



DHV CONSULTANTS &
DELFT HYDRAULICS with
HALCROW, TAHAL, CES,
ORG & JPS

VOLUME 3
HYDRO-METEOROLOGY

FIELD MANUAL - PART III

AUTOMATIC RAINGAUGE STATION
(ARG or TBR and SRG)
OPERATION AND MAINTENANCE

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GENERAL

The Field Manual for Hydro-meteorology, comprises the procedures to be carried out to ensure proper execution of rainfall and climatological network design, operation and maintenance. The operational procedures are tuned to the task descriptions prepared for each Hydrological Information System (HIS) function. The task description for each HIS-function is presented in, Volume 1, Field Manual, Hydrological Information System.

It is essential, that the procedures, described in the Manual, are closely followed to create uniformity in the field operations, which is the first step to arrive at comparable hydro-meteorological data of high quality. Further, reference is made to the other volumes of the manual where hydrometry, sediment transport measurements and water quality sampling and analysis is described. It is stressed that hydro-meteorology cannot be seen in isolation; in the HIS integration of networks and of activities is a must.

This Volume of the Field Manual consists of 5 parts:

- Part I deals with the steps to be taken for network design and optimisation. The procedures refer to network design/review based on measures of effectiveness for estimating areal values of rainfall and potential evapotranspiration, and interpolation. Furthermore, site selection procedures are included.
- Part II comprises operation and routine maintenance of rainfall stations with SRG (non-recording rain gauge).
- Part III comprises operation and routine maintenance of rainfall stations with ARG or TBR (recording rain gauge) and SRG (non-recording rain gauge).
- Part IV comprises operation and routine maintenance of full climatic station (FCS).
- Part V covers the field inspections and audits as well as maintenance and calibration.

In the Parts II to IV for each of the stations the day to day activities are spelled out, with reference to a HIS-function. The procedures as listed out in this manual are in concurrence with the procedures adopted by IMD to operate its network, who in turn follow closely the WMO-recommended procedures.

Part III of the manual on observations practice is primarily designed for staff (Job Category M-1) working at rainfall stations equipped with an ARG or a TBR and an SRG. It provides guidance on recommended practices namely: what to do, how to do and when to do. It is the responsibility of the observer to make regular and careful observations punctually at the prescribed hours of observations and make entries immediately in the prescribed forms and the Register.

1 RAINFALL MEASUREMENT BY STANDARD RAIN GAUGE

1.1 STANDARD RAINGAUGE (SRG)

The amount of rainfall at a station in a specified period is measured as the depth to which it would cover a flat surface. The measurement of this is made by a standard rain gauge, which in India is made of Fibre Glass Reinforced Polyester (FRP) and shown in Fig. 1.1.

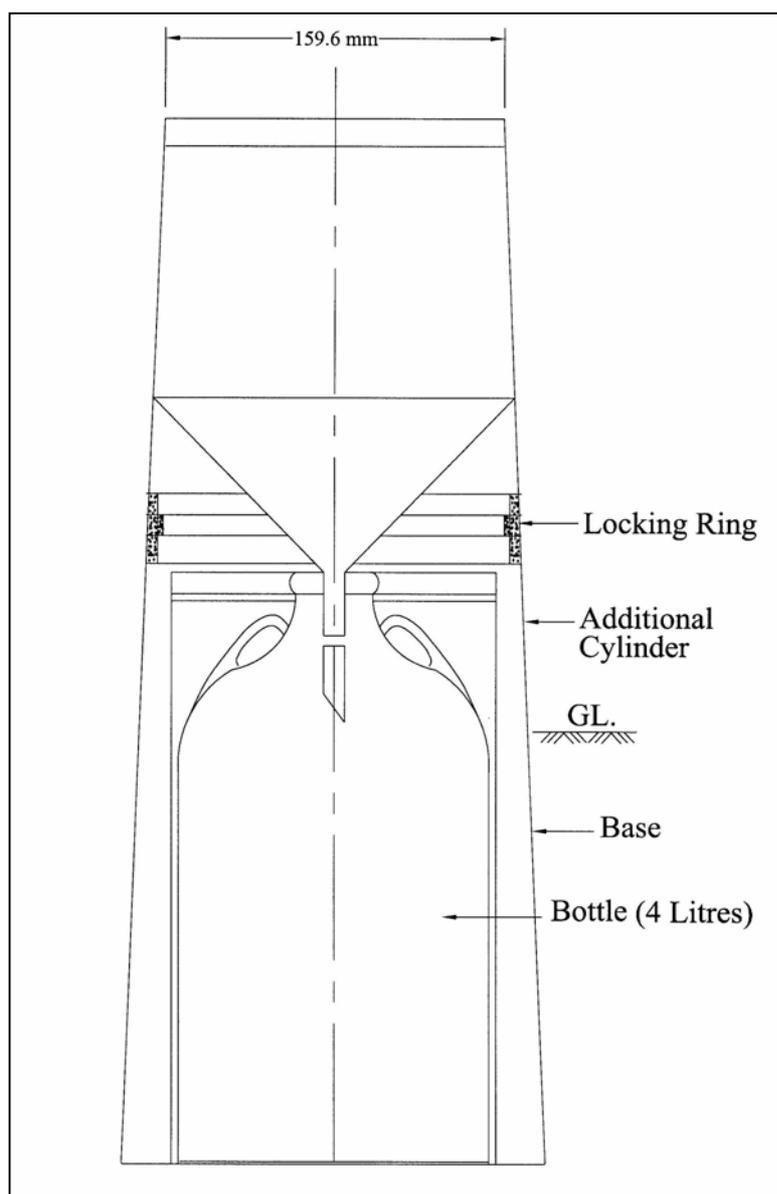


Figure 1.1:
Standard rain-gauge

1.2 STANDARD MEASUREMENT PRACTICE SRG

The rain falling into the funnel collects in the bottle kept inside the base and is measured by a measure glass. The measurement is made daily at 0830 hrs IST in the morning. The following procedure is used:

1. Remove the funnel of the rain gauge and take out the polythene bottle.
2. Place the measure glass in an empty basin and slowly pour the rainwater from the receiver (polythene bottle) into the measure glass to avoid spilling. If by chance, any rainwater is spilled into the basin, add it to the rainwater in the measure glass before arriving at the total amount collected.
3. While reading the measure glass, hold it upright or place it on a horizontal surface. Bring the eye to the level of the rainwater in the measure glass and note the graduation (scale) reading of the lower level of the curved surface of water. The reading is recorded in mm to one decimal place.
4. If the rainfall is more than 20 mm (for the 200 cm² gauge), the measurement should be taken in two or more instalments depending upon the amount of rainfall.
5. After the first measurement, the rainfall amount is checked by re-measurement, before the rainwater is thrown away.
6. During heavy rain, check the rain gauge at hourly intervals to avoid overflow. If necessary, take out the rainwater in a separate bottle, securely corked for measurement at the time of observation.
7. All rainfall observations are made at 0830 hrs IST daily. The amount recorded at 0830 hrs is the rainfall of the preceding 24 hours ending at 0830 hrs of the observation day (Today's date). In other words, the rainfall of the day is the total rainfall collected in the rain gauge from 0830 hrs IST of previous day to 0830 hrs IST of the day and is recorded (entered) against today's date. The layout of the field data form is presented in Annexure - I.
8. If there is no rain, enter 0.0 (Note: The column should not be left blank or '-' should not be used for indicating '0' rainfall) and if the rain is below 0.1 mm, enter "t" (trace) in the prescribed form and also in the Register. Daily rainfall data, recorded on the prescribed form, is sent to the controlling office daily as per the arrangement fixed for the field station.

1.3 ROUTINE MAINTENANCE SRG

The following routine inspection and maintenance procedures should be used to ensure that the gauge continues to provide accurate records.

1. The collector (funnel) of the rain gauge should be inspected for blockage with dirt/dry leaves etc and cleared if necessary.
2. The collector, receiving bottle and the base should be checked for leakage. If leakage is found, immediate repair / replacement is to be undertaken.
3. While replacing the collector on the base, it should be ensured that the two locking rings are engaged properly.
4. The rain gauge and the enclosure should be kept locked for safety.
5. The enclosure should be kept clean. No shrubs or plants be allowed to grow near the instrument as they will affect exposure conditions and the catch.

It is advisable to keep a spare measure glass at the field station. Adhesive solution used in patching up external cracks of the fibre glass material and for attaching any broken piece like the funnel outlet tube should be available at the station to attend to minor defects. However, if the instrument becomes out of order or the measure glass breaks, inform the controlling office immediately for replacements.

2 RAINFALL MEASUREMENT BY AUTOGRAPHIC RAINGAUGE (ARG)

2.1 AUTOGRAPHIC RAINGAUGE (ARG)



Figure 2.1:
Installation of natural siphon recording
rain gauge

Short duration rainfall in India has been measured in the past almost invariably using the natural siphon recording gauge. The record is produced on a chart and is therefore referred to as autographic. The essential parts of the Autographic Raingauge are shown in Figures 2.1 and 2.2.

2.2 STANDARD MEASUREMENT PRACTICE ARG

A Instrument Setting

1. Wrap a chart on the clock drum taking care that the corresponding horizontal lines on the overlapping portions are coincident and that the bottom of the chart touches the flange. Fix the chart in place with the spring clip.
2. Replace the cover and pour water into the tube leading to the float chamber till the water begins to siphon. The pen should come down to the zero line on the chart after all the water is siphoned.
3. Next, measure out the equivalent of 10 mm of rainfall in a measure glass and pour this water gently into the receiver as before, and the pen should touch the 10 mm line of the chart. If it does not, loosen the set-screw fixing the collar in the lid and slightly raise the collar by turning it till the correct range is obtained on the chart.

B Operations

1. The chart is changed at 0830 hrs IST daily in the morning. First remove the previous day chart and put the fresh chart on the clock drum and set the instrument as explained at 'A' above.
2. Put sufficient ink in the pen, wind the clock and set the pen to the correct time. To set the correct time, turn the clock drum slowly from left to right until the pen indicates the correct time. Give a time mark on the chart by gently tapping the pen. The instrument is now set for recording.

C Tabulation

1. Tabulate hourly rainfall values from the 'removed' autographic chart and make entries as per performa supplied, see Annexure - II. The autographic chart gives a continuous record of rainfall during the past 24 hours on a daily basis. As a SRG and ARG are installed side by side, it is expected that the total rainfall recorded during the past 24 hours by both the rain gauges should agree. In case of any discrepancy, the rainfall amount recorded by the SRG is taken to be correct.
2. Despatch tabulated performa's to the Controlling Office on monthly basis or as prescribed.

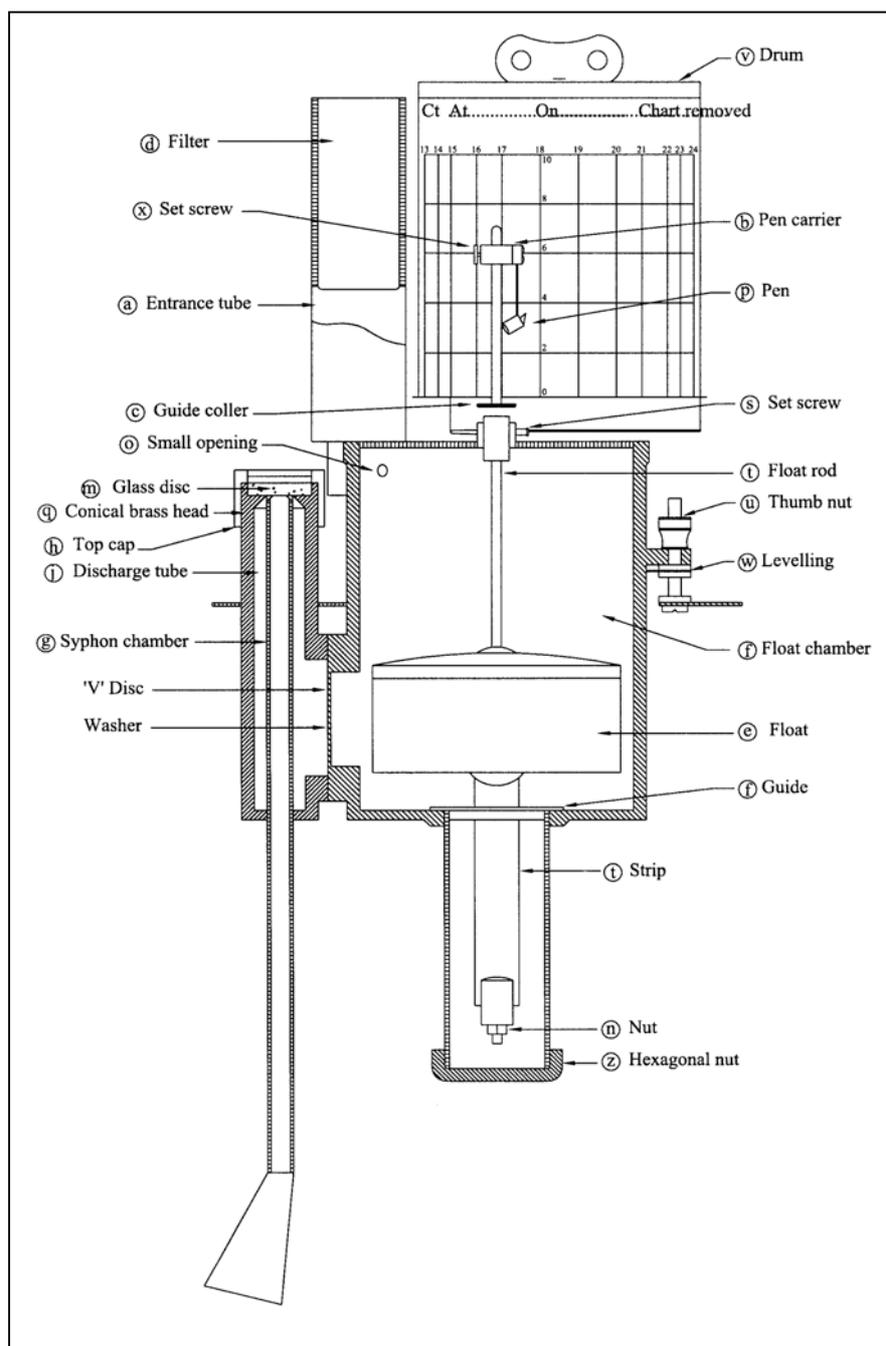


Figure 2.2: Recording mechanism of autographic rain gauge

2.3 ROUTINE MAINTENANCE ARG

The raingauge should be regularly checked for dirt and debris in the funnel. In the rainy season, the wire-gauge filter should be cleaned once a week or immediately after a thunderstorm or dust storm. The inside of the glass disc should be kept clean. This is very necessary for proper siphoning. For cleaning the receiver, the float and the funnel, proceed as follows:

1. Lift off the cover, remove the chart drum and the three thumb nuts. Remove the three small screws and washers, who hold the receiver lid in place. Gently lift the float from the chamber.
2. To clean the float chamber, lift it off the base, flush it out with water after unscrewing the hexagonal nut.
3. To clean the siphon tube, unscrew the top cap and see if the fibre gasket is in good condition. Then remove the glass disc and lift off the conical brass head with a bent pin. Clean the siphon tube. After cleaning, reassemble the parts carefully.
4. Next, the hallite washer between the float chamber and siphon is checked. The chamber should be replaced, if it leaks at this joint.
5. The time of siphoning should be checked occasionally, to see whether the outlet tube is choked. The time taken for this should be 15 to 20 seconds.
6. Special ink is used in the pen to obtain a thin and fine trace on the chart. During summer, a minute drop of glycerine may be added to reduce evaporation of the ink from the nib. The tip of the nib is kept clean with methylated spirit.
7. Minor leaks or cracks in the body of the raingauge can be sealed by using adhesive material.

The following are typical problems, which arise and cause the instrument to become out of adjustment. The listed actions may be used to correct.

1. Incorrect siphoning: the float may not go up to the 10 mm mark but siphoning takes place.

Actions:

- Check and adjust the levelling of the float chamber using a spirit level.
- Reduce the friction by rubbing the float rod with a lead pencil.
- Check whether the threaded collar is limiting the movement of the float. If so, raise the collar slightly after loosening the set-screw.

2. Unstable zero: when no rain, the trace on the chart is not along the zero line.

Actions:

- Check the alignment of the drum
- Check the wrapping of the chart on the drum. If a fault appears in the drum, it should be replaced.

3. Prolonged siphoning: siphon tube is partly blocked.

Action:

- To clear the siphon tube, unscrew the top cap (h), remove the fibre gasket, glass disc and then lift off the conical brass head (q) with a bent pin. Clear the tube by pushing a piece of soft wire through it. Clean and replace the conical brass head and glass disc. Change the fibre washers, if necessary.

4. Gradual fall of pen: either due to a leak in the float chamber or the pen arm is loose on the float rod.

Actions:

- For the leak at the joint of the float chamber and siphon chamber, the hallite washers between them should be replaced.
- Tighten the pen arm properly on the float rod.

5. Siphoning occurs after more than 10 mm of rain occurs: this happens if the float develops a leak.

Action:

- Float is to be replaced.

6. During the period of heavy rainfall siphoning may be triggered before the pen reaches the 10 mm line.

Action:

- Take it that each siphon represents 10 mm of rain.

7. Keep the observatory enclosure locked, clean and fencing intact.

3 RAINFALL MEASUREMENT BY TIPPING BUCKET RAINGAUGE (TBR)

3.1 TIPPING BUCKET RAINGAUGE (TBR)

The Tipping Bucket rain gauge is a widely proven technology for recording rainfall amounts and intensities in remote and unattended places. Once the TBR is installed and calibrated, it is ready for use. The principle of the Tipping Bucket rain gauge is shown in Figure 3.1.

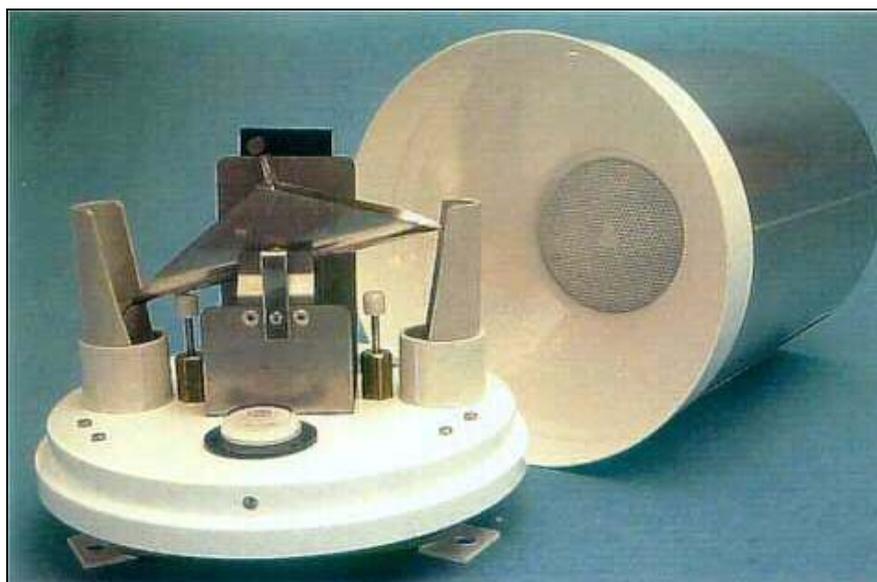


Figure 3.1: Tipping Bucket rain gauge

3.2 STANDARD MEASUREMENT PRACTICE TBR

The TBR is equipped with a data logger, which automatically stores the number of tipplings per unit of time or the timings of each tipping. At monthly intervals the logger is read out. On a daily basis the functioning of the equipment is to be checked as per instructions of the supplier.

3.3 ROUTINE MAINTENANCE TBR

Maintenance of TBR should be carried out in accordance with the instructions supplied with the equipment. The collector should be kept clear of obstructions and it should be done gently without disturbing the tipping bucket switch. If the bucket does not tip, it is probably sticking on its bearings. If the bucket does tip but the counter reading fails to advance, the trouble may be due to a faulty counter or switch. For rectification of these defects, only an expert mechanic needs to attend.

Annexure – I

Layout of field data form SRG

Annexure II

Field data form ARG