SOLAR WATER HEATING SYSTEM

A) Natural Circulation (Thermosyphon) and

B) Pressurized system

Capacity & Temperature: 125 LPD to 3000 LPD and 60^0 C.

Sr. No.	Item and Specifications	Natural Circulation (Thermosyphon)	Pressurized @ 3.5 Kg/Cm^2 Thermosiphon
1	Supply of collectors and stand with installation	As per system capacity	As per system capacity
	Absorber: cu-cu only. Box		
	Aluminum (ISI Mark Only) IS 12933		
2	Supply & installation of insulated storage tank with stand	Capacity same As per system capacity	Capacity same As per system capacity
	Material of construction	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides
	Insulation with thickness of material	Rock wool 100 mm/ PUF 50 mm upto 2000 LPD system	Rock wool 100 mm/ PUF 50 mm upto 2000 LPD system
	Density of insulation	RocKWool - 48 kg / m^3	RocKWool - 48 kg / m^3
		PUF - 40 kg / m^3	PUF - 40 kg / m^3
	Insulation cover	Aluminum sheet 22 swg	Aluminum sheet 22 swg
3	Supply control instruments with installation	1 set for each system	1 set for each system
	□ Tap (Brass Tap)	1 No.	1 No.
	□ Gate Valve (Brass, 1 inch, ISI Mark)	2 Nos.	2 Nos.
	□ Non return valve (ISI Mark)	1 No	1 No
	□ Air release valve (ISI Mark)	1 No	1 No
	□ Strainer (ISI Mark)	1 No	1 No
	□ Pressure Release Valve	NA	1 No
	□ Pressure Gauge	NA	1 No
	□ Temperature Gauge (4" dial, H Guru make)	1 No (1500 lpd to 3000 lpd)	1 No (1500 lpd to 3000 lpd)
4	Capacity of cold water tank	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)
5	Supply of piping G I,	6 mtr for each system	6 mtr. for each system

	Class B, ISI		
	Cold Water - 1 "		
	User piping upto one use point.	30 mtr for each system	30 mtr for each system
	Dia 20 mm (insulated) (Kitec or equivalent slandered make.)		

1. ABSORBER

(A) Material : Absorber shall be of Cu-Cu type only (Copper Sheet and Copper Tube)

(a) Thickness of Sheet : 34 SWG (0.19 mm) minimum

(b) Risers : Diameter: 12.7 mm (+ 0.5 mm)
Thickness: 24 SWG (0.56 mm)
(+ No limit, - 0.07 mm)

(c) Header : Diameter: Minimum 25.4 mm (OD) + 0.5 mm
Thickness: 0.71 mm (+ no limit -0.07 mm)
Projection: 40 mm (+ 5mm) out side
(Including the collector box flange thickness)

* Number of fins and tubes : Nine / collector

(d) Space between Riser Tubes :

Maximum space between riser tubes shall be12 cm from centre to centre of the risers. The free edges at the sides should not exceed 6 cm from the centre of the extreme and riser tube. For independent fins or joints in the sheet an overlap of minimum 2 mm shall be provided.

(e) Bonding between Riser and sheet:

Welding may be of continuous nature inert arc spot welding type with the product of number of spots per fin and area of spots exceeding the product of length of the fin and twice the thickness of the fin for each fin. (Continuous welding)

(B) Area of Absorber : 2.0 Sq. M (+0.1 m^2) including the projected area of the header.

(C) Header - Riser Joints :

The assembly of risers with the header shall ensure not more than 5 mm tube extension inside the header. The riser shall be brazed to the header with suitable brazing alloys with or without the use of flux.

Any flux used in soldering/ brazing shall be mechanically removed and neutralized with the solution of sodium carbonate to avoid corrosion problem in future.

(D) Absorber Coating:

Selectively coated with solar absorptive more than 0.92 and infrared emissive less than 0.20 shall be used. The coating should be stable up to 300 ^{0}C.

02 FLAT PLATE COLLECTORS:

(a) Overall Dimensions of the Collector Box : a) Length = 186 cm (+1cm) / 212 cm (+ 1 cm) / 205 cm (+ 1 cm)
b) Breadth = 124 cm (+1cm)/104cm (+ 1 cm) / 93 cm (+ 1 cm)
c) Height = 10 cm (+1 cm) / 10 cm (+ 1 cm) / 9.3 cm (+ 1 cm)

(b) Collector Box Materials : Excluding glass and glass retainer

(i) Aluminum:

Aluminum extruded sections of size approximately 100 mm x 25 mm channel sections and of thickness 1.6 + 0.2 mm

Aluminum sheet for the bottom shall be of thickness 0.71 + 0.07 mm

Aluminum Sheet for entire body shall be of 1.0 mm thickness (minimum) 1.2 mm thick Aluminum angle (dimensions 25 mm x 25 mm) as a retainer for glass.

(ii) Fabrication of the Box:

Side Channels shall be welded by inert arc gas welding or gas brazing to ensure leak proof continuity of the joints of the box.

(iii) Attachment of Bottom sheet:

Bottom sheet shall be attached by riveting, spot welding or with S.S. screws and caulking of the joints with sealing paste of Zinc Oxide based or rubber based or silicon rubber based epoxy based sealing compounds. Caulking may be done on the inside joints or inside as well as outside joints or inside as well as outside joints to ensure leak proof joints.

(iv) The complete aluminum box should be powder coated or anodized.

3 Testing of Riser - Header Assembly:

It will be tested for leakage and strength at a minimum hydraulic / pneumatic pressure of 5 kg/cm^2 for all thermos phonic systems and systems designed for operation at 2.5 kg / cm^2 or below. For systems designed for operation at higher pressure, test pressure shall be twice the system design pressure.

4 COLLECTOR BOX INSULATION:

(a) Back Insulation:

Insulation of R value = 1.67 m^2 C /W to withstand a temperature of 250^0 C should be used.

Typical insulations are:

Sr. No.	Trade Name	K	(kg/m^3)	R	Minimum thickness
1.	Spintex 300 (Rock wool)	0.029	48	1.67	50 mm
2.	Twig Glass wool	0.033	48	1.67	65 mm

Aluminum foil of thickness 0.016 mm + 0.005 mm shall be used for covering the back insulation.

(b) Side Insulation:

Resin bonded white glass wool/Rigid polyurethane/ industrial grade Spintex shall be used. So as to achieve R value =1.67 m^2 ^{o} C/W. Typical insulation is as given in 4 (a).

The side insulation shall be 15 mm thick (minimum). Aluminum foil of thickness 0.016 mm to 0.015 mm shall be used for covering the side insulation.

5 FRONT GLAZING:

4 mm thick + 0.2 mm toughened / tempered (Hardened) glass having transitivity of 85% or more shall be used. In hilly region only toughened glass of 4mm / 5mm of transitivity 82% or more should be used.

6 HEADER FLANGES:

a) Brass flanges of 62 mm + 3 mm diameter and minimum thickness of 4 mm with provision for four numbers of SS / GI or cadmium plated bolts with diameter of 5 mm - 6 mm shall be used. Flanges shall be brazed to the header and brazing tested for leakage at the test pressure. In no case crude soldered flanges shall be used. The assembly of the flanges should be at right angle to the header area to ensure proper assembly at the site of installation.

7 GROMMET:

Suitable sealing between the inlet and outlet of header and casing of the following materials shall be provided, Neoprene, EPDM, Silicon Rubber and Butyl Rubber.

The grommet shall be suitable for a temperature upto 150^{o}C and mechanical loading during transportation of collectors. Typical size of grommet may be 40 mm outer dia. and 25 mm inner dia.

8 ASSEMBLIES OF COLLECTORS:

The load of the absorber should not be on the insulation. It should be taken by the collector box.

The air gap between the glazing and the absorber should be 30 mm (+5 mm).

Insulation should not be allowed to slide one of the ways is to provide extra glass wool pad below the header to clamp the back insulation pad between the header and the collector box. Glazing shall be fixed on the collector box by using EPDM channels /sponge rubber strips both at the top and bottom of the glass.

The glass should be firmly held, without strain, taking into account the expansion of glass. A typical while fixing the screws on the top of the box example is by retaining the glazing with the help of stainless steel screws and aluminum angle retainer of dimensions 25 mm x 25 mm x 1.6 mm fixed on the top of the box it shall be ensured that the screws are not touching the glass edge.

Top surface along the edge between the glass and the aluminum angle shall be sealed with suitable sealants such as zinc oxide based / rubber based / silicon rubber based and polysulphide rubber sealants.

9 GASKET FOR FLANGES:

3 mm thick compressed asbestos fiber gasket or Neoprene rubber or EPDM gasket shall be used for sealing the joints between flanges.

10 COLLECTOR SUPPORT FRAME:

The structure should be in a position to withstand a wind velocity of 100 Kms / Hr. A typical way to do this is that it shall be made with angle iron stronger than 35 mm x 35 mm x 3 mm and shall have vertical support at top and bottom edge of the inclined plane of the collector at a distance of 2.5 m or less. The vertical support shall be firmly grouted to the roof in the ground in case of ground mounted system. The grouting blocks shall be of minimum equal to 25 cm x 25 cm x 15 cm and finished properly. In case the grouting is carried out on a roof already water proofed with asphalt the back support of the collectors may be anckled to the parapet or the size of the grouting block shall be increased to provide for a dead weight anchoring of 75Kg per leg of the vertical support

11 PAINTING OF STANDS:

Proper cleaning and degreasing of the surface should be done before painting. Two coats of zinc chromatic red oxide primer shall be applied followed by one coat of enamel paint of suitable color. For coastal areas and areas of sulphuric fumes and chlorides suitable anti-corrosion paints like polyurethane paint or epoxy paint should be applied after proper treatment in shop.

The manufacturer may use Zinc plated stand as it has longer life.

12 STORAGE TANK

(A) Material: De-Pressurized

The tank shall be made up of stainless steel or C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 22 SWG stainless steel only. Copper tank of thickness 20 SWG may also be used. However, proper precautions shall be taken in case of higher heads.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 20 SWG, for 500-1500 liters, it shall be of 16 SWG, for 1500- 3000 liters, it shall be of 14 SWG and for capacity more than 3000 liters it shall be of 10 SWG thickness or more with proper stiffening.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

Material: Pressurized@3.5 kg/cm^2

The tank shall be made up of stainless steel or C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 16 SWG stainless steel only.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 14 SWG, for 500-1500 liters, it shall be of 12 SWG, for 1500-3000 liters, it shall be of 10 SWG and for capacity more than 3000 liters it shall be with proper stiffening & with standing strength.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

(B) Insulation:

Insulation of R value = 3.34 m^2 $^oC/W$. to withstanding a temperature of 100 ^oC. Should be used. Typical insulations are: -

Sr. No	Trade Name	K (W/ mk)	Density (kg/m^3)	R	Minimum Thickness
1.	RockWool	0.029	48	3.34	100 mm

RockWool insulation with the same density will be permitted for the use. Thin polythene sheet shall be used as covering between the rockWool and the cladding sheet besides the retaining material such as chicken mesh etc.

13 PIPING:

(A) Material:

Medium class (B class) GI as per IS 1239 shall be used for piping. Brand for piping to be used must be of ISI mark only.

(B) Insulation:

Insulation of R = 1.67 m^2 Deg. C/W to withstand a temp. of 100^0 C. shall be used. Typical insulation is as given below,

Sr. No	Trade Name	K (W/ mk)	Density (kg/m^3)	R	Minimum Thickness
1.	RockWool	0.029	48	1.67	50 mm

The Manufacturer can also use PUF insulation of 25 mm for all water heating system pipeline and for hot water tank Puff insulation is of 50 mm.

Thin plastic sheet shall be used as covering between RockWool and aluminum cladding besides other retaining material 26 SWG aluminum sheet shall be used for cladding the insulated pipe.

14 VALVES / NIPPLES / TEES / BENDS:

Gunmetal valve as per ISI specification shall be used.

Nipple/Tees and bends shall be of medium class GI (B class).

Gunmetal valve in each row shall be provided. Air vents in each row are to be provided. Valve should be of chrome plated 90^0rotation ball valve should be used having standard brand.

15 Those items, which are exposed to the air and likely to be corroded, therefore should be treated with anti corrosive treatment i.e. application of epoxy painting.

16 The system shall be supplied and installed with ISI mark, Cu-Cu selectively black chrome coated only or Cr-Al selective coating of International standard and with BIS approval.

17 All the joints should be flanged-type / union type with proper temperature gaskets. Rubber joints will not be accepted. Bolts and nuts used in the joints should be adequately protected against corrosion.

18 All pipe lines used should be ISI marked for the hot as well as cold water should be galvanized iron class - B conforming to IS No. 1239.

19 Instrumentation control valves and other accessories should be of high quality and of ISI make with high reliability.

20 All metal parts which are likely to get corroded should be protected by suitable paints.

21 The whole assembly shall be tested hydrolytically to withstand a pressure of 5 kg / sq. cm.

22 All installations including collectors and pipelines are to be supported ion suitable permanent metal structural supports designed for the purpose and grouted / bolted properly.

23 Civil Engineering work or construction work of any kind shall be carried out by the Contractor.

24 Angle of response for collector should be latitude plus 15^0, facing south with no shadow on neighboring collector rows.

25 All pipe lines carrying hot water above ambient temperature should be insulated with fiber rock wool / mineral wool 50 mm thick with thermal conductivity less

than 0.04 K cal/hr-m degree C. or polyurethane of equivalent thickness. Hot water tank should be insulated with 100 mm thick rock wool / mineral wool.

26 The system should be painted with anticorrosive paint. One coat of primer and two final coats should be applied.

27 Scope of work:

a. Design of the system.

b. Fabrication, supply and installation of suitable flat plate collectors.

c. Design, fabrication, supply and the installation of suitable support for the collectors, pipes, vales and other components and accessories.

d. Design, supply, fabrication, installation of cold water tank and insulated storage tank, cold water piping, insulated user piping.

e. Supply and installation of control instrumentation required for the system.

f. Civil work (grouting) of collectors, collector stands and tank.

g. Hydraulic testing and commissioning of the system.

h. Any additional works not covered above.

i. Supply of manual for Operation and Maintenance to the Maintenance department of concerned beneficiary institute.

j. Commissioning of the entire system.

k. Training to the user for operation and maintenance of the system.

C) Forced flow circulation System (Soft Water): (Capacity 3000 to 5000 lpd)

Forced Circulation system - The systems between 3000 lpd to 5000 lpd shall operate on forced circulation pattern. The system should operate on differential temp. controller logic. The following should take into consideration while designing the same:

For Pump Control Panel with DTC

Description	Specification / Make
OLR & MCB	L&T / Siemens
Sensors	RTD PT-100 with SS-304, 12” stem
Motor Selector Switch	L&T / KEC

For: Inter circulation Pumps

Make	Grundfoss / Kirloskar / reputed make
Type	1 Hp
Purpose	Internal Circulation
Quantity	1 + 1 standby