PROCUREMENT PROCEDURE OF CPRI (NON WORKS)

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Section IV T -Technical Specification

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Tender Enquiry No : CPRIBLR23ERED37S1161

Description of the Equipment/Goods/Services : Automated Solar Water Heater Test Facility

Note : 1) The technical bid submitted in other than this format is liable to be rejected.

2) All blue fields are mandatorily to be filled in.

Name and address of the bidder	
Quotation Number and Date	

Sl.No.	Technical Specifications/Parameters	Qty	To be completed by the Bidder		
			Detials of guaranteed technical parameters offered by the bidder	Guaranteed Technical Particulars (GTP)	Deviations from GTP
1	Equipment proposed for procurement: Automated Solar Water Heater(SWH) test set up consists of 4 test rigs each consisting of test systems for 2 SWH	1			
1.1	Scope: Supply, Installation, Commissioning and training at CPRI				
1.2	Application: Testing of SWH as per IS 16368:2015 (RA:2020). The test set up shall be suitable to test SWH with Flate Plate Collector (FPC), Evacuated Tubular Collector (ETC), unglazed/glazed FPC working on thermo-symphonic flow of water in outdoor.				
1.3	Description: The test set up consists of 4 test rigs each having capacity to test 2 SWH simultaneously. The test set up will be capabe to test a total 8 numbers of SWH simultaneously as per IS 16368:2015(RA 2020). The test is to find out efficiency of SWH				
2	Automated solar water heater (SWH) test facility for testing 8 nos of SWH simultaniously as per IS 16368:2015 (RA 2020)	4 test rigs each consisting of test systems for 2 SWH			
3	A mounting platform structure (Test rig) with an area of 2500 mm x 2500 mm which can be tilted to adjust the platform angle from 0 deg (horizontal) to 45 deg and associated piping. It should have wheels for movement with locking mechanism. Test rig shall have the flexibility to accommodate any odd/custom made dimensions of SWH. Mounting platform structure shall be 50 cm (minimum) above the ground level (Test rig base).	4			
4	One test rig shall have provision to accommodate two test systems. One test system consists of a solar water heater and associated piping, instruments and sensors.				
5	It shall be possible to integrate two such platform to make a bigger single platform with 5000 mm x 2500 mm dimension.				
6	These test rigs are used to install solar water heater collectors during testing. Sufficient fixing mechanism which can be operated without any tool has to be provided on the platform to hold collectors. If any mechanism requires tools, then tools shall be supplied with the system.				

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7	Provision shall be given in the test rig to install one pyranometer and two cup type anemometer. Pyranometer shall be mounted in such a way that it measures radiation on the plane of test rig. Anemometer shall be mounted in such a way that it measures wind velocity on the plane of collector.				
8	Mounting structure shall be provided associated with the platforms for installing storage tank of solar water heater (two tanks per test rig). Mechanism shall be provided to accommodate two numbers of storage tank of 100 L to 300 L in each test rig and one number of 500 L when two test rigs are integrated.				
9	Structure material shall be resistant to weather conditions as it will be installed outdoor.				
10	Automatic shading mechanism shall be provided associated with each test rig. Shade cover shall be opaque and white on the top exterior. A gap of 60 cm shall be maintained between the platform and the shade when it is covered	4			
11	Suitble holder to place 3 RTD temperature sensor uniformly spaced vertically in the storage tank though 25 mm diameter hole without leakage of water through the hole during the test shall be provided. RTD placement shall be adjustable based on storage tank dimensions.				
12	Piping as per Annexure 1, Annexure 1A. There shall be no permanent connection between piping and the platform for easy movement of the plat form.				
13	Water filter shall be used in the cold water supply before and after cold water storage tank				
14	2000 L cold water storage tank from which a common header is used to draw water to test systems. Water shall be distributed to 8 test systems separately through 25 mm diameter pipe using mixing pumps and automatic control valves.				

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15	Length of the pipes shall be made as short as possible between SWH and flowmeter. Also, all the piping including for hot water withdrawal, mixing pumps, etc, shall be insulated with 50 mm glass wool insulation with necessary cladding to protect it from moisture ingress, etc.				
16	Necessary coupling provision shall be given to connect cold water supply pipe and hot water draw-off pipe to the SWH. Pipe diameter shalle be 25 mm				
17	1000 L hot water storage tank to store drained hot water from the SWH storage tank.				
18	Provision to reuse the hot water drawn from the SWH as shown in Annexure 1. Pump shall be operated automatically to pump water from hot water tank to cold water tank based on water temperature and level. Pump shall operate when water temperature is less than 30 °C.				
19	A hydraulic pressure source capable of providing 1 kg/cm².				
20	Emplty line valve shall be used to empty the water from the test system once test is completed or whenever required.				
21	Valves shall be remotely operated by the software whenever is required to fullfill test procedure as per Annexure 2				
22	Each test system shall consist of following sensors:				
22.1	3 wire RTD temperature sensor Accuracy ±0.1 °C or better Type PT 100, Mineral insulated (Brand such as Omega/Jumo equivalent)	6 nos per test rig (3 nos per test system) and 10 nos spares with 10 m cable for each. Additional as required as operational/safety requirement			
22.2	Cup type anemometer with ± 0.1 m/s or better accuracy	1 per test rig			
22.3	Class A thermopyle pyranometer (Make such as Kipp& Zonen, Eko equivalent) One pyranometer shall be installed in each test platform. One pyranometer shall be installed to monitor radiation level.	1 per test rig+ 1 common +3 nos spare			
22.4	Flow meter with accuracy of 1 % or better Type: Magnetic inductive type (Brand such as Krohne/ABB/SIEMENS equivalent) Proper environmental safety enclosure against sunlight/dust/rain shall be provided as these systems are installed in open environment condition	2 numbers per rig (1 no per test system); Total 8 +4 nos spare			
22.5	One 3 wire RTD temperature sensor shaded with stevenson screen for measuring ambient temperature. Outside surface of Stevenson screen shall be of white colour	1			
23	Data acquisition, recording and controlling				
23.1	PLC based fully automatic control system shall be provided PLC brand: SIEMENS/Allen Bradley Equivalent				

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23.2	Data acquisition system shall have provision to acquire data from 4 pyranometers, 8 anemometers (but only 4 numbers shall be supplied), 25 RTD temperature sensors for testing purpose. Additional channel may be provided as required.				
23.3	Computer based systems shall be used for data monitoring and logging. Digital recorders shall be used and shall have accuracy equal to or better than ±0.5 percent of the full-scale reading. Data shall be monitored in 1 s interval and recording shall be possible for 1 s to 10 min (selectable). Computer and associated accossories shall be installed on the floor below the roof top. Data logger shll be placed as close to the test rigs (which shall be installed on the roof top) and shall be housed in a weather proof enclosure.				
23.4	Data acquisition system shall be backed by 2 kVA(or better) single phase online UPS with 16 hours of backup.				
24	Test Software				
24.1	Testing shall be completely automated through the software. Software shall have control on each component in the test set up which can be controlled. Software shall acquire, display and save data from all the sensors.				
24.2	Software shall control necessary components in the system to conduct the test as Annexure 2 (As per IS 16368: 2015).				
24.3	Provision shall be given in the software to select any test system for testing. Data displaying and recording shall be made independently for each test system. Test system shall be numbered from 1 to 8 in the software. Provision shall be given in the software to configure sensors with test systems.				
24.4	A separate calibration tab shall be provided in the software to display all the measured data at the data acquisition channels long with scaling factor (if applicable). Scaling factor shall be editable.				
24.5	Provision to enter and edit data such as Sample ID, Solar noon time for any selected dates, Specifications of SWH as per Annex D-A (General)& B (Specification of the test sample) of IS 16368:2015 (RA 2020). Provision to enter results of inspection after pre conditioning test and after static pressure leakage test.				

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24.6	Log sheet shall be generated for daytime test as per Annex B and for Night time test as per Annex C of IS 16368:2015 (RA 2020). 10 min recording interval shall be considered for this.				
24.7	Following parameters shall be clculated as per IS 16368:2015 (RA 2020) based on the log sheet 1. Percentage Maximum efficiency of the system 2. Average overall heat loss coefficient of the system during day-time test 3. Average overall heat loss coefficient of the system during night-time 4. Cooling time constant 5. Percentage efficiency at standard test conditions 6. Average amount of energy collected during the period of daytime test corresponding to standard test conditions				
24.8	Provision to generate report as per Annex D of IS 16368:2015(RA 2020) shall be provided				
24.9	Provision shall be given to view previous data during the test without interruption. Additional features may be provided to make the software user friendly.				
24.10	Provision to see status of each components such as valves, pump, solar shade, etc. in the scematic diagram.				
24.11	An executable software set up file shall be provided. Software shall be compatible with windows 10 or above.				
25	A 100 L solar water heater shall be provided for demo testing purpose	1			
26	Computer specification (or better): Intel core i7/ Ryzen 7 or equivalent, 4.4 GHz or better, 16 GB DDR4 3200 MHz RAM, Minimum 256 GB NVMe SSD for operating system with 1 TB SSD for storage, Windows 10 or above, MS office , 1 HDMI, 2 RJ-45, Wi-Fi, Bluetooth, 2 USB, mic, headset jack, camera, wireless keyboard and wireless mouse, 24 inch FHD display	1			
27	Printer with below specification, Colour output,Laser printing,Automatic duplex (2 side) printing, Automatic scanning(duplex), Scan format-JPG, PDF, Copy, USB port, Built in WiFi and Ethernet connectivity, Host USB ,Touch screen, Paper size-A4, letter and A5, Resolution 300x300 dpi or better	1			
28	1 TB SSD external hard disk for storage/backup/data transfer	2			

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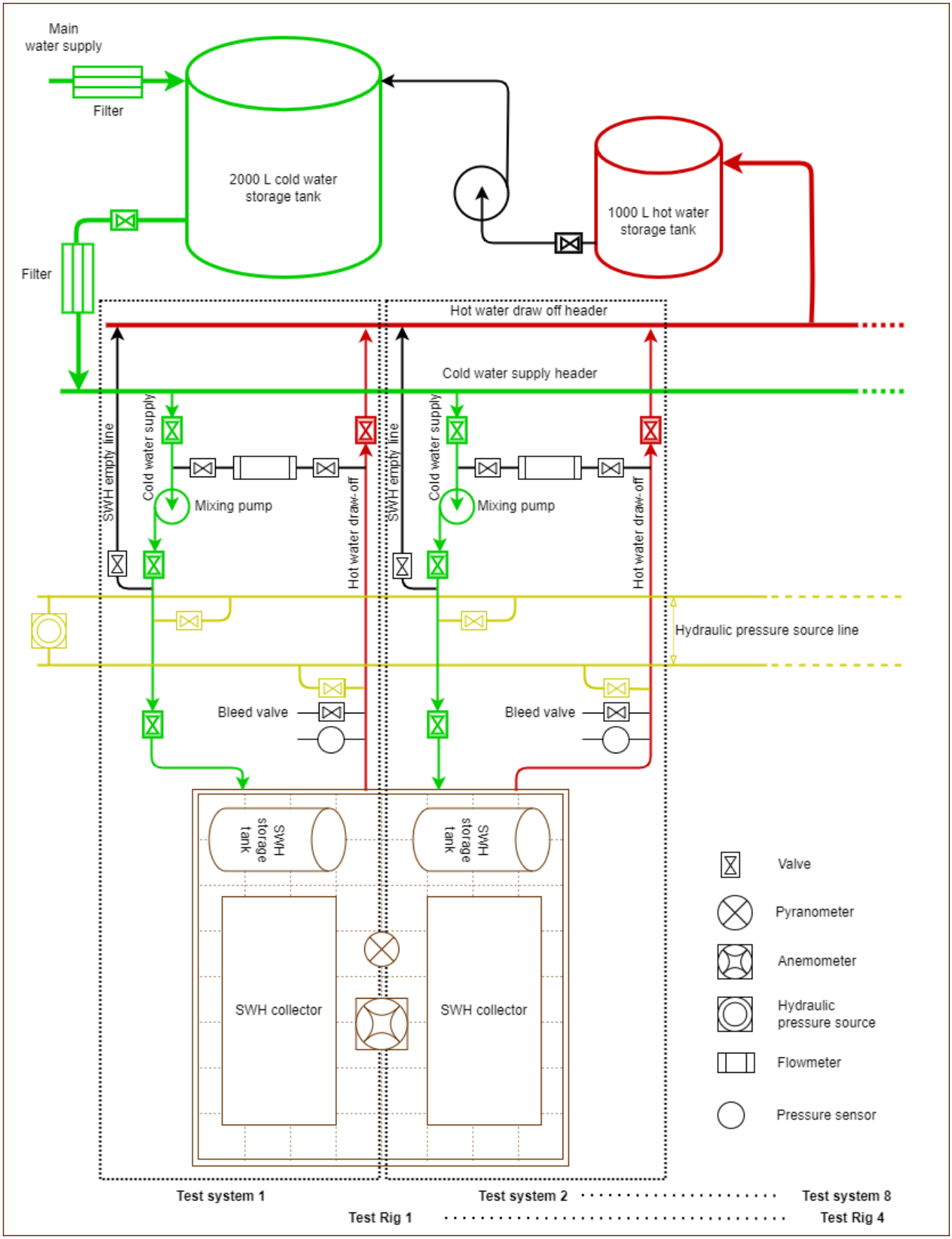
29	Minimum 10 inch touch screen tablet for wireless remote data monitoring and control system shall be provided. Tablet shall be configured with the computer to monitor and control the test process. Range shall be 100 m or better. Tablet specification: 4 GB RAM, 64 GB ROM, Android 11 or better, 2 GHz or better, 7000 mAh battery or better.	1			
30	Test rig and associated equipment such as fow meter, valves,etc, shall be capable to operate under a pressure of 5 bar without any leakage.				
31	Two wireless surveillance camera shall be installed and configured with the system to monitor the test set up.				
32	One day training shall be provided on operation of the system to CPRI officials				
33	Two hard copy and one softcopy in PDF format of operational manual for test set up and software shall be provided				
34	All the sensors/transducer (Pyranometer, Anemometer, flow meter, RTDs) and data loggers shall have calibration traceable to IS/ISO/IEC 17025 /NABL accredited.				
35	Warrantee/guarantee: At least 1-year warranty for the entire test set up from the date of successful installation and commissioning. 2 years comprehensive AMC after warranty period. Scope of AMC shall include quarterly visit for preventive maintenance and breakdown maintenance when called upon.				
36	Vendor can visit CPRI premises to get better understanding about the place of installation, requirement of cable/piping length and other needs.				

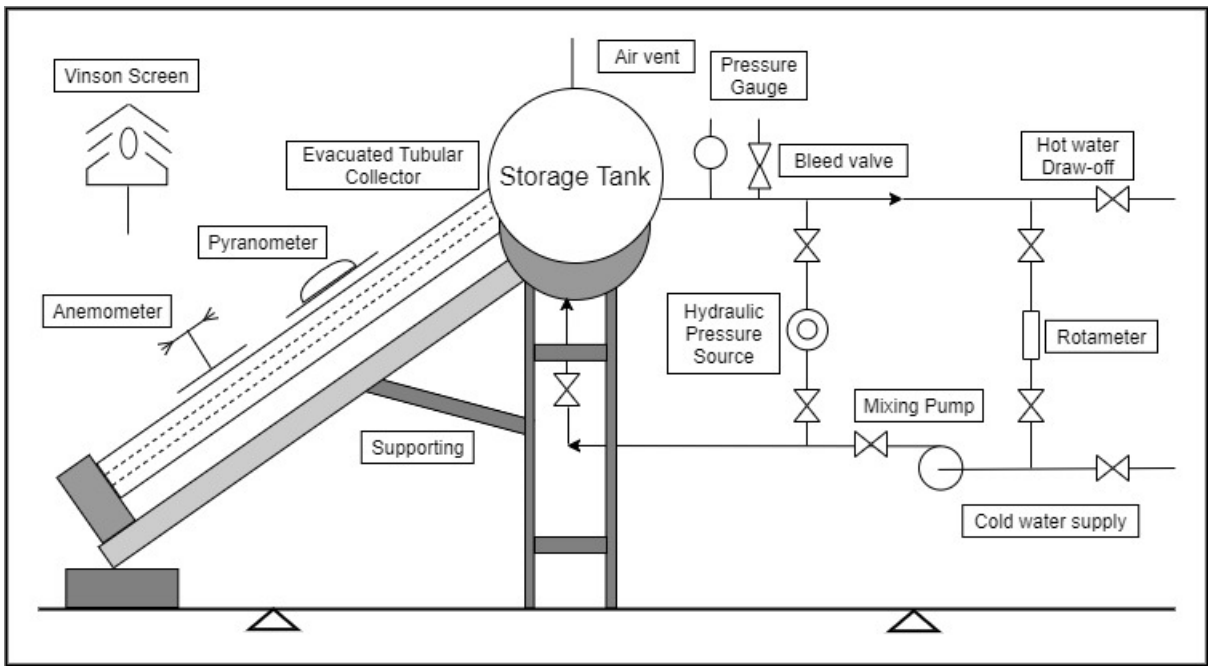
PN: 1) Mere statement of "Complied" do not suffice the requirement. The details of technical parameters in proof of CPRI requirements shall be furnished along with technical write-up, catalogues, brouchers, literatures, phamplates, or any other documents shall be submitted in hard copy along with technical bid.
2) Calibration reports/certificates, factory test reports/certificates from an accreditated agencies/facilites shall be submitted wherever applicable.
3) CPRI reserves the right to conduct "predispatch inspection" prior to dispatch at the works of the supplier and the expenditure towards PDI shall be borne by CPRI. However information regarding the rediness of the equipment/machinary for the PDI shall be communicated in writing at lease 70 days in advance.

ANNEXURE 1



Schematic diagram of the test set up

ANNEXURE 1-A



Schematic diagram of the test set up. This represent only one test system.

Accuracy requirement for the measurements as per IS 16368:2015 are as follows,

Sl No	Parameter	Accuracy
1	Area	± 0.1 %
2	Wind velocity	± 0.1 m/s
3	Temperature	± 0.1 °C
4	Time	± 0.2 %
5	Volume	± 1 %
6	Data recording	± 0.5%

ANNEXURE 2

TEST PROCEDURE

The test shall be carried out in the following sequence:

Sequence	Test
1	Pre-conditioning test
2	Static pressure leakage test
3	Thermal performance test (day time and night-time tests shall be performed one after another to complete one data set)

1. Pre-Conditioning Test

Fully assembled system filled with water shall be kept exposed to weather conditions for 15 days having daily solar irradiance on the plane of solar collectors more than 16 MJ/m2. The days with solar irradiance lesser than this value shall not be counted. All parts of the system shall be inspected thoroughly.

2. Static Pressure Leakage Test

Initially, air bleed valve is kept open and it is ensured that all air is removed from the collector by circulating water through it. Thereafter, the solar water heating system (Tank + Collector) is filled with water at a temperature of 60 ± 2 °C. Heated water during pre-conditioning test may be used for this. After filling, the bleed valve and all other valves are closed, and a hydraulic pressure 0.5 kg/cm2 is applied for flat plate collector system and a hydraulic pressure of 0.2 kg/cm2 is applied for evacuated tabular collector system. The system is kept pressurized for a period of 30 min for both ETC and FPC system. After 30 min, all parts of the system shall be inspected for any abnormality.

3. Thermal Performance test

The testing of the system shall be carried out in two steps, namely, the solar test (Day test) and the no-solar test (Night test).

3.1 Day time test shall be conducted in the following

steps:

a) Determine Indian Standard Time (IST) corresponding to the solar noon. This may be calculated by the software or provision may be given to enter manually.

b) Solar collector is shaded completely with an opaque cover, white on the top exterior, at about 4 h before the solar noon. The storage tank of the solar water heating system is filled fully with water. The quantity of water filled in the storage tank shall be taken as notional capacity of the solar water heating system.

c) The water in the storage tank is fully mixed by switching on pump for 5 min before beginning of the test at the designated time instant.

d) Initial value of the storage water temperature, T_{sid} is measured and recorded, and the shade cover

is removed at 210 min before the solar noon.

e) Measurements for ambient air temperature, water temperature of the storage tank, and solar irradiance on the plane of solar collector get commenced at the start of the test. The measurements are continued subsequently for the entire period of the test at an interval of 1 min or less, however, recording of data is adequate at an interval of 1 to 10 min (selectable).

f) To end the day-test cycle, the solar collector is again shaded on expiry of 210 min from solar noontime. The water in the storage tank is again mixed by operating the pump for 5 min and final storage water temperature (T_{sfd}) is measured and recorded.

g) The test is repeated for at least ten days with different values of initial storage water temperature. The first test shall be carried out with cold (supply) water in the storage tank. For subsequent days, initial water temperature shall be raised in uniform steps to cover up to 70°C (fully mixed storage).

h) Different initial temperature in the storage tank may be achieved by adding appropriate quantity of cold water to the previous day's heated water in the storage tank. Alternatively, hot water from any other source may also be used to achieve the required temperature of the water in the storage tank.

3.2 Night Time Test

The duration of test is 10h under no-solar conditions. The following steps are undertaken to perform this test:

a) Measure the amount of solar radiation falling on the plane of solar collector(s) before starting the night-test; if the measured value is more than 50 W/m2, cover the solar collector(s) by an opaque shield. This may be done by fixing the cover leaving a, gap of about 0.5 m above the solar collectors to allow free flow of surrounding air. After the solar radiation falls below the value of 50 W/m2, the cover should be removed.

b) Switch on the mixing pump for about 5 min before the start of night test time so that water temperature in the storage tank is fully mixed and attains uniform temperature. Undertake

measurement of initial storage water temperature, T_{sin}.

c) Carry out measurements of water temperature of storage tank, and ambient air temperature at an interval of 10 min during the test period.

d) Again, switch on the mixing pump at the end of test period of for about 5 min and measure final storage water temperature, T_{sfn}.

e) Repeat the experiments for number of days for which the day time test was performed.