



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

VOLUME 3
HYDRO-METEOROLOGY

FIELD MANUAL - PART V

***FIELD INSPECTIONS, AUDITS, MAINTENANCE
AND CALIBRATION***

Table of Contents

GENERAL	1
1 FIELD INSPECTIONS CUM TECHNICAL AUDIT	2
1.1 GENERAL	2
1.2 INSPECTIONS OF RAINGAUGES (SRG & ARG)	2
1.3 INSPECTION OF FULL CLIMATIC STATION (FCS)	3
2 MAINTENANCE	5
2.1 GENERAL	5
2.2 ROUTINE MAINTENANCE	6
2.3 MAINTENANCE COST	7
3 CALIBRATION	7
3.1 GENERAL	7
3.2 STANDARD RAINGAUGE (SRG)	7
3.3 AUTOGRAPHIC RAINGAUGE (ARG)	8
3.4 TIPPING BUCKET RAINGAUGE (TBR)	8
3.5 WIND INSTRUMENTS	8
3.6 THERMOMETERS	9
3.7 THERMOGRAPH	9
3.8 HYGROGRAPH	9
3.9 PAN EVAPORIMETER	9
3.10 SUNSHINE RECORDER	10
ANNEX I: FIELD INSPECTION AND QUALITY AUDIT REPORT	11
RAINFALL STATIONS (SRG/ARG)	12
FULL CLIMATIC STATIONS (FCS)	13
ANNEX II: MAINTENANCE NORMS	16

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 stations (FCS).
- Part V comprises field inspections, audits, equipment and station 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.

1 FIELD INSPECTIONS CUM TECHNICAL AUDIT

1.1 GENERAL

The quality of the data depends upon:

1. Condition of the instrument,
2. Exposure conditions,
3. Correct procedures of recording observations, and
4. Accuracy in reading and in preliminary arithmetical computations like totals and means.

While obvious observational and computational errors are detectable in scrutiny of the data at the Divisional/Regional centres, most of these points necessitate periodic inspection of observatories for checking the instruments, exposure conditions and instructing or imparting training to observers on deficiencies.

Under the HIS, it is envisaged that each Division/Regional centre is responsible for the inspection, custody and scrutiny of the data in respect of the field observatories situated in its jurisdiction. The periodic inspection of the field meteorological stations is to be carried out by trained IMD Inspectors.

1.2 INSPECTIONS OF RAINGAUGES (SRG & ARG)

It is of great importance that the raingauge (SRG and ARG) is inspected periodically, in order to ensure that instrument condition and exposure always conform to the standards laid down by WMO and adopted by India Meteorological Department (IMD).

The main task of the Inspector should be to ascertain:

1. Whether the instrument is suitably fixed (installed) and is in good working condition.
2. Whether the measure glass is appropriate to the capacity of the raingauge (SRG) or charts appropriate to the capacity of the ARG.
3. Whether the observer is fully conversant with rainfall measurements and makes correct observations at the proper time (0830 hrs IST) and makes correct entries in the records.
4. Whether the observer sets or removes charts (ARG) at the proper time (0830 hrs IST)
5. Whether the observer checks the working of the clock drum and the siphoning mechanism of the instrument before commissioning the raingauge (ARG)
6. Whether all rainfall records are properly and neatly maintained and the data despatched to the controlling office in time.
7. Whether any part of the raingauge requires repair or resetting or replacement.
8. Whether the capacity of the raingauge is appropriate at places where heavy rainfall is recorded.
9. Whether the observatory enclosure is kept clean and the fencing and the exposure conditions are good.

It is advisable to inspect all raingauge stations (SRG and ARG) before the onset of the monsoon season every year. Considering the busy schedule of IMD Inspectors, it is desirable that every raingauge station should be inspected once in 3 years. At the completion of the routine inspections, the Inspector is supposed to submit an Inspection Report. A copy of this Report is given to the controlling centre with a purpose to implement the recommendations made by the Inspector as early as possible.

It is the standard practice to install an instrument at the field station only after its certification / calibration by IMD. In case the instrument undergoes some replacement, it is advisable to check its calibration.

1.3 INSPECTION OF FULL CLIMATIC STATION (FCS)

In addition to a SRG and ARG, a full climatic station is equipped with a wind, temperature, evaporation and radiation instrument both manual and autographic. While carrying out the routine inspection of the station, the Inspector should ensure that the station is well maintained and that the observer is fully trained. For this purpose the Inspector follows the following procedure:

IMD Inspectors are provided with an Inspection Kit. It contains all necessary items required for the inspection work like proper functioning of all meteorological instruments, their testing, adjustment, cleaning, oiling, painting and minor repairs. The observer also carries out all the observational work in the presence of the inspector.

Wind instruments

As a part of inspection, the Inspector checks:

1. Whether the wind instruments are properly installed, i.e. height 2 m above the ground, balanced lever that turns freely, no rusting, etc.
2. Whether the exposure conditions are good and both the anemometer and the windvane are fixed at least 2 meters apart.
3. Whether the observer lubricates the ball bearing with a few drops of spindle oil every fortnight.
4. Whether the observer washes all parts of the instrument thoroughly in kerosene oil, clean and lubricate them every six months.
5. Whether the observer measures the wind speed by following the correct procedure.
6. Whether all nuts, especially that of cups are fully tight.

It is advisable if the Inspector carries out the complete cleaning and oiling operation of the wind instrument by following the laid down maintenance procedure. He should also check the accuracy after reassembling the instruments.

Thermometers

For temperature measurement, the instruments provided at a FCS are:

- Dry bulb thermometer
- Wet bulb thermometer
- Maximum thermometer
- Minimum thermometer, and
- Thermograph.

The Inspector should ensure that all the thermometers are mounted properly and are having proper exposure, i.e. sunshade and ventilation.

The relative humidity is calculated from the difference of temperature between the dry bulb thermometer and the wet bulb thermometer. It is also measured directly from the hygrograph.

The inspector should check that:

1. No break exists in mercury thread or alcohol column.
2. The wick of the wet bulb thermometer is clean and properly tied.
3. The thermometers setting is done correctly.
4. The thermometers are recording the correct temperature by taking a test reading.
5. The graduation is clearly readable.
6. The Stevenson screen door opens towards North and no obstructions exist to the prevailing wind.

7. The Stevenson screens are fixed at the proper height above the ground, well painted and free from white ants.
8. The sensors of both the thermograph and the hygrograph are clean and that the instruments are working properly.
9. The temperature and humidity values should be comparable with the observation made by mercury thermometers.

Evaporimeter

Evaporation is measured by a class 'A' Pan evaporimeter. As the measurement of evaporation is made by adding a known quantity of water to the pan from a graduated cylinder, the observer has to be thoroughly conversant with the whole procedure. This has to be checked by the Inspector. He should also ensure that:

1. The instrument is clean, painted, levelled and covered with wire mesh from top.
2. The Reference Point is sharp.
3. No leak in the pan exists.
4. The pan is cleaned and filled with fresh water every fortnight and painted with chlorinated white rubber paint every year.
5. During the rainy season, the wooden platform and bottom of the pan are perfectly horizontal.

For radiation measurement, the FCS is equipped with a sunshine recorder. This instrument is fixed by an IMD expert keeping in view the latitude of the station. The Inspector has to ensure that the observer is fully aware of the seasonal practice of putting the appropriate chart. This instrument should also be provided with a good exposure condition in the direction of the sunrise and sunset.

Autographic charts

Autographic charts of the autographic instruments, like the ARG, thermograph, hygrograph and sunshine recorder, requires hourly tabulation. The Inspector should check the actual tabulation by picking up 1 or 2 charts of each instrument.

On the completion of the Inspection of the observatory, the Inspector should give proper instructions/guidance to the observer, which he considers important for improving the working of the Station. He should also prepare 3 sets of Inspection Reports with his recommendations, one copy to be given to the controlling office for rectification of defects, one copy for the Head and third copy for IMD. The Inspector must keep an office copy with him and take it with him when he goes again to that station for inspection and check whether his previous recommendations have been implemented or not.

2 MAINTENANCE

2.1 GENERAL

For proper maintenance of a hydrometeorological station, the observer should follow the instruction elaborated in Volume 3, Field Manual Hydrometeorology (Part II – IV). In addition, the hydromet station should be inspected by the trained inspectors of India Meteorological Department (IMD) periodically. Normal practice in IMD is to inspect the station once in 3 years. At the completion of the routine inspection, the inspector prepares an Inspection Report. A copy of this Report is to be submitted to the controlling Division for taking follow-up actions.

It is very important to keep spares at each Division office. The number or quantity of spares depends upon the number and type of the field stations like SRG, ARG and FCS functioning under its control. The following Table 1 is included as a guide:

Item	Number of spares	Remarks
Rain measuring cylinder (Appropriate dimension)	1 Rain measuring cylinder for every 3 SRG sites	
Autographic charts	A set of 30 charts appropriate to the autographic instrument for every 2 ARG or 1 FCS site	
Nibs for Autographic Instruments	1 Nib for every 4 ARG sites or 1 FCS site	To be replaced by a trained person
ARG washer	1 washer for every 3 ARG sites	To be replaced by a trained person
Clock Drum	1 Clock drum for every 6 ARG or 4 FCS sites	To be replaced by a trained person
Chart Clip	1 Chart clip for every 4 ARG or 1 FCS site	
Winding key or battery cells for clock drum	1 Winding key or 1 set of battery cells for every 4 ARG or 2 FCS sites	
Thermometer	1 Thermometer for every 4 FCS sites	
Forms and Registers	15 days stock for every site	

2.2 ROUTINE MAINTENANCE

SRG

1. The collector (funnel) of the SRG should be cleared of any blockage like dirt or dry leaves.
2. The collector, receiving bottle and the base of the SRG should be checked for leakage. If leakage is detected, 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 observatory enclosure should be kept clean and locked.

ARG

1. The ARG funnel should be regularly checked for dirt/debris
2. The wire gauge filter of the ARG should be cleaned once a week or immediately after thunder/dust storm.
3. The inside of the glass disc should be cleaned once a week.
4. Clean the float chamber before the commencement of rainy season.
5. Keep the tip of the nib clean with methylated spirit every week.
6. Special ink is used in the pen to obtain a fine trace on the chart. During summer, a minute drop of glycerine to be added to reduce evaporation of ink from the nib.
7. Check the alignment of the drum if the trace on the chart is not along the zero line when no rain has fallen.
8. Check the float for leakage if syphoning occurs after more than 10 mm of rain occurs.
9. Keep the observatory enclosure locked, clean and the fencing intact.

Wind Instrument

1. Instrument should be kept clean and it should be lubricated at intervals of 15 days.

Maximum and Minimum Thermometers

1. Both the maximum and minimum thermometers are to be set after the routine morning 0830 hrs. observation.
2. The minimum thermometer is again set after the routine 1730hrs observation.
3. Ensure that the mercury or alcohol thread in the thermometer is not broken anywhere.
4. The thermometers are kept inside the Stevenson screen, to protect the instruments from direct sun light and to provide good air ventilation.

Wet bulb Thermometer

1. The wick should be clean and changed every fortnight, but immediately after a dust storm.

Thermograph

1. The instrument should be kept clean, the bearings of the spindle and gate suspension cleaned with methylated spirit every fortnight.
2. The pressure of the pen on the chart should be adjusted carefully after setting the chart.
3. The sensor should be kept free from dust by wiping it with a soft cloth once a week.

Hygrograph

1. The instrument should be kept clean, the strand of hair should be cleaned by washing with distilled water every week.
2. The strand of hair should not be touched with fingers.
3. The spindle pivots are cleaned once a month with methylated spirit.

Pan Evaporimeter

1. Clean the pan once a fortnight alongwith the three side holes in the stilling well.
2. A small amount of copper sulphate is to be added to the fresh water, when refilling the evaporimeter to avoid the growth of algae.
3. Clean the stilling well and centre point rod with a soft cloth every week.

Sun Shine Recorder

1. Keep the instrument clean by wiping it with a soft cloth.
2. Insert a proper chart, appropriate to the season.

Observatory Enclosure

1. Ground should be levelled and clean
2. Fencing strong and tight.
3. Excellent exposure condition.
4. Observatory to be kept always locked.

2.3 MAINTENANCE COST

For smooth and uninterrupted functioning of a hydrometeorological station (SRG, ARG or FCS), an adequate budget provision is kept for its maintenance on yearly basis. Considering the accepted norm, that is, 15% of the total cost of establishment of a hydromet station as the depreciation value and 10% of the total cost as the yearly running cost of the station, which includes the stationery, form, autographic charts etc, the annual budget is prepared.

Considering the cost of instruments, civil works and materials prevailing during the year 2000, the cost of setting up a SRG station comes to Rs. 10,000/-, an ARG station to Rs. 30,000/- and a FCS station to Rs. 1,50,000/-. Accordingly, on an average, the yearly cost of maintaining a SRG station is Rs. 2,500/-, an ARG station: Rs. 7,500/- and a FCS station: Rs. 37,500/-.

3 CALIBRATION

3.1 GENERAL

All surface meteorological instruments are manufactured in accordance with the Indian Standards (IS). For details, the users may refer to the 'Equipment Specification Surface Water' as a special volume of the Manual. It is obligatory on the part of the manufactures to send these instruments to India Meteorological Department (Instrument Division, Pune) for "certification" before the instruments are supplied to the users. IMD, on their part, carry out the testing and calibration of surface meteorological instruments and each instrument with its serial number is provided with a certificate.

It is essential to procure meteorological instruments with certification for the sake of uniformity in the field operations, which is the first step to arrive at comparable hydrometeorological data of high quality.

3.2 STANDARD RAINGAUGE (SRG)

The standard raingauge and rain measure glass are tested for their general appearance, dimensions, locking ring and leak. Rain measures are calibrated for every 0.5 mm using a standard burette. A polythene bottle of capacity of 2 litres, 4 litres or 10 litres is kept within the base (10 litre bottle is used in very heavy rainfall areas). The mouth of the bottle shall be not less than 45 mm in diameter. It is ensured that these conform to the Indian Standard (IS 5225 and IS 4849) and authenticated by IMD Certification.

3.3 AUTOGRAPHIC RAINGAUGE (ARG)

The autographic raingauge is tested for its general appearance, dimensions, calibration, clock rating and syphon time conforming to the Indian Standard (IS 5235) and authenticated by IMD Certification.

The ARG is calibrated under controlled laboratory conditions by slowly running water of a fixed quantity equivalent to 16.2 mm from a controlled burette to a 203 mm internal diameter ARG to get one syphoning of 10 mm rainfall and the syphoning time is adjusted to 15 seconds. The clock work mechanism of the ARG is also calibrated and tested with a standard clock and compensated for all temperatures between 0 and 40°C. The charts used in the ARG should conform to Indian Standard (IS 5947) for a good result.

All the autographic raingauges shall be tested before the onset of the monsoon rains. The instrument needs recalibration if the clockwork mechanism is replaced.

3.4 TIPPING BUCKET RAINGAUGE (TBR)

The tipping bucket raingauge is tested for its general appearance, dimension, calibration and data logger system. The TBR assembly is calibrated by measuring the volume of water required to cause one tip of the bucket. A controlled burette is filled with rainwater until it reads '0' (zero). Water is poured slowly from the burette into the collector to produce 3 tips of the bucket, the rate of flow being reduced to discrete drops before each tip, the burette reading is noted after each tip. The process is repeated to give a total of 12 tips and the average volume per tip is calculated. For a 750 cm² collector (MK 3 IMD), each tip will be $V/75$ mm of rainfall, where V is the average volume of water per tip. The calibration value of $V/75$ mm must lie within the range 0.196 to 0.204 mm per tip.

All TBR's shall be tested before the onset of the monsoon rains.

3.5 WIND INSTRUMENTS

Windvane: Mechanical windvanes are tested for general appearance, dimensions, assembly, sensitivity (friction test) and balancing, conforming to the Indian Standard (IS 5799) and authenticated by IMD Certification.

For calibration purposes, the 4 direction arms are fixed with the help of a magnetic compass and for the sensitivity of the instrument, the complete instrument on final assembly is held firm at the bottom and the balance weight is imparted an impact by a hammer weighing 0.72 kg and having a handle length of 240 mm, it shall make not less than 5 and not more than 10 complete revolutions before coming to rest.

Anemometer: Cup counter anemometers are tested for general appearance, dimensions, counter changing, bearing test (sensitivity test) and cup balancing, conforming to the Indian Standard (IS 5912) and authenticated by IMD Certification.

For calibration purposes, a wind tunnel generating wind upto 125 km per hours conforming to Indian Standard (IS 5912) is used. After calibration, the instrument is tested within the tolerance limit of +/-12% for speed below 5 km per hour and +/- 10% for speed above 5 km per hr. For the sake of sensitivity, the ball bearings and other moving parts should be kept clean and suitably lubricated every week.

3.6 THERMOMETERS

All liquid in glass thermometers (dry bulb, wet bulb, maximum, minimum) are tested for general appearance, uniform graduation, no break(s) in liquid column and corrections conforming to the Indian Standard (IS 5681) and authenticated by IMD Certification.

For calibration purposes, the instrument is kept in a constant temperature water bath between 0 to 50° C after removing possible breaks in the liquid column. The true temperatures of the water bath are obtained from 'Reference Thermometers'. The relevant correction factor is also determined and the value is put on a card and attached to the instrument to determine the correct temperature. Instrument needs daily checking for possible break(s) in the liquid column.

3.7 THERMOGRAPH

All thermographs are tested for general appearance, friction, clockwork mechanism and calibration, conforming to the Indian Standard (IS 5901) and authenticated by IMD Certification.

For calibration purposes, the instrument is kept in a thermostatic chamber working within the temperature range of –20°C to +60°C. Temperature is controlled with a laboratory 'Reference thermometer'.

The scale error of the instrument is determined by immersing the sensing element (bimetallic element) successively in comparison baths, kept well stirred and maintained at 3 or 4 different temperatures, the difference between the lowest and the highest temperature being about 40°C. The range of temperature indicated by the reference thermometer and the instrument shall be correct to within +/- 1°C.

The clockwork mechanism is also calibrated and tested as in the case of the ARG (para 4.3).

3.8 HYGROGRAPH

All hair hygrometers are tested for general appearance, friction, clearing, clock work mechanism and humidity comparison, conforming to Indian Standard (IS 5900) and authenticated by IMD Certification.

For calibration purposes, the instrument is kept in a properly designed and operated humidity cabinet, giving sufficient time for the instrument to reach equilibrium. The humidity is checked against a psychrometer and adjusted to read the ambient relative humidity of 95% after attaining equilibrium when the hair is wetted with distilled water. The error should not exceed +/- 5% at any point above 20%.

The clockwork mechanism is also calibrated and tested as in the case of the ARG (para 4.3).

3.9 PAN EVAPORIMETER

The open pan evaporimeter is tested for general appearance, dimensions, leak, chlorinated rubber paint inside and stilling well reference rod, conforming to Indian Standard (IS 5973) and authenticated by IMD.

The calibration is mainly of the graduated measuring cylinder from which water is poured into the pan and is graduated with a scale 0 to 20 cm. It has a diameter exactly one tenth that of the pan viz. 122 mm as the diameter of the pan is 122 cm, so that the cross sectional area of the cylinder is 1/100 of

the pan. It means 200 mm water from the cylinder added to the pan, raise the level in the pan by 2 mm. The measurement can be made correct to 0.1 mm.

A thermometer to measure the temperature of water in the pan is fixed to the side of the pan and wind instruments to measure the wind speed and direction are installed at a height of 2m above the ground near the pan. Their calibration procedures have already been discussed in foregoing paragraphs.

3.10 SUNSHINE RECORDER

The sunshine recorder is tested for general appearance, dimensions, movement of the standard gauge, quality of burning and centre of the sphere and the bowl must be coincident, and conforming to the Indian Standard (IS 7243) and authenticated by IMD.

For calibration purposes, the instrument must confirm to the following conditions:

- The centre of the sphere and the bowl must be coincident
- The bowl must be level in the east-west direction
- When a card is in position, the hour lines printed across it must be in meridian planes of the celestial sphere corresponding to the hour angle 15, 30, 45 degree etc. measured from the geographical meridian.

Above three conditions are ensured during manufacture.

Finally the installation of the instrument is to be carried out by an expert who should refer to the proper diagram giving variations of the sun's altitude and azimuth at different times of the year and in different latitudes 0-34 degree North, with the hours of the day in local apparent time marked on the curves. The 3 types of cards are used as follows: the long curved during summer, the short curved during winter and the straight one during equinoxes.

ANNEX I:

FIELD INSPECTION AND QUALITY AUDIT REPORT

- **RAINFALL STATIONS (SRG/ARG)**
- **FULL CLIMATIC STATIONS (FCS)**

.....STATE SURFACE WATER
RAINFALL STATIONS (SRG/ARG)

Division:.....

Station No:.....

Station name:.....

River:.....

Basin:.....

1. INSPECTION/AUDIT: GENERAL DETAILS

Date of inspection:.....

Inspected by:.....

Designation:.....

Assisted by:.....

Designation:.....

Time of start:.....

Time of completion:.....

2. SITE CONDITIONS

Weather conditions:.....

River conditions:.....

3. STAFFING (manned sites only)

(1) No.	(2) Name	(3) Position	(4) Present (Yes/No)	(5) If answer to column (4) is 'No'; give reason	(6) Remarks

4. INSPECTION CHECK LIST (SRG/ARG)

S. No.	Particulars	Remarks of Inspecting Officer	Observations of next higher authority
1	2	3	4
1	Whether the instrument is suitably fixed (installed) and is in good working condition.		
2	Whether the measuring glass is appropriate to the capacity of the rain gauge (SRG) or charts appropriate to the capacity of ARG and clean.		
3	Whether the observer is fully conversant with rainfall measurements and makes correct observation at proper time (0830 hrs IST) and makes correct entries in the records. Whether Observer is synchronising his watch to get proper time setting.		
4	Whether the observer sets or removes charts (ARG) at proper time (0830 hrs IST)		
5	Whether the observer checks the working of clock drum and siphoning mechanism of the instrument before commissioning the rain gauge (ARG)		
6	Whether all rainfall records are properly and neatly maintained and data despatched to controlling SDO office in time.		
7	Whether any part of the rain gauge requires repair or resetting or replacement.		
8	Whether the capacity of the rain gauge is appropriate at places where heavy rainfall is recorded.		
9	Whether the observatory enclosure field, instrument housing/ enclosures are kept clean, and fencing and exposure conditions are good.		
General Remarks			
Date: _____		(Signature & Designation) (inspecting Officer)	

.....STATE SURFACE WATER
FULL CLIMATE STATIONS (FCS)

Division:.....

Station No:.....

Station name:.....

River:.....

Basin:.....

1. INSPECTION/AUDIT: GENERAL DETAILS

Date of inspection:.....

Inspected by:.....

Designation:.....

Assisted by:.....

Designation:.....

Time of start:.....

Time of completion:.....

2. SITE CONDITIONS

Weather conditions:.....

River conditions:.....

3. STAFFING (manned sites only)

(1) No.	(2) Name	(3) Position	(4) Present (Yes/No)	(5) If answer to column (4) is 'No', give reason	(6) Remarks

4. INSPECTION CHECK LIST (SRG/ARG)

S. No.	Particulars	Remarks of Inspecting Officer	Observations of next higher authority
1	2	3	4
1	Whether the instrument is suitably fixed (installed) and is in good working condition.		
2	Whether the measuring glass is appropriate to the capacity of the rain gauge (SRG) or charts appropriate to the capacity of ARG and clean.		
3	Whether the observer is fully conversant with rainfall measurements and makes correct observation at proper time (0830 hrs IST) and makes correct entries in the records. Whether Observer is synchronising his watch to get proper time setting.		
4	Whether the observer sets or removes charts (ARG) at proper time (0830 hrs IST)		
5	Whether the observer checks the working of clock drum and siphoning mechanism of the instrument before commissioning the rain gauge (ARG)		
6	Whether all rainfall records are properly and neatly maintained and data despatched to controlling SDO office in time.		
7	Whether any part of the rain gauge requires repair or resetting or replacement.		
8	Whether the capacity of the rain gauge is appropriate at places where heavy rainfall is recorded.		
9	Whether the observatory enclosure field, instrument housing/ enclosures are kept clean, and fencing and exposure conditions are good.		
General Remarks		(Signature & Designation) (inspecting Officer)	
Date:			

5. INSPECTION CHECKLIST FOR WIND INSTRUMENTS

S. No.	Particulars	Remarks of Inspecting Officer	Observations of next higher authority
1	2	3	4
The inspector should check the following:			
1	Whether the wind instruments are properly installed at 2m height above ground, balanced lever turns freely, no rusting etc.		
2	Whether the exposure conditions are good and both the anemometer and the windvane are fixed at least 2 m apart.		
3	Whether Ball bearing is received with a few drops of spindle oil every fortnight.		
4	Whether the observer washes all parts of the instrument thoroughly in Kerosene oil, clean and lubricate them every six months.		
5	Whether the observer measures the wind speed by following the correct procedure.		
6	Whether all nuts, especially that of cups, are fully tightened		
General Remarks			
1 Date:		(Signature & Designation) (inspecting Officer)	

It is advisable that the Inspector carries out the complete cleaning and oiling operation of the wind instrument by following the laid-down maintenance procedure. He should also check the accuracy after reassembling the instruments.

Thermometers

For temperature measurement, the instruments provided at FCS are:

- Dry bulb thermometer
- Wet bulb thermometer
- Maximum thermometer
- Minimum thermometer and
- Thermograph

The Inspector should ensure that all the thermometers are mounted and placed properly i.e. for sunshade and ventilation.

The relative humidity is calculated from the difference of temperature between dry bulb thermometer and wet bulb thermometer. It is also measured directly from Hygrograph.

6. INSPECTION CHECK LIST FOR THERMOMETERS

S. No.	Particulars	Remarks of Inspecting Officer	Observations of next higher authority
1	2	3	4
The inspector should check the following:			
1	Wick of the wet bulb thermometer is clean and properly tied.		
2	Thermometers setting is done correctly		
3	Ensure that the thermometers are recording correct temperature.		
4	The graduation is clearly readable.		
5	The Stevenson screen door opens towards North and does not obstruct to prevailing wind.		
6	The Stevenson screens are fixed at proper height above the ground, well-painted and free from white ants.		
7	Sensors of both Thermograph and Hygrograph are clean and instruments are working properly.		
8	The temperature and humidity values are comparable with the observation made by mercury thermometers.		
General Remarks			
Date:		(Signature & Designation) (inspecting Officer)	

Evaporimeter

Evaporation is measured by class 'A' Pan Evaporimeter. As the measurement of evaporation is made by adding known quantity of water to the pan from a graduated cylinder, the observer has to be thoroughly conversant with the whole procedure. This has to be checked by the Inspector.

7. INSPECTION CHECK LIST FOR EVAPORIMETER:

S. No.	Particulars	Remarks of Inspecting Officer	Observations of next higher authority
1	2	3	4
The inspector should also ensure the following:			
1	The instrument is clean, painted, levelled and covered with wire mesh from top.		
2	The Reference Point is sharp.		
3	There is no leak in the pan.		
4	Pan is cleaned and filled with fresh water every fortnight and painted with chlorinated white rubber paint every year.		
5	During the rainy season, ensure that the wooden platform and bottom of the pan are perfectly horizontal.		
General Remarks			
Date:		(Signature & Designation) (inspecting Officer)	

8. SUNSHINE RECORDER

For radiation measurement, the FCS is equipped with a sunshine recorder. This instrument is fixed by IMD expert keeping in view the latitude of the station. The Inspector has to ensure that the observer is fully aware of the daily and seasonal practice of putting the appropriate chart. This instrument should also be provided good exposure condition in the direction of the sunrise and sunset.

9. AUTOGRAPHIC CHARTS

Autographic charts of the autographic instruments, like ARG, thermograph, hygrograph and sunshine recorder, require hourly tabulation. The Inspector should check the actual tabulation by picking up 1 or 2 charts of each instrument.

On the completion of the inspection of the observatory, the Inspector should give proper instructions / guidance to the observer which he considers important for improving the working of the Station. He should also prepare 3 sets of Inspection Reports with his recommendations, one copy to be given to the controlling office for rectification of defects, one copy for the Head and the third copy for IMD. The Inspector must keep an office copy with him and take it with him when he goes again to that station for inspection and check whether his previous recommendations have been implemented or not.

Date:.....

.....
(Signature of Inspecting Officer)

ANNEX II: MAINTENANCE NORMS

1. GENERAL

Maintenance norms are discussed for meteorological stations.

There are various types of meteorological monitoring stations in the HP Network. The first type consists of the meteorological stations, spread over various states of the peninsular India, is predominantly the rainfall monitoring stations using SRG or SRG/ARG instruments. These are inspected and are being reactivated as part of HP, by rectifying deficiencies wherever feasible. Other type constitutes a few climate stations in each state.

The meteorological station types in the reactivated variety are:

1. SRG (Standard Rain Gauge) stations
2. ARG (Autographic Rain Gauge) stations
3. HP-FCS (HP- Full Climate Stations)

The maintenance costs of the above types comprise the following components:

1. Maintenance of civil works
2. Cost of consumable items
3. Charges of staff

2. MAINTENANCE NORMS FOR STANDARD RAIN GAUGE (SRG) STATIONS

Maintenance costs are required for civil works, consumable items and charges to staff. The details of costs under these headings are worked out as given below.

PART A

Maintenance of civil works

1. Barbed wire fencing usually sags during a span of two-three years. Hence, it is necessary to tighten it.
2. Angle iron posts are rusted or damaged with time generally two to three posts are damaged every year, which are to be replaced.
3. While tightening the barbed wire, damaged barbed wire is replaced by a new one. For this purpose barbed wire 'U' nails are required. Some quantities of barbed wire and 'U' nails are required almost every year.
4. Painting to angle iron posts is necessary to protect against rusting.
5. Jungle clearance, repairing approach roads, etc.

PART – B**Consumable items**

Stationery is required to keep record of the data at every rain gauge station:

- 200 pages register, with hard cover binding - 1 no./station
- Forms for data recording on monthly basis - 15 nos/station
- Postal charges to despatch data forms to SDDPC - monthly

PART – C**Payment to rain gauge reader**

Payment to rain gauge reader deployed on SRG stand alone sites is recommended @ Rs. 500/- p.m.

Conclusion

Considering all the above points, the estimated expenditure for the maintenance of Standard Rain Gauge Station per year works out to be approximately Rs.5,750/- as detailed below:

**Maintenance Cost
Standard Rain Gauge (SRG) Station**

Item No.	Item	Qty.	Rate (Rs.)	Unit	Amount (Rs.)
<i>Part A: Maintenance of Civil Works</i>					
1.	Tightening of barbed wire fencing	Job/year			
2.	Replacing twisted/ broken angle iron posts, Lump Sum (LS).	Job/year			
3.	Providing 'U' nails & barbed wire etc. LS	6 kgs			
4.	Jungle clearance, repairing approaches, painting to angle posts as necessary, LS	Job/year			
Total for Civil Work maintenance					1,000
<i>Part B: Cost of Consumable Items (Stationery)</i>					
5.	Measuring Jar	1			
6.	200 pages card board bound register	1			
7.	Data recording forms	15			
8.	Postage	L S			
Total for Consumable Items					500
<i>Part C: Charges of Staff (One Rain gauge Reader)</i>					
11.	Rainy seasons	5	500	Per month	2,500
12.	Off-season	7	250	Per month	1,750
Total Charges of Staff					4,250
Grand Total					5,750

N.B.:

- a) The HIS network covers Peninsular India. Hence, providing uniform cost throughout the country may not be appropriate. Costs are recommended amounts, and may be adjusted according to local conditions.
- b) The cost on account of deployment of staff is the main component of the running cost. It is necessary that some of the staff performing multiple activities have to be considered only once.

3. MAINTENANCE NORMS FOR THE AUTOGRAPHIC RAIN GAUGE (ARG) STATIONS

Maintenance costs are required for civil works, equipment, consumable items and payments to staff. The details of costs under these headings are worked out and given below:

PART – A

Maintenance of Civil Works

1. Barbed wire fencing usually sags during a span of two-three years. Hence, it is necessary to tighten it.
2. Angle iron posts are rusted or damaged with time generally two to three posts are damaged every year, which are to be replaced.
3. While tightening the barbed wire, damaged barbed wire is replaced by a new one. For this purpose barbed wire 'U' nails are required. Some quantities of barbed wire and 'U' nails are required almost every year.
4. Painting to angle iron posts is necessary to protect against rusting.
5. Jungle clearance, repairing approach roads, etc.

PART – B

Maintenance of Equipment

The autographic-raingauge (ARG) is to be set ready for observation before the arrival of the monsoon for recording the rainfall. For replacement of the defective parts of the instrument, suggested spares are to be kept at the divisional level so that repairs are attended to speedily and the period of data loss is totally reduced.

PART – C

Cost of consumable items

- a) For the ARG instrument working on quartz clock, 1.5 volts batteries are required after every 15 days or as per necessity during the working season (i.e. monsoon season).
- b) The autographic charts for the ARG instrument are required to be used as needed.
- c) The ARG time mechanism, including pen on the chart requires attention. Some oil to the time mechanism and glycerine for pen is to be applied.
- d) Stationary:

i) 200 pages hard cover register	2 nos/station
ii) Data recording forms – monthly	15 nos/station
iii) Postage	LS/ station
iv) Rainfall recording graphs (one set contains 100 graphs papers)	4 sets/station
v) Recording ink bottles 10 ml capacity	2 nos/station

PART – D

Charges of Staff

Payment to the rain-gauge reader during the whole year is recommended, as he has to record/ verify SRG values and analyse autographic charts.

Conclusion

Considering all the above points, the estimate for the annual maintenance of an Autographic Rain gauge Station works out to be approximately Rs.8,200/-.

Maintenance Norm Autographic Rain Gauge (ARG) Station

Item No.	Item	Qty	Rate (Rs.)	Unit	Amount (Rs.)
1.	<i>Part A: Maintenance of Civil Works</i> Tightening of barbed wire fencing	Job/year			
2.	Replacing broken angle posts after every three years	Job/year			
3.	Providing 'U' nails & barbed wire etc.	6 kgs			
4.	Painting to angle posts after every two years Quantity: $8.00 \text{ m}^2 \times \text{Rs.}40/\text{m}^2 = 320/2 \text{ years} = 160/\text{year} = \text{Rs.}160/-$	Job/year			
5.	Clearing and levelling yard	Job/year			
	Total for Civil Work maintenance				1,000
6.	<i>Part B: Maintenance of Equipment</i> Repairs to ARG instrument (Repairs/Renewals)	Job/year			
	Total for maintenance of Equipment				500
7.	<i>Part C: Cost of Consumable Items (Stationery)</i> 200 pages hard cover register	2			
8.	Data record forms for SRG monthly	15			
9.	Data record forms for analysed values of ARG charts	15			
10.	Autographic charts (100 nos. book)	4			
11.	Recording ink bottles 10 ml capacity	2			
	Total for Consumable Items				700
15.	<i>Part D: Charges of Staff (One Rain gauge Reader)</i> During rainy season 1-6 to 31-10 (part time)	5	500	Month	2,500
16.	Off-season (1-11 to 1-5) (part time)	7	500	Month	3,500
	Total Charges of Staff				6,000
	Grand Total				8,200

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- The cost on account of deployment of staff is the main component of the running cost. It is necessary that some of the staff performing multiple activities have to be considered only once.

4. MAINTENANCE NORMS FOR FULL CLIMATIC STATION (FCS) FOR METEOROLOGICAL OBSERVATIONS

Maintenance costs are required for civil works, maintenance of equipment, consumable items and payments to staff. The details of costs under these headings are worked out as given below:

PART – A**Maintenance of Civil Works**

- a) Maintenance for fencing due to wear and tear is necessary once a year.
- b) Painting to angle iron posts of fencing is necessary yearly.
- c) It is necessary to keep the meteorological yard clean and tidy, during the rainy season. Normally, there is growth of weeds and shrubs in the station yard. It shall be cleaned of all such growths. The provision for cleaning the FCS yard is made in the estimate.

PART – B**Maintenance of Equipment**

All the meteorological instruments shall be kept in good working conditions throughout the year.

- a) **Temperatures:** Maximum-minimum, dry bulb and wet bulb thermometers should be attended to as detailed under routine maintenance.
- b) **Anemometer and Wind vane:** Should be attended to as detailed under routine maintenance.
- c) **Rainfall measuring instruments:** ARG and SRG instruments shall be attended to as detailed under routine maintenance.
- d) **Pan Evaporimeter:** Pan evaporimeter shall be checked as detailed under routine maintenance. Painting to evaporation pan should be done as and when required to avoid rusting and further damages.
- e) **Sunshine Recorder:** It shall be attended to as detailed under routine maintenance.
- f) **Pillars:** Pillars of the instruments such as anemometer, wind vane, sunshine recorder shall be cement washed and Stevenson's screen shall be oil painted once a year or as and when required.

PART - C**Cost of Consumable Items**

- a) For rainfall measuring instruments (SRG/ARG), the requirements are given in Chapter 2 and 3 and will remain the same.
- b) The specific type of chart papers for ARG, Thermograph, Hygrograph and Sunshine recorder, should be used as per requirement.
- c) Stationery:

i) 200 pages hard board register	3 nos/station
ii) Data record forms for SRG –monthly	15 nos/station
iii) Data record forms for hourly rainfall ARG	40 nos/station
iv) Autographic Raingauge charts	2 sets/station
v) Sunshine recorders strip charts	1 set/station
vi) Weekly or ten-daily forms for data despatch	200 nos/station
vii) Recording ink bottle for charts, 10 ml. capacity	2 nos/station
viii) Postage and stationery	LS

PART – D**Payments to Staff**

At every meteorological station, one M2 observer is required. He should see and keep the meteorological instruments in good working condition and record meteorological observations.

Conclusion

Considering all above points, the maintenance costs of meteorological stations is estimated at approximately Rs.56,000/- per year as detailed below:

Maintenance Cost Full Climatic Station

Item No.	Item	Qty	Rate (Rs.)	Unit	Amount (Rs.)
<i>Part A: Maintenance of Civil Works</i>					
1.	Providing and carrying out repairs	Job/year	200	Job/year	200
2.	Removing grass, shrub etc.	500 m ²	1	m ²	500
3.	Providing/applying oil paint to fencing	Job/year	800	Job/year	800
Total for Civil Works maintenance					1,500
<i>Part B: Maintenance of Equipment</i>					
4.	Painting to pan evaporimeter, Stevenson's Screen, and pillars of instruments	Job/year	1,000	Job/year	1,000
5.	Repairs to SRG/ARG, Thermograph, and Hygrograph	Job/year	2,000	Job/year	2,000
6.	Repairs to wind instruments	Job/year	500	Job/year	500
Total for maintenance of Equipment					3,500
<i>Part C: Cost of Consumable Items (Stationery)</i>					
8.	Register for data entry	12	25	No.	300
9.	White paper and ruled paper	(500p's)	100	1 Ream	100
10.	Autographic Rain Gauge charts	4	100	Sets	400
11.	Sunshine recorder strip charts	350	2	No.	700
12.	Hygrograph charts	350	2	No.	700
13.	Thermograph charts	350	1	No.	350
14.	Recording ink bottle, 10 ml. capacity	6	25	No.	150
15.	Muslin cloth and wick for wet bulb LS	1 m	50	No.	50
16.	Cells for quartz clock run instruments	25	10	No.	250
Total for Consumable Items					3,000
<i>Part D: Payments to Staff (One Raingauge Reader)</i>					
17.	M2 Met Observer's Salary	1 x 12	4,000	Month	48,000
Total for Pay and Allowances					48,000
Grand Total					56,000

N.B.:

- The HIS network covers Peninsular India. Thus to provide uniform costs may not be appropriate. Costs are recommended amounts, and may be adjusted.
- The cost on account of deployment of staff is the main component of running cost. It is necessary that some of the staff performing multiple activities have to be considered only once.