is frequently used in soil erosion studies and is relevant to some aspects of crop pathology).

1.1 Description of the WRG 100 raingauge.

The WRG 100 aerodynamic raingauge has been designed to minimise the above effect by presenting a reduced area to the wind. Rainfall is measured by the well-proven tipping bucket method. Precipitation is collected by a the funnel and is passed to one of the two buckets situated at either end of a short balance arm. The balance arm tips when the first bucket is full, emptying this bucket and positioning the second bucket under the funnel. The tipping process repeats indefinitely as long as the rain continues to fall, with each tip corresponding to a fixed quantity of rainfall; at each tip the moving arm forces a magnet past a reed switch, causing contact to be made for a few milliseconds.

1.2 Choosing a site.

The site chosen to install the raingauge will depend in part on the application to which it is being put and in part on the particular circumstances at the site. But if possible site the raingauge so the distance between the raingauge and an obstruction, such as Trees or buildings is at least as great as twice the height of the obstruction. If the application is very specific, such as monitoring a building site, then the siting of the raingauge is largely prescribed by use. Those users who wish to enquire more fully into raingauge exposure are referred to the references at the back of the book.

NOTE : No two raingauge designs are ever likely to produce identical results, and identical raingauge can give slightly different catches even when sited close to each other.

2. INSTALLATION OF THE RAINGAUGE

2.1 Unpacking the raingauge.

The raingauges tipping bucket mechanism is immobilised before shipping to prevent damage in transit. To release the mechanism, remove the funnel from its base by unscrewing the three thumbscrews. Remove the piece of foam from under the bucket mechanism. This foam may be saved and used whenever the raingauge is moved.

2.2 Mounting and levelling the raingauge.

Due to the low weight of the raingauge (1kg approximately) it must be mounted securely, the use of the WRG BP Baseplate is recommended for this. However the gauge may be mounted via the three holes in the base to a paving slab for example. It is suggested that rawlbolts are used for this purpose as they provide a means of levelling the raingauge.

2.2.1 Baseplate method.

1. Drill out the three holes in the raingauge base to 6.5 mm & debur.
2. Assemble the baseplate and raingauge as in figure 1.
3. Fix the baseplate on soft ground using the 4 pegs supplied. If force is needed then remove the raingauge first.

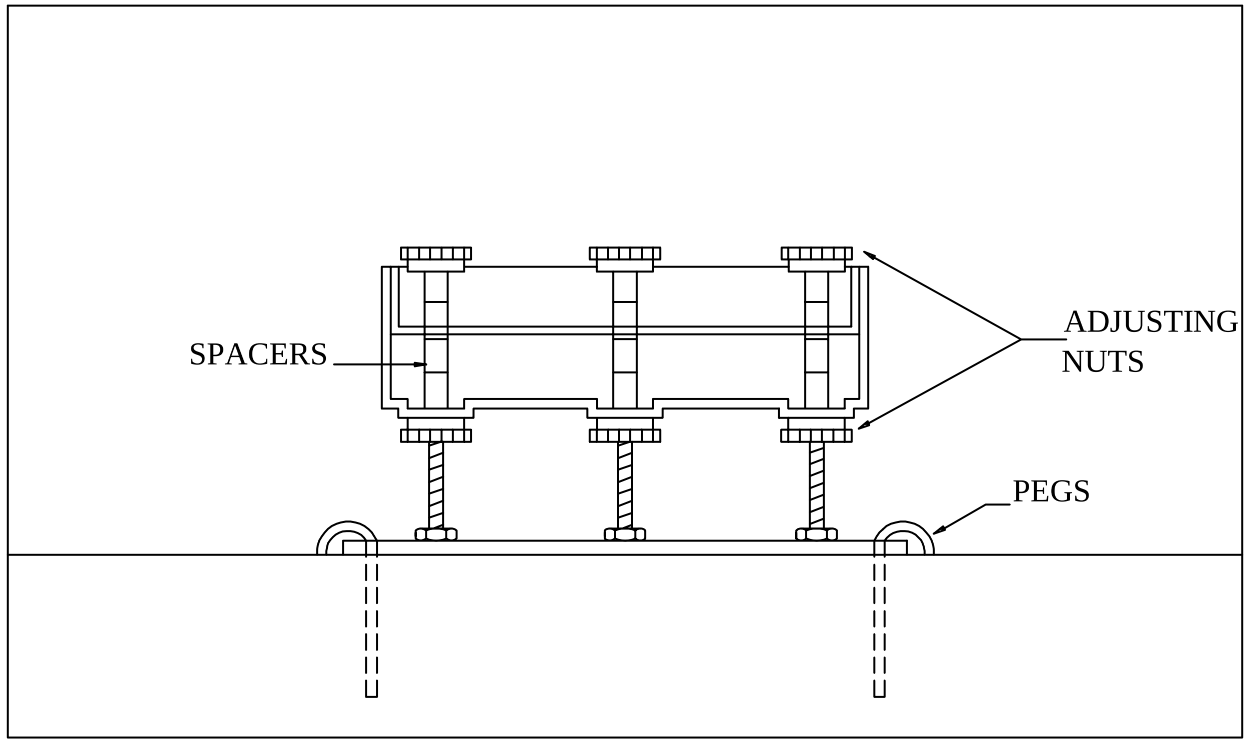

FIGURE 1 THE BASEPLATE METHOD IN DETAIL.

5. CALIBRATION OF THE RAINGAUGE.

The sensitivity of the raingauge is accurately calibrated at manufacture to a nominal 0.2 mm/tip. Each raingauge being supplied with its own calibration figure. A purpose built calibration rig supplying an adjustable constant head of water allowing accurate calibration of the raingauge.
Environmental Measurements also provides a re-calibration and overhaul service to customers; however this section describes a good alternative for re-calibrating the raingauge if the user prefers.

The last page of this manual will allow calibration records to be kept on the raingauge. If you have a number of raingauges that you wish to keep records of please photocopy this page and insert in the manual.

5.1 Static calibration.

1. Before re-calibrating the raingauge take this opportunity to carry out any maintenance that may be required (see Section 4).
2. Install the gauge over a sink as illustrated in Figure 5, ensuring that it is correctly levelled (the WRG BP baseplate can be used for this).
3. Using a burette or pipette, slowly drip in 10.13 cm^3 of water for 0.2 mm/tip. The bucket should tip on the last drip of water. Adjust the relevant thumb screw, (located under each bucket) until the above condition is met. Repeat for other side of bucket.

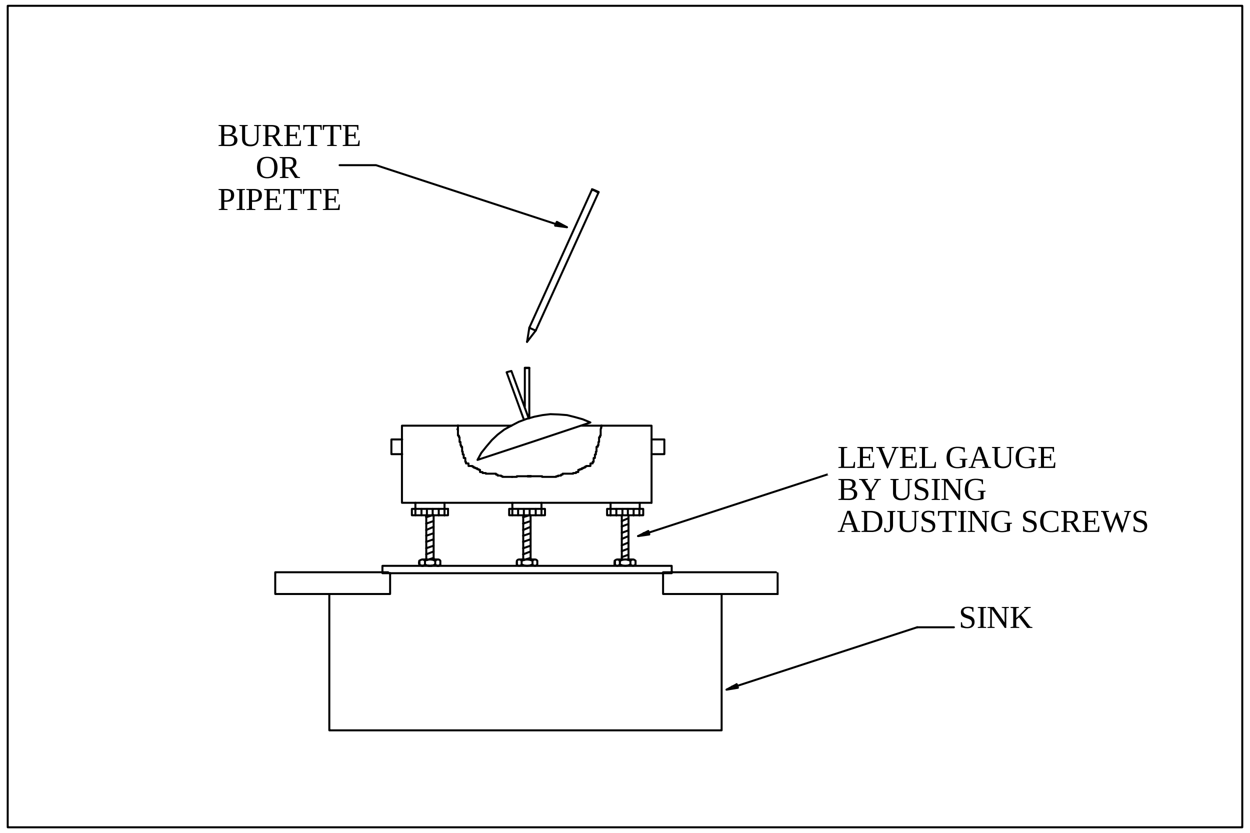

FIGURE 5 STATIC CALIBRATION

4. MAINTENANCE OF THE RAINGAUGE.

To ensure reliable and accurate measurements, we recommend that the following checks are carried out at each visit to the raingauge.

Please note that if the gauge is still connected to a data logger, and logger is operating care must be taken to avoid tipping the bucket when carrying out the following operations.

1. Inspect the funnel and filter for any damage or blockage. At certain times of the year leaves may have accumulated in the funnel, dirt and dust can also block the filter preventing or reducing the flow rate to a slow drip to the buckets beneath. The leaves can easily be removed from the funnel and the filter cleaned by removing the end cap from the filter tube, remove the filter material carefully, clean and replace the filter and cap.

2. Check that the gauge is still level. It is surprisingly easy for apparently immovable gauge to become tilted as a result of small ground movements, vandalism or just an inquisitive finger.

3. Remove and clean any dirt from the bucket, being careful not to tip the bucket should the raingauge still be logging.

4. There will be times when for one reason or another the raingauge will be not logging or will be disconnected from the logger, during these times it is a good idea to check the balance arm of the bucket for stiffness. The easiest way to do this in the field is to try and balance the bucket in its centre position, it should be very difficult if not impossible to achieve this, if the bucket balances easily then examine the bucket closely for any dirt or wear on the pivot pin and bucket tubes.

NOTE : A spares kit is available which contains a new filter and cap, and some replacement screws.
Order No. WRG SP

NOTE : The baseplate may be mounted to hard surfaces like concrete by replacing the pegs with screws and rawlplugs. For temporary mounting on hard surfaces use some bricks or heavy weights on the four corners of the baseplate (the height of the weights should be kept as low as possible to cause the minimum interference with the aerodynamics of the raingauge).

2.2.2 Paving slab method.

1. Drill slab to suit studs.

2. Drill out the three holes in the raingauge base to suit studs & debur.

3. Assemble all as shown as in figure 2.

4. Position on ground and level carefully.

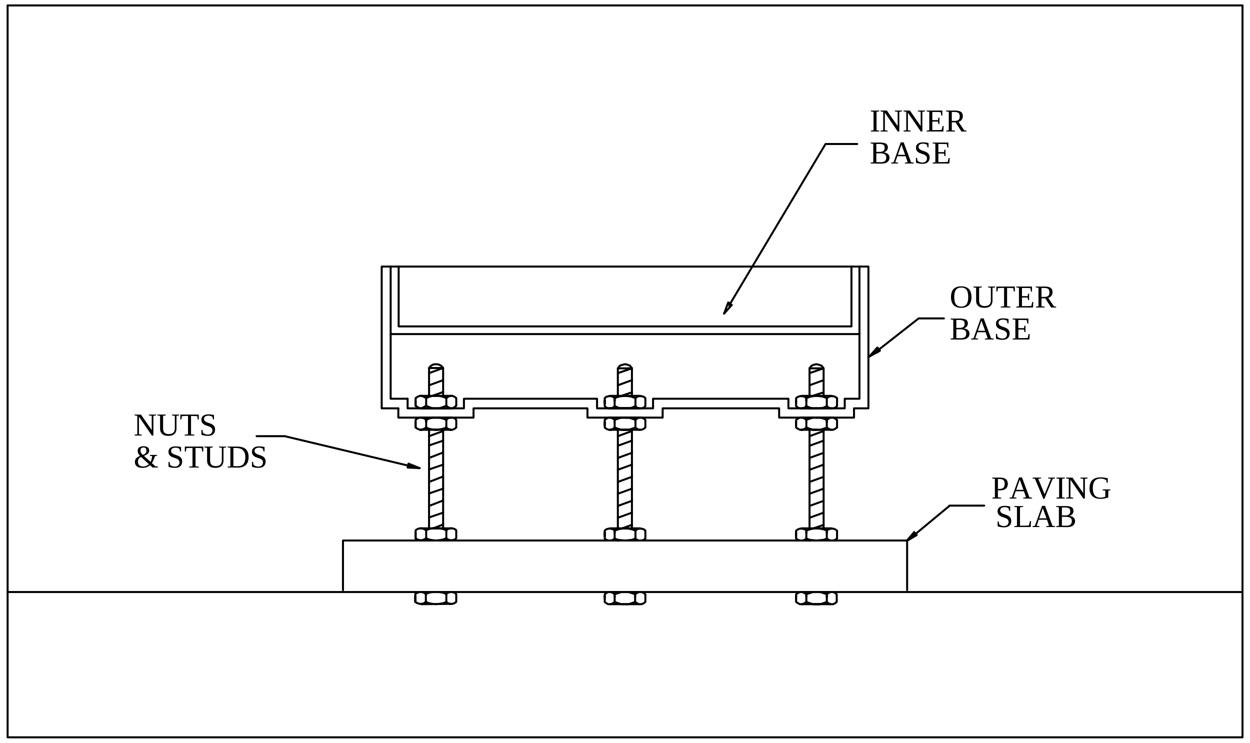

FIGURE 2 THE PAVING SLAB METHOD IN DETAIL.

2.2.3 Levelling the raingauge.

It is important to ensure that the rim of the raingauge is levelled precisely, using a spirit 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 accuracy of rainfall measurements. Although a small circular sprit level is provided in the base of the raingauge, it is advisable to make an independent check that the rim is levelled on installation and regular checks are made.

3. WIRING AND CONNECTION INFORMATION.

This section gives information on the wiring of all versions of the WRG 100 raingauge.

For most applications the raingauge may be connected directly to a pulse counting input on a data logger, but some care is needed if the raingauge cable has to be extended. In a long cable significant capacitance can exist between the conductors, which discharges across the reed switch as it closes. As well as shortening the life of the switch, a voltage transient may be induced in any other wires which run close to the raingauge cable each time the raingauges tips. A 47 W resistor is fitted close to the raingauge, this will protect the switch from arcing and help prevent transients.

3.1 The WRG 100 (standard).

The WRG 100 is supplied with two short lengths of wire of approximately 220 mm. A series resistor is inserted in one wire (as shown in Figure 3) and covered by adhesive type heatshrink sleeving

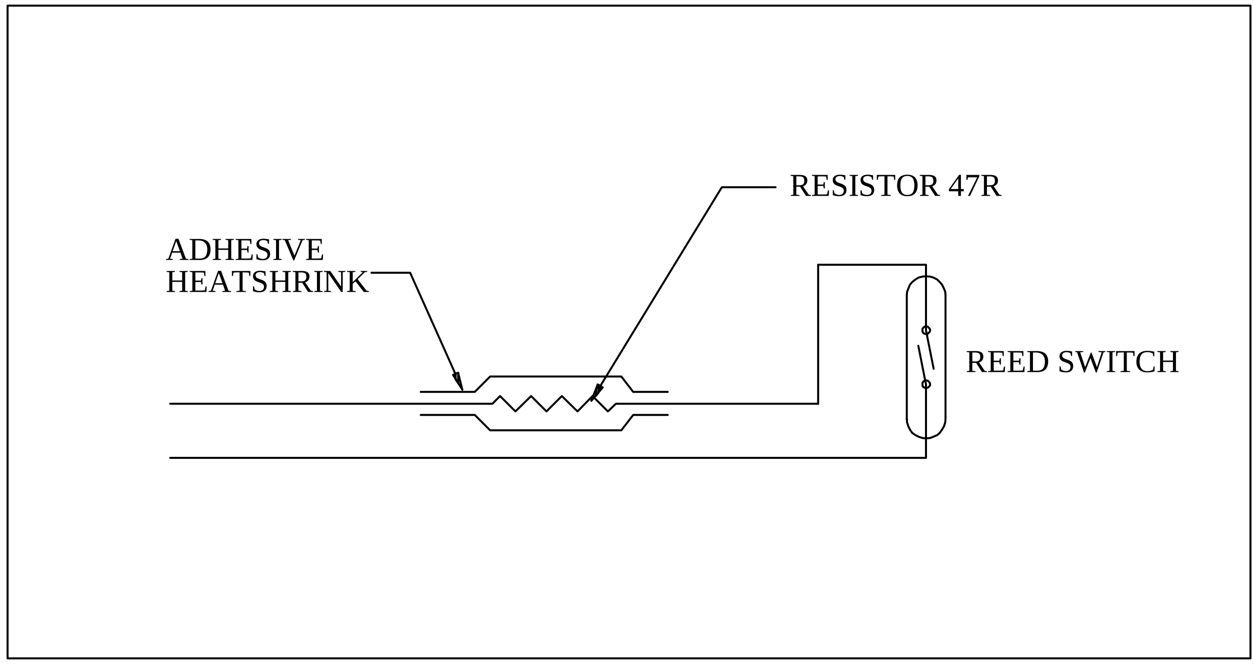

FIGURE 3 WIRING DIAGRAM OF WRG 100.

3.2 The WRG 100 EC (extra cable).

The WRG 100 EC is supplied fitted with a 6 metre extension cable. One wire is attached to the resistor (as shown in Figure 4; Note that the plug is not fitted to this version) and covered with adhesive type heatshrink. The other wire is attached, covered with heatshrink and the entire joint covered again with heatshrink. The cable passes through a grommet in the outer base.

The cable length may be shortened or lengthened as required. If the cable is lengthened, please ensure a good quality environmental connector, or a heatshrink joint similar to the one described previously, is used. Extension cables used must be of a similar specification.

3.3 The WRG 100 LX (1lx).

The WRG 100 LX is supplied for use with Automatikprodukters internally fitting 1LX data logger. Wiring is similar to WRG 100 EC, except that the cable passes through a grommet in the inner base and a 'Binder 712' series, 3 pin plug is fitted (as shown in Figure 4)

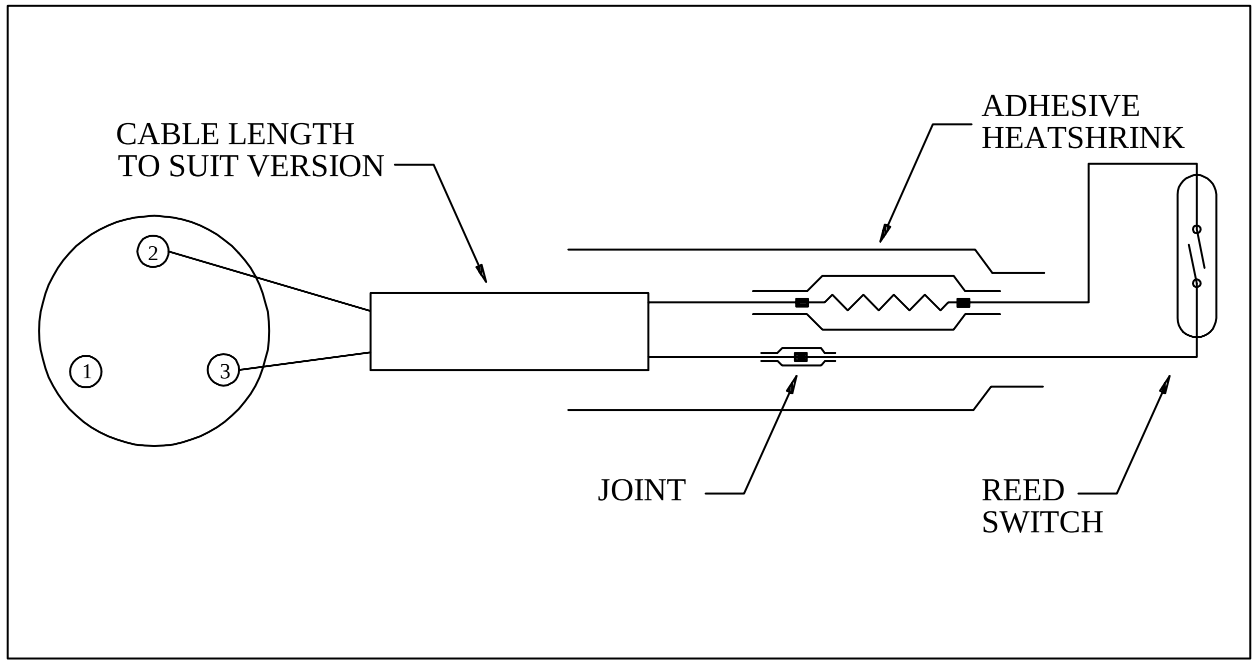

FIGURE 4 WIRING DIAGRAM OF WRG 100 LX AND EC VERSIONS.

3.4 Cable Specifications.

The cable used in all versions of the raingauge except the WRG 100 (standard) is a single twisted pair of 7/0.25 mm (22awg) tinned copper conductors, insulated with polyethylene, wrapped in an aluminised tape with a 7/0.25 mm tinned drain wire and a PVC outer sheath.

Temperature Range:	-30°C...+70°C
Overall dia.:	4.6 mm
Char. impedance :	85 ohm
Capacitance/metre:	154 pF

Equivalents:

Alpha	2401	**Belden**	8761	**UL style**	2092