Apricus Solar Hot Water

Installation Manual

For Commercial Hot Water Systems

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CONTENTS

CHAPTER 1: INTRODUCTION

TERMINOLOGY

- Bank: Multiple collectors in series (one after the other).
- Boost: The process where a heating component (such as an electric element or gas heater) is used to provide additional heating when solar-heated water is not of an adequate temperature
- Clean Energy Regulator (CER): Government body responsible for overseeing the implementation of the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES).
- Collector: The Apricus solar collector includes the manifold with heat pipes and evacuated tubes inserted.
- Expansion Control Valve (ECV): Installed on the cold mains line to relieve excess pressure.
- Expansion Tank: Fitting an Expansion Tank to the system allows the water to move into the expansion tank and occupy its volume, rather than increasing the system pressure. This reduces the wastage of water through the PTRV and protects the system from high pressures and undue wear.
- Evacuated Tube: functions to harness the solar energy by capturing and retaining the heat due to the presence of the vacuum.
- Flow Line: The plumbing line running from tank solar flow port to the inlet of the collector. This line incorporates the circulation pump.
- Heat Pipe: A copper pipe that sits inside the evacuated tube and is inserted into the collector manifold. A small volume of liquid acts as a heat transfer fluid. It absorbs heat via evaporation, and transfers heat to the system fluid via condensation.
- Header Pipes: The copper “heat exchanger pipes” in the manifold of the Apricus collector through which the water flows.
- Insolation: solar radiation level, expressed in kWh/m2/day.
- Manifold: Refers to the solar collector enclosure that contains the header pipes.
- Pressure Temperature Relief Valve (PTRV): installed on the hot water storage tank to relieve pressure, and excessive temperatures.
- Return Line: The plumbing line running from the solar collector to the solar return port on the tank.
- Stagnation: Stagnation is the maximum temperature a collector will reach, at which point the rate of heat gain and rate of heat loss is balanced.
- Stratification - the passive separation of water into distinct layers of different temperatures; where the temperature at the top of the tank can be significantly higher than the temperature at the bottom.

1.2 SCOPE

- This manual has been designed to provide installation instructions for the installer or plumber.

CHAPTER 2: WARNINGS AND PRECAUTIONS

2.1 INSTALLER REQUIREMENTS

Installation of an Apricus solar Commercial Hot Water (CHW) system must be completed by a licensed plumber and in accordance with the requirements listed below, as well as any relevant local standards and regulations.

- AS/NZS 3500.4 - National Plumbing and Drainage Code
- AS/NZS 2712.2007 - Solar and Heat Pump Water Heaters: Design and Construction
- AS/NZS 4234.2008 - Heated Water Systems - Calculation of Energy Consumption
- AS/NZS 5601.2004 - Gas Installations

2.2 OCCUPATIONAL HEALTH AND SAFETY

The installer must adhere to occupational health and safety guidelines and other relevant industry associations. Under no circumstances should any installer attempt to install an Apricus solar CHW system without reading and understanding this installation manual. For any queries Apricus staff may be contacted on 1300 277 428.

2.3 OVER PRESSURE AND TEMPERATURE PROTECTION

2.3.1 PTRV

Any system design must allow a means of pressure release at no more than 850kPa, using a PTRV. The PTRV must have a downward direction copper pipe connected that is open to the atmosphere, running the expelled hot water or air to a safe, frost free and appropriate drainage location. From time to time the PTRV may discharge small amounts of water under normal operations, this can be up to 10% of tank capacity. If the tank is installed indoors, a safe-tray must be installed beneath the hot water tank to safely collect any water expelled from the PTRV.

2.3.2 MAINS PRESSURE CONTROL

Where the mains supply pressure can exceed or fluctuate beyond the pressure of 500kPa, a pressure-limiting valve must be fitted to the cold mains line. The device is installed after the duo valve (isolation valve and check valve) and should have a pressure limit of 500kPa.

In some states it is a mandatory requirement that an expansion control valve be fitted on the cold mains line to provide a form of pressure relief. A separate drain line must be run for this relief valve (as per AS/NZS 3500). If unsure please check with the local authority.

Apricus recommends the use of an ECV on every installation.

2.4 WATER QUALITY

2.4.1 WATER QUALITY THRESHOLDS

Water quality is an important aspect of system lifetime. For the system to be warranted, the water used in the system must meet the requirements outlined in Table 1.

Table 1 Water Quality Threshold Values

Total Dissolved Solids	< 600 mg/L or ppm
Total Hardness	< 200 mg/L or ppm
Electrical Conductivity	850 µS/cm
Chloride	< 250 mg/L or ppm
pH Level	Min 6.5 to Max. 8.5
Magnesium	< 10 mg/L or ppm
Sodium	< 150 mg/L or ppm

If in doubt contact your local water authority or have a water test completed. In areas of poor water quality all major components will have a reduced life due to the hardness of the water. In areas with "hard water" (>200 mg/L or ppm), it is advised to install a water softening device to ensure the long term efficient operation of the system is met. It is also advisable that a glass-lined tank is used as opposed to a stainless steel tank, since the glass-lined tank has a sacrificial anode to protect from corrosion. Apricus recommend the anode be inspected at least every three (3) years, and serviced as required.

2.4.2 LEGIONELLA CONTROL

Legionella bacteria can be found naturally in the environment and thrives in warm water and damp places. It can weaken the body's immune system, which can increase the chances of developing Legionnaires' disease. To ensure legionella growth is inhibited, the boosting regime must meet the guidelines as shown in Chapter 8: Auxiliary Heating. This is in accordance with 'AS3498.2009 Authorisation requirements for plumbing products - water heater and hot-water storage tanks' It is therefore, very important that the auxiliary boosting system remains on. It will only activate if the temperature falls below the temperatures outlined.

2.5 WEATHER RELATED ISSUES AND ACTS OF GOD

2.5.1 FREEZE PROTECTION

All Apricus systems have freeze protection built in. This is provided by the controller which will circulate water through the collector once the temperature falls below 4°C. This freeze protection method has passed Frost Level 1 protection (down to -15°C) in line with AS/NZS 2712:2007.

WARNING
Freeze protection will not operate if there is no power supply to the controller or pump.

2.5.2 LIGHTNING PROTECTION

At installation locations that are prone to lightning strikes, it is advisable to earth/ground the copper circulation loop of the collector to avoid lightning related damage, or electrical safety issues. Refer also to local building codes regarding lightning safety and grounding.

The inclusion of a residual-current device (RCD) may be used in these lightning prone areas and is to be sourced from others.

2.5.3 HAIL RESISTANCE

The borosilicate glass evacuated tubes have been tested under the Australian Standards requirement (AS/NZS 2712:2007 - Solar and heat pump water heater - design and construction). The impact resistance test results indicate that the evacuated tubes are able to withstand impact from hailstones up to 25mm/1" in diameter at 25 m/s.

2.5.4 BROKEN OR DAMAGED TUBES

In the unlikely circumstance that an evacuated tube should become broken it can be easily replaced. The solar collector can still function properly with one or more broken tubes, however it will result in a reduced heat output from the collector. A broken evacuated tube should be replaced only by a professional installer or service agent.

2.6 STAGNATION AND NO-LOAD CONDITIONS

2.6.1 INFORMATION ON STAGNATION

Stagnation is the maximum temperature a collector will reach, at which point the rate of heat gain and rate of heat loss is balanced. This typically occurs during clear skies and high insolation days, when the pump may be off. The Apricus evacuated tube collectors will stagnate at 230ºC.

During stagnation it may be observed that the pump stops running, due to the high tank temperature protection feature built into the controller, which turns the pump off.

The system is designed to allow stagnation to prevent the tank from overheating. This means that the collector and plumbing in close proximity may reach temperatures of up to 220°C; therefore components that may be exposed to the high temperatures such as valves, plumbing or insulation, should be suitably rated.

The system designs listed in the 'CER' Register meet the No-load system requirements detailed in AS/NZS 2712:2007. This means that they will not dump large volumes of water from the PTRV and do not require an auto air-vent.

During periods of extended stagnation, condensation pressure shocks can occur in the tank. When the tank is topped out and suddenly a hot water load is drawn from

the tank this can lead to rapid mixing of cold water and superheated steam in the return line. This can produce a "gurgling" noise, as the steam collapses on itself upon rapidly cooling and condensing. This is a normal occurrence in any hot water storage system and does not affect the system's operation.

2.6.2 HYDROGEN BUILD UP

Glass lined (vitreous enamel) tanks are fitted with a Magnesium anode to provide corrosion protection for the tank from the storage water. Small quantities of hydrogen gas can be released by the anode, which generally remains dissolved in the water and flushed away as hot water is used from the tank. Depending on the water quality there may be a degree of hydrogen build-up in the tank if the water heater hasn't been used for two or more weeks.

To resolve the build-up of hydrogen within the tank "purge" the tank for approximately 30 seconds from the lever on the PTRV.

WARNING
Ensure there are no open flames or ignition sources close to the tank.

2.6.3 WATER BOILING TEMPERATURES

The boiling point of water varies based on the pressure within the hot water system. Under stagnation and no load conditions, the solar collector has the potential to reach temperatures well above 100°C. As the water temperature rises and water expands this creates pressure within the system. As the pressure rises, so too does the boiling point of water. This is why the solar hot water system will not boil at 100°C, but at a pressure and temperature as listed in Table 2. Note that if the system does boil, it is not detrimental to the system's life time or performance, see section 'Information on Stagnation' for further detail.

Table 2 Relationship between pressure and boiling point

Pressure (kPa)	Boiling point (°C)
101	100
203	120
304	133
405	143
507	151
608	158
709	164
811	170

CHAPTER 3: SITE INSPECTION

3.1 SOLAR COLLECTOR

3.1.1 COLLECTOR LOCATION

The location of the solar collector is crucial to achieving optimal system performance. A number of factors need to be considered when determining the placement of the collectors on the roof of a building. These are detailed below:

- Solar collector vicinity to tank: The collector(s) should be positioned as close as possible to the storage tank to avoid long pipe runs and minimise heat loss.
- Collector orientation with respect to the sun: To ensure optimal heat output, the collector should face the equator, which in Australia and New Zealand (Southern hemisphere) is due north. A deviation of up to 15° east or west from due north is acceptable, and will have minimal effect on heat output.
- Collector plane: Both sides of the manifold can be used interchangeably as the inlet and outlet ports. However, if the manifold is not level horizontally, the higher side must be used as the outlet as hot water rises.
- Collector angle: In order for the collector(s) to achieve maximum solar exposure, collector(s) are to be installed at an angle of the location's latitude +/- 10°. A minimum install angle of 20° is required for flush-mounting the collectors. Refer to table below for major cities and their latitudes and see Chapter 5: Framing for more details on installation angles.

Table 3 Latitudes of major Australian cities

City	Optimal Installation Angle
Adelaide	34
Brisbane	30
Canberra	35
Hobart	44
Melbourne	38
Perth	32
Sydney	34

3.1.2 STRUCTURAL DESIGN OF MOUNTING SYSTEM

For mounting frame certification to apply, the installation conditions from Chapter 5: Framing must be met.

3.1.2.1 MOUNTING FRAME WEIGHTS

Table 4 AP-series mounting frame weights

No. Tubes	AP-series Frame Weight (kg)		
	Flush Mount	Low Tilt Frame	High Tilt Frame
30	18.35	23.95	25.5

Table 5 ETC-series mounting frame weights

No. Tubes	ETC-series Frame Weight (kg)		
	Flush Mount	Low Tilt Frame	High Tilt Frame
30	10.7	12.5	13.55

3.1.2.2 COLLECTOR WEIGHTS (DRY AND WET)

Table 6 AP-series collector weights

No. Tubes	AP-series Collector Weights (kg)	
	Dry	Wet
30	112	112.7

Table 7 ETC-series collector weights

No. Tubes	ETC-series Collector Weights (kg)	
	Dry	Wet
30	95	95.8

IMPORTANT

Installers must ensure that the installation of the solar water heater does not compromise the structural integrity of the building and that the roof is capable of carrying the full weight of the solar collectors, if in doubt it is advised to consult with a structural engineer.

3.1.3 EDGE EXCLUSION ZONES

As per AS/NZS 1170.2:2011, the flush-mounted and tilt-mounted frame systems need to be installed within the internal roof zone. The edge exclusion zones are calculated from the minimum of 0.2x'D' (width of the building), 0.2x'B' (length of the building) and 'H' (average height of the building).

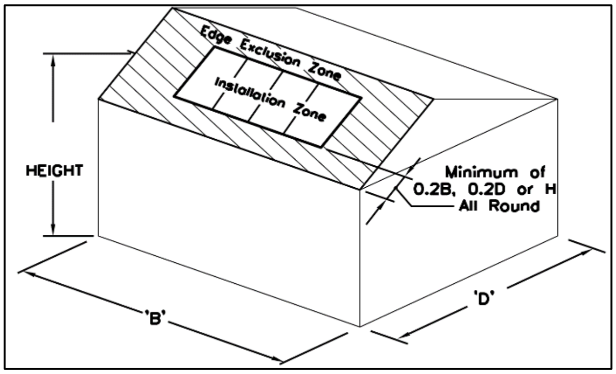

Figure 1 Edge exclusion zones

3.1.4 ROOF SPACE AND COLLECTOR SHADING

When placing the collector(s) on the roof, take into account the maximum area required for a single Apricus collector. Refer to the tables below for these values.

Table 8 Coverage of single AP-series collector

Collector (Tubes)	Width (mm)	Length (mm)	Area (m^2)
30	2240	2025	4.5

Table 9 Coverage of single ETC-series collector

Collector (Tubes)	Width (mm)	Length (mm)	Area (m^2)
30	2196	2005	4.4

Shading is another factor that needs to be taken into account. It is recommended that shading from nearby objects, buildings or trees are avoided to optimize the amount of sun the collector receives.

3.2 STORAGE TANK LOCATION

- The storage tanks are able to be installed indoors or outdoors.
- The storage tanks are to be installed at ground or floor level and must stand vertically upright as the manufacturer has intended.
- The storage tank should be located as close as possible to the most frequent draw off points in the building such as the bathroom or kitchen. If the storage tank is located a long way from hot water draw points, a hot water circulation loop on a timer may be considered to reduce the time-lag for water to heat up and resultant water wastage.
- Consideration should be given to the location of the storage tank respective to the auxiliary boosting where applicable.
- The tank should not obstruct any windows, doors or exits and should cause minimal intrusion to the existing site. Clearances must be allowed for to make servicing and maintenance convenient without the need for ladder or scaffold. For servicing, the PTRV must also be easily accessible.
- For glass-lined tanks, consider the positioning of the tank to allow room for anode removal and replacement maintenance.
- The storage tank must be installed in a properly drained safe tray where leakage may otherwise cause damage. The installation of the storage tank and safe tray must comply with AS/NZS 3500.4 and all local codes and regulatory authority requirements with regards to its construction, installation and draining. Tanks installed outside must be installed on a suitable concrete slab.
- The tank label must be clearly visible.

3.3 TRANSPORTATION AND UNPACKING

3.3.1 TRANSPORTATION OF COMPONENTS

- When transporting boxes, note the orientation of the "THIS WAY UP" arrows.
- Ensure all boxes are strapped and secured to prevent movement during transit.
- All tanks must be transported upright. Stacking is not recommended for any tanks.
- Products should always be handled with care. Damage incurred during the transportation is not covered under product warranty.

3.3.2 UNPACKING OF COMPONENTS

- When unpacking, take care to ensure that the components are not damaged in the process.
- Avoid using sharp blades or knives as this can scratch the surfaces of the products particularly the evacuated tubes and tanks.
- For evacuated tubes and heat pipes, tear open both ends of the box(es) to allow inspection of the vacuum at the bottom and for the heat pipes to be exposed for the application of heat transfer paste.

3.4 OTHER COMPONENTS

3.4.1 GAS HEATER LOCATION (IF APPLICABLE)

The gas heater(s) must be installed over a properly drained safe tray where leakage may cause damage. The installation of the water heater and safe tray must comply with AS/NZS 3500.4 and all local codes and regulatory authority requirements with regards to its construction, installation and draining.

CHAPTER 4: COMPONENT INSPECTION

4.1 COMPONENTS PROVIDED BY APRICUS WITH THE SYSTEM

Upon receiving the system prior to installation, check that the following components have been provided. Any concerns must be brought to the attention of Apricus immediately.

4.1.1 MANIFOLD

- Ensure that the manifold inlet and outlets show no signs of damage.
- Ensure that the correct brassware is provided. For each bank of *n* collectors, there will be provided a minimum of two straight fittings, and *n-1* connectors. Note that a bank contains maximum of five collectors.

4.1.2 TUBES & HEAT PIPES

- Ensure that the evacuated tubes are all intact, the bottom of each tube should be silver. If a tube has a white or clear bottom, it has lost its vacuum and should be replaced. In this case, the heat pipe should be removed and inserted into the replacement tube.
- The evacuated tubes have rubber tube caps on the end. These are to protect the bottom tip of the glass tube from being broken.
- Heat pipes are bright and shiny when newly manufactured, but will dull and may form dark grey surface discoloration over time. This is due to mild surface oxidation (when exposed to air) and does not affect the heat pipe's operation.
- Do not remove and/or expose the tubes to sunlight until ready to install, otherwise the heat pipe tip will become very hot, sufficient to cause serious skin burns. Note: The outer glass surface will not become hot.

WARNING
NEVER touch the inside of the evacuated tube or heat pipe tip after exposure to sunlight. WEAR thick leather gloves if handling the heat pipe. WEAR safety glasses at ALL times when handling the glass tubes.

4.1.3 FLUSH MOUNT FRAME

- Ensure that all necessary components required for installation have been received in the packaging. Refer to Chapter 5: Framing.

4.1.4 SOLAR STORAGE TANK(S) AND PTRV

- Ensure the tank(s) is/are accompanied by an appropriate PTRV.

4.1.5 ANCILLARIES

Ancillaries that are required for a solar CHW system include:

- Circulation pump and unions
- Controller and sensor leads

4.1.6 GAS SYSTEM: GAS BOOSTER

- Ensure the gas booster shows no signs of damage.

4.1.7 GAS SYSTEM: GAS BUFFER TANK(S) AND PTRV

- Ensure the tank(s) is/are accompanied by an appropriate PTRV.

4.1.8 ELECTRIC SYSTEM: HD ELECTRIC TANKS AND PTRV

- Ensure the tank(s) is/are accompanied by an appropriate PTRV.
- Ensure that it has the appropriate number of elements and rating.

4.2 NECESSARY COMPONENTS

Ensure that the following components have been sourced for the installation. These are not provided as a

standard with the system and must be sourced from others.

- Duo valve
- Cold water expansion control valve (mandatory in certain states)
- Pressure reducing valve
- Four way cross
- Check valve
- Flow meter

4.3 OTHER COMPONENTS

Other components that may be required for installation that must be sourced from others include:

- Three way ball valve for solar return line drain.
- Tempering valve solar rated (if applicable)

There may be additional parts or materials required by plumbers/installers for installation not listed here.

CHAPTER 5: FRAMING

5.1 FRAMING OPTIONS

There are four easy to install mounting options:

- Flush mounted with roof rail, suitable for tin roofs
- Flush mounted with roof straps, suitable for tiled roofs
- Low angle tilt, 30°, and
- High angle tilt, 45°.

Refer to the sections below for more detail on the AP-series and ETC-series frames.

5.2 AP-SERIES MOUNTING FRAMES

5.2.1 FLUSH MOUNT FRAME (AP-SERIES)

The figure below shows a standard AP-series flush mounted frame suitable for use in all wind regions with: 5 x Tracks and 5 x L-bracket packs.

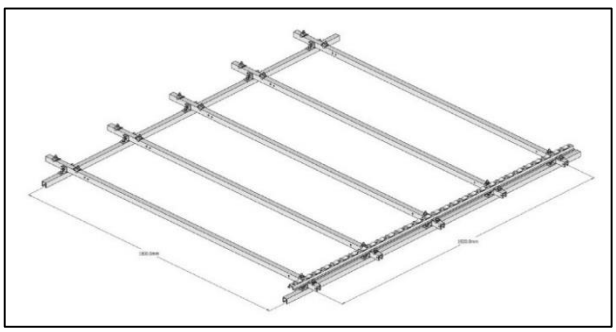

Figure 2 Flush mount frame at 1800 mm spacing with 5 tracks

5.2.2 TILT MOUNT FRAME (AP-SERIES)

The figure below shows a typical AP-series cyclonic wind region C frame with: 5 x tracks and 5 x Rear Legs.

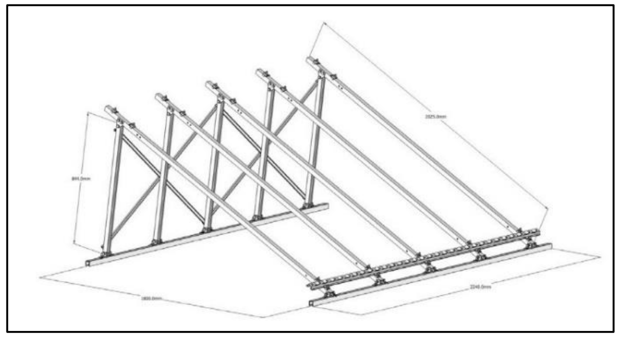

Figure 3 Tilt-mount frame at 1800 mm spacing with 5 tracks

5.2.3 INSTALLATION CONDITIONS

The AP series frames are suitable to use in Australian wind regions A, B, C and D, subject to a set of conditional requirements.

Under these requirements these systems are certified to Australian Standards AS/NZS 1170.2:2011 Structural Design Actions Part 2: Wind Actions. Check with your local building authority to confirm whether or not this standard is a regulatory requirement in your region.

5.2.3.1 FRAME FIXTURES (AP-SERIES)

The installer is to provide the fixings for the frame to the roof, ensuring the fixings are applied in accordance with the table of fixtures provided below. Holes can easily be drilled into the extruded aluminium components. They are to be no larger than ø10 mm and not closer than 30 mm center to center.

Note for the tables below showing the number of fixtures required; 'FT' is an abbreviation for Front Track, 'TB' for Timber Batten, and 'SB' for Steel Batten.

Table 10 Number of screw fixings required per front track (on each end), on the front and rear roof rails for Flush Mounted frames.

No. Tubes	Wind Regions											
	A			B			C			D		
	No. FT	TB	SB	No. FT	TB	SB	No. FT	TB	SB	No. FT	TB	SB
30	3	2	2	3	2	2	5	2	4	5	2	4

Table 11 Number of screw fixings required per rear leg, on the rear roof rail for Tilt Mounted frames.

No. Tubes	Wind Regions		
	A	B	C

	No. FT	TB	SB	No. FT	TB	SB	No. FT	TB	SB
30	3	4	4	5	4	4	5	4	8

Additionally, for tilt mounted frame systems, there are two screws required per front track for the front roof rail.

WARNING
DO NOT use power tools or long shafted tools that may over-torque the bolts (as stainless steel bolts are susceptible to galling/locking). Tighten frame bolts with spanners or short shafted socket wrenches only.

Bolt assemblies come with spring washers to maintain long-term tension.

The AP series frame systems come pre-packaged to ensure the most streamlined and simple assembly process. Follow the assembly instructions provided with the frame.

5.2.3.2 ROOF FIXING GUIDE (AP-SERIES)

To proceed with attaching the mounting frame to the roof, follow all fixing rules as per the Installation conditions (for certification to apply).

Batten/Purlin Spacing is to be 600, 900, 1500 or 1800mm.

Batten/Purlin Screws are to be installed as follows:

- Timber Battens/Purlins: 14G Ø6.3mm timber screw, with minimum 35mm embedment into battens. Minimum joint group J4.
- Steel Battens/Purlins: 14G Ø6.3mm tek screw. Minimum steel thickness 0.75mm, Grade G550.
- There is an even number of screws per roof rail, so fixing points should be equidistant from the roof rail. This will ensure that the wind loads are equally distributed across the roof rail. Line up the roof rails with battens accordingly. For tilt-mount systems the batten/purlin spacing can be increased where the angle of the tilt decreases. Table 10 and Table 11 show the number of screws required per frame for a flush mounted and a tilt mounted frame respectively.

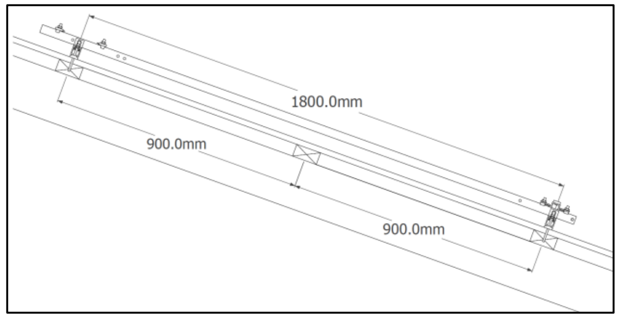

Figure 4 Roof fixing locations 1800 mm

Note that Battens and purlins are the same components and are usually located horizontal, or perpendicular to the roof pitch. This differs from rafters which are situated parallel to the roof pitch.

Maximum average building height of install: 10m above ground.

Flush Mount: roof pitch needs to be 20-45° to the horizontal.

Tilt Mount: roof pitch needs to be 0-10° to the horizontal. For efficient heat transfer of the evacuated tubes they should be installed at a minimum overall pitch of 20°.

- **Regions A and B:** Maximum tilt angle 45° to the horizontal
- **Region C:** Maximum tilt angle 30° to the horizontal

Existing roof check: the structural adequacy of supporting roof members must be confirmed by a practicing structural engineer prior to all installations unless a roof rail is used for every batten location.

IMPORTANT
Ensure all roof penetrations are watertight.

Use the following examples as a guide for installation for different roof types.

5.2.3.3 TIN ROOF INSTALLATION (AP-SERIES)

For corrugated/tin roofs, place fixings on the peak of the roofing sheet material to minimise the risk of leaks. Fixings are to be screwed into the batten with minimum 35 mm embedment.

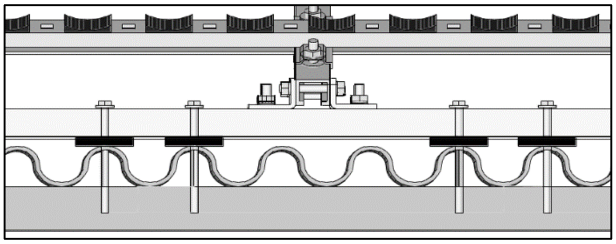

Figure 5 35 mm embedment into the batten/purlin [rear view]

5.2.3.4 TILED ROOF INSTALLATION (AP-SERIES)

For tiled roofs (where drilling is undesirable) use Apricus roof straps to attach the frame to the battens/purlins. Roof straps can also be attached to roof rails by drilling through them.

IMPORTANT
Tilt mount frame systems installed on tiled roofs are not certified under AS/NZS 1170.2.

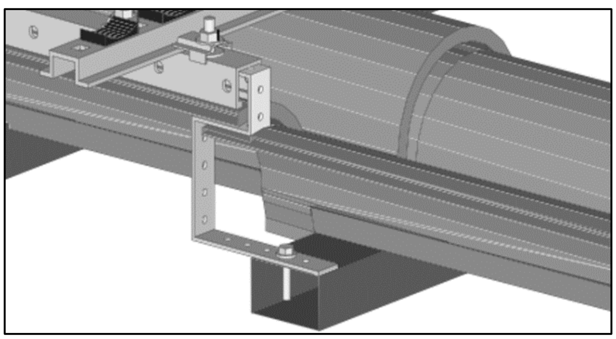

Figure 6 Roof attachment strap example

5.2.3.5 ADJUSTING TILT MOUNT ANGLE

When installing tilt-mount systems, the mounting frame can be modified to achieve a reduced tilt angle. This would be preferable where the optimal tilt angle is not achievable for the given roof pitch and tilt leg.

To reduce the installation angle of the collectors, the aluminium legs should be cut to a reduced length and a new hole should be drilled to allow for securing. By reducing the length of the aluminium tilt leg, the frame is brought closer to the roof and the angle is reduced. The total pitch of the collectors should not be reduced below 20^{o}.

Note that decreasing the tilt angle will consequently decrease the wind loading on the system and as such will not impact the structural integrity of the system.

5.3 ETC-SERIES MOUNTING FRAMES

5.3.1 FLUSH MOUNT FRAME (ETC-SERIES)

The figure below shows a standard flush mount frame suitable for use in all wind regions with: 2x front tracks. Note the image also shows the roof rails and bottom track.

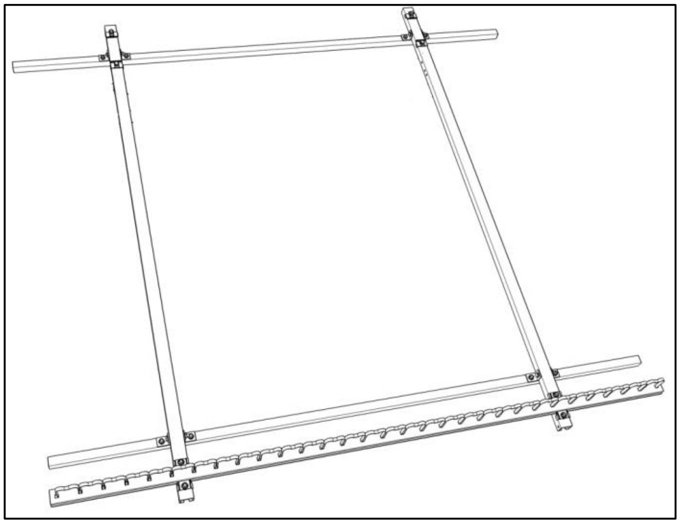

Figure 7 ETC series Flush mount frame

5.3.2 TILT MOUNT FRAME (ETC-SERIES)

The figure below shows the tilt frame configuration for use in all wind regions: 2x front tracks and 2x Rear Legs. Note the image below also shows the roof rails and X brace.

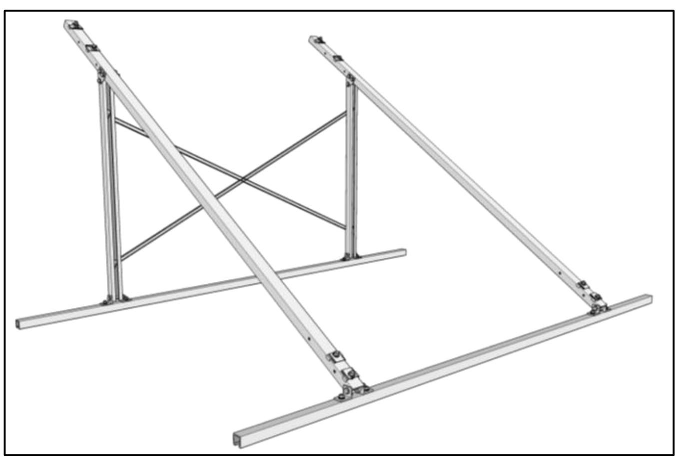

Figure 8 ETC series Tilt-mount frame

5.3.3 INSTALLATION CONDITIONS (ETC-SERIES)

All variations of the ETC series frames are cyclone rated, suitable to use in Australian wind regions A, B, C and D.

Under these requirements these systems are certified to Australian Standards AS/NZS 1170.2:2011 Structural Design Actions Part 2: Wind Actions. Check with your local building authority to confirm whether or not this standard is a regulatory requirement in your region.

5.3.3.1 FRAME FIXTURES (ETC-SERIES)

The installer is to provide the fixings for the frame to the roof, ensuring the fixings are applied in accordance with the table of fixtures provided below. Holes can easily be drilled into the extruded aluminium components. They are to be no larger than ø10 mm and not closer than 30mm center to center.

Note for the tables below showing the number of fixtures required; 'TB' is an abbreviation for Timber Batten, and 'SB' for Steel Batten.

Table 12 Number of screw fixings required per front track (on each end), on the front and rear roof rails for Flush Mounted frames.

No. Tubes	Wind Regions							
	A		B		C		D	
	TB	SB	TB	SB	TB	SB	TB	SB
30	2	2	2	2	2	2	2	2

Table 13 Number of screw fixings required per front track, on the front roof rail for Tilt Mounted frames.

No. Tubes	Wind Regions							
	A		B		C		D	
	TB	SB	TB	SB	TB	SB	TB	SB
30	2	2	2	2	2	2	N/A	N/A

Table 14 Number of screw fixings required per rear leg, on the rear roof rail for Tilt Mounted frames.

No. Tubes	Wind Regions							
	A		B		C		D	
	TB	SB	TB	SB	TB	SB	TB	SB
30	2	2	2	2	2	4	N/A	N/A

WARNING

DO NOT use power tools or long shafted tools that may over-torque the bolts (as stainless steel bolts are susceptible to galling/locking).
Tighten frame bolts with spanners or short shafted socket wrenches only.

Bolt assemblies come with spring washers to maintain long-term tension.

The ETC series frame systems come pre-packaged to ensure the most streamlined and simple assembly process. Follow the assembly instructions provided with the frame.

5.3.3.2 ROOF FIXING GUIDE (ETC SERIES)

To proceed with attaching the mounting frame to the roof, follow all fixing rules as per the Installation Conditions provided below (for certification to apply).

Batten/Purlin Spacing is to be 600, 900, 1500 or 1800mm.

Batten/Purlin Screws are to be installed as follows:

- Timber Battens/Purlins: 14G Ø6.3mm timber screw, with minimum 35mm embedment into battens. Minimum joint group J4.
- Steel Battens/Purlins: 14G Ø6.3mm tek screw. Minimum steel thickness 0.75mm, Grade G550.
- There is an even number of screws per roof rail, so fixing points should be equidistant from the roof rail. This will ensure that the wind loads are equally distributed across the roof rail. Line up the roof rails with battens accordingly. For tilt-mount systems the batten/purlin spacing can be increased where the angle of the tilt decreases.
- Table 12 to Table 14 show the number of screws required per frame for flush mounted and tilt mounted frames respectively.

Note that Battens and purlins are the same components and are usually located horizontal, or perpendicular to the roof pitch. This differs from rafters which are situated parallel to the roof pitch.

Maximum average building height of install: 15m above ground.

Flush Mount: roof pitch needs to be 0-30° to the horizontal. Although the wind loading conditions allow for a horizontal pitch at 0°, for efficient heat transfer of the evacuated tubes they should be installed at a minimum overall pitch of 20°.

Tilt Mount: roof pitch needs to be 0-20° to the horizontal.

- **Regions A, B, C and D:** the maximum tilt angle is 45° to the horizontal.

Existing roof check: the structural adequacy of supporting roof members must be confirmed by a practicing structural engineer prior to all installations.

IMPORTANT

Ensure all roof penetrations are watertight.

Use the following examples as a guide for installation for different roof types.

5.3.3.3 TIN ROOF INSTALLATION (ETC-SERIES)

For corrugated/tin roofs, place fixings on the peak of the roofing sheet material to minimise the risk of leaks. Fixings are to be screwed into the batten with minimum 35mm embedment. Refer to Figure 5.

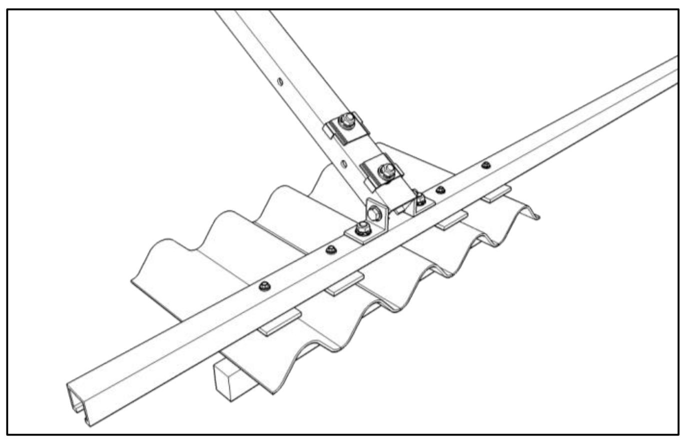

Figure 9 Close-up of front track connection to roof rail, and fixings on peaks of tin roof equidistant from front track.

5.3.3.4 TILED ROOF INSTALLATION (ETC SERIES)

For tiled roofs (where drilling is undesirable) use Apricus roof straps to attach the frame to the battens/purlins.

Roof straps can also be attached to roof rails by drilling through them. Refer to Figure 6.

IMPORTANT
Tilt mount frame systems installed on tiled roofs are not certified under AS/NZS 1170.2.

5.3.3.5 ADJUSTING TILT MOUNT ANGLE

When installing tilt-mount systems, the mounting frame can be modified to achieve a reduced tilt angle. This would be preferable where the optimal tilt angle is not achievable for the given roof pitch and tilt leg.

To reduce the installation angle of the collectors, the aluminium legs should be cut to a reduced length and a new hole should be drilled to allow for securing. By reducing the length of the aluminium tilt leg, the frame is brought closer to the roof and the angle is reduced. The total pitch of the collectors should not be reduced below 20^{o}.

Note that decreasing the tilt angle will consequently decrease the wind loading on the system and as such will not impact the structural integrity of the system.

CHAPTER 6: SYSTEM PLUMBING

6.1 SYSTEM LAYOUT

The system components that are a part of a typical electric and gas solar hot water systems are depicted in the system schematics in Figure 19 and Figure 20**Error! eference source not found.** in Chapter 10: Appendix, respectively.

See Table 15**Error! Reference source not found.** and Table 16 below for the corresponding numbered components to the schematics for electric and gas systems respectively.

Table 15 Components that make up a typical Electric boosted solar hot water system.

No.	Component	Function
1	Evacuated tube collector(s)	Solar energy collection
2	Circulation Pump(s)	Circulates water from the solar storage tank(s) to the collectors(s)
3	Controller	Monitors temperatures and controls the system
4	Expansion Tank(s)	Allows the system to "breathe" when pressure increases in the system (Optional)
5	Solar Storage Tank(s)	Stores solar hot water
6	PTRV	Pressure Temperature Relief Valve
7	Ring Main Pump(s)	Recirculates water back from the ring main into the auxiliary heater.
8	Heavy duty (HD) electric storage water heater(s)	Provides the auxiliary backup energy source for cloudy days and legionella protection.

Table 16 Components that make up a typical Gas boosted solar hot water system

No.	Component	Function
1	Evacuated tube collector(s)	Solar energy collection
2	Circulation Pump(s)	Circulates water from the tank to the manifold
3	Controller	Monitors temperatures and controls the system
4	Expansion Tank(s)	Allows the system to "breathe" when pressure increases in the system (Optional)
5	Solar Storage Tank(s)	Stores solar hot water
6	PTRV on each tank	Pressure Temperature Relief Valve
7	Ring Main Pump(s)	Recirculates water back from the ring main into the auxiliary heater.
8	Gas Recirculation Pump(s)	Circulates water from the inlet of the buffer tank into the auxiliary heater.
9	Buffer tank(s)	Provides storage to increase the first hour delivery litres.
10	Gas Heater(s)	Provides a backup energy source for cloudy days and legionella protection

6.2 PIPING

6.2.1 PIPE MATERIAL AND PIPE SIZE

For solar CHW system installations, the recommended pipe is copper and the size is variable depending on the system design. Only qualified or competent persons are to size the piping for each specific commercial application.

Factors affecting the choice of pipe sizing include the flow rate and pressure drop. These two factors are closely related; a higher pressure drop will reduce the flow rate. Pressure drop increases with decreased pipe diameters as well as the presence of bends, elbows and other components that restrict flow.

It may be necessary for some installations with numerous pipe bends and significant pipe runs to increase the pipe diameter to reduce the pressure drop. All pipe work must be installed in accordance with AS/NZS 3500.4.

IMPORTANT
It is necessary that all valves, fittings and piping connections used are solar rated and are able to withstand temperatures of up to 220ºC.

6.2.2 PIPE INSULATION

Insulate all pipes running to and from the manifold with insulation of at least 15mm thickness, or 25mm in cold

climates. Also, ensure the insulation is tight against the all ports (minimizing the loss of heat from any exposed areas). As with solar CHW systems the pipe sizes and lengths can vary from application to application, the pipe insulation may as well. A qualified plumber must determine the appropriate insulation required.

IMPORTANT

All insulation needs to be solar-rated. Any insulation exposed to sunlight must be UV-stabilized.

6.3 STORAGE TANK

6.3.1 COMMERCIAL GLASS-LINED STORAGE TANK

The Apricus 400L Glass-lined storage tank contains seven ports, and is typically used as solar storage and/or as gas buffer tanks. Note that when this tank is used as a gas buffer tank, the unused ports are plugged.

1. Inlet (Mains): Inlet line from mains water supply
2. Solar Flow: Flow line to the collector
3. Solar Return: Return line from the collector
4. Outlet: Outlet line to tempering valve and load
5. Sensor 1 Port: Bottom temperature sensor
6. Sensor 2 Port: Top temperature sensor
7. PTRV: Pressure temperature relief valve location

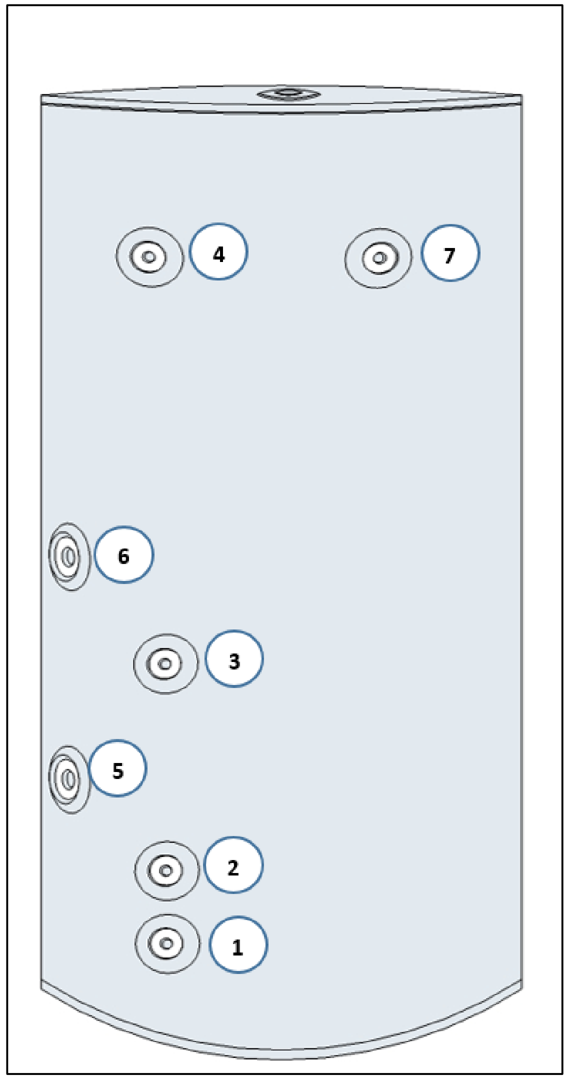

Figure 10 Commercial 400L Glass-Lined Storage Tank

The inlet and outlet ports on this tank are 40mm (1.5”) BSP, while the remaining ports are of 20mm (3/4”) BSP. Teflon tape must be used to seal any fitting. Copper olives must be used with all compression fittings.

IMPORTANT

Apricus tanks must be installed in accordance to AS/NZS 3500.4 as well as any other relevant local/government standards.

6.3.1.1 INLET (MAINS)

The mains line should consist of the following brass components when installing:

- Duo valve
- Cold Water ECV
- Pressure Reducing Valve

- Four-Way Cross

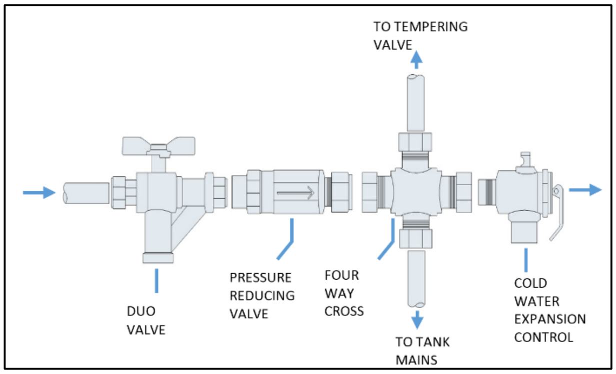

Figure 11 Mains Line Valves

The set of mains line valves can be purchased as a kit from Apricus and provides the above components with insulating jackets to streamline the installation process.

IMPORTANT
Where applicable, the tempering valve must be the last downstream component installed before the hot water reaches the hot water fixtures.

6.3.1.2 SOLAR FLOW

This port is used for the water line directed up to the solar collectors to be heated. This line consists of the following components in order from closest to furthest away:

- Circulation Pump
- Flow meter
- Check valve
- Collectors

6.3.1.3 SOLAR RETURN

This port is used for the water line returning from the solar collectors after being heated. This line does not require any additional components, but should be run as short as possible and have continuous fall back to the solar return port.

Apricus recommends using a three way ball valve and drain on the solar return line to allow convenient system filling and draining.

On the solar return line near the tank port, it is recommended to include a U-shaped heat trap with an approximate 25cm dip in the piping configuration to prevent reverse thermos-siphoning.

6.3.1.4 OUTLET

The outlet is where the hot water from the tank is extracted to be supplied to the auxiliary heaters before supply to the commercial application fixtures.

6.3.1.5 SENSOR PORTS

The sensors must be coated with heat transfer paste and inserted through the cable gland into the appropriate sensor port and tightened.

The first temperature sensor port is located on either side of the collector manifold. Sensor 1 (S1) must be connected to the outlet of the manifold (the higher side). The top sensor port houses S3 and the bottom sensor port houses S2.

Depending on the complexity of functions required for the commercial application, the controller will vary. All controllers will need to have the temperature differential function to control the solar circulation pump. The controller will require three sensor leads to be installed into the appropriate sensor ports in the solar system. Additional temperature sensors may be used for other functions or to monitor temperatures across the system.

6.3.1.6 PTRV PORT

The PTRV port is where the tank 'pressure and temperature relief valve' is to be installed. All PTRV's must be fitted with a copper drain pipe to carry any discharge to an appropriate drain.

IMPORTANT
All storage tanks include a PTRV, which is located in the vertical column or element cover.

6.4 SOLAR COLLECTORS

6.4.1 BANKS OF COLLECTORS

It is recommended that a maximum of five collectors are installed in series. It is possible to have multiple banks of three to five collectors to achieve larger collector combination arrays.

Note that the solar collectors are to be installed in reverse return unless balancing valves are installed (sourced by others). This is important as the heat transfer rate is dependent on the flow rate. If the flow rate is unequal there will be uneven heating, this means you will not get the most out of your system.

IMPORTANT
Poor design of collector pipe runs will result in sub-optimal operation of the solar collectors. This will lead to uneven thermal cycling of your collectors. The result is reduced solar yield and potential reduction of system.

6.4.2 BRASSWARE

The commercial solar manifolds require appropriate brassware to be used for plumbing.

In order to connect collectors in series, you must use a connector brass nipple (both flared ends ¾"). See Figure 12.

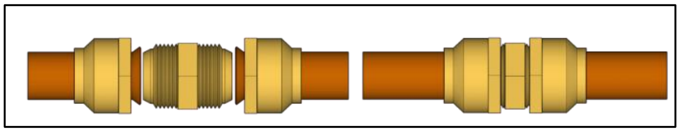

Figure 12 Connector brass nipple being used to connect one manifold with another manifold in series.

In order to connect a collector to solar flow or solar return piping, a straight flared brass nipple (a flared end ¾" and ¾"MBSP) must be connected to the manifold inlet/outlet. Once this is done, the copper piping can be connected to the inlet/outlet. See Figure 13.

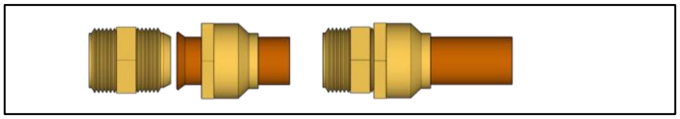

Figure 13 Straight flared ¾" brass nipple connection to manifold inlet/outlet.

CHAPTER 7: COMMISSIONING

7.1 SYSTEM FILLING AND AIR PURGE

After all the plumbing connections to the solar collector have been made, the solar hot water system needs to be filled with water and the collector loop purged of air. This should be completed prior to insertion of evacuated tubes and connection of the tank to the hot water load.

To fill the system:

1. Open the cold mains line and fill up the tank and open the hot water outlet or hot water taps.
2. Turn the pump dial to speed 3 and connect it directly to the electricity mains rather than the controller.
3. Open up an outlet to drain the solar return line.
4. Close the drain when filling is completed, this is indicated by a constant stream of water exiting from the solar return line.
   If constant flow is not achieved, closing and opening the duo valve can force air back into the tank to be relieved at hot water fixtures.
5. Set the pump back to speed 1 and reconnect the pump to the controller.

7.2 CONTROLLER

1. Connect all sensor leads to the appropriate ports in the tank and manifold.
2. Plug in the controller power adaptor to the wall socket and ensure all sensor leads are connected to the correct sensor ports.
3. Test for water leaks around the pipe works and brassware.
4. Check that all temperature readings on the controller are functioning with the parameters of the product.

7.3 FLOW METER SETTINGS

The flow rate of the system network should be checked after installation to ensure suitable conditions are met. The table below shows the maximum flow rate settings for Apricus collectors.

Table 17 Maximum and suggested flow rate requirements

Collector (Tubes)	Maximum Flow Rate (L/min)	Suggested Flow Rate (L/min)
30	2	1.25

7.4 SOLAR COLLECTORS

7.4.1 FRAMES

Refer to the Frame Assembly Guide provided with the frame.

1. Assemble the frame according to the relevant frame assembly guide.
2. Align the roof rails of the completed frame with the batten/purlin on the roof.
3. Drill holes through the roof rails and secure the frame to the roof using suitable screws. Number of fixtures required can be found in Chapter 5: Framing.
4. Mount the manifold onto the front tracks, ensuring alignment with bottom track.
5. Ensure that the attachment plate sits in the front groove of the manifold and the rear attachment plates sit in the rear groove.

After installation of the frame and manifold, return to complete the plumbing of the system, tank and pump station.

WARNING
DO NOT insert the evacuated tubes into the manifold until the system has been filled with water and all other steps are complete.

7.4.2 PIPING AND SENSOR CONNECTION

Refer to the Basic Installation Guide provided with the manifold.

1. Insert the sensor into the sensor port on manifold.
2. Connect the brass fitting on the manifold inlet/outlet.
3. Piping insulation will need to be done all the way up to the manifold.

7.4.3 EVACUATED TUBES AND HEAT PIPES

Refer to the Basic Installation Guide provided with the manifold.

1. If weather conditions are dusty, take care to ensure heat paste is not contaminated with impurities, as this may reduce thermal conductivity and efficiency of the heat paste. If weather conditions are wet, take care to ensure water does not enter the inside of the evacuated tube.
2. Open the evacuated tube box on the side with the heat pipes.
3. Pull the heat pipe out ~10cm and ensure to keep the rest of the tube shaded.

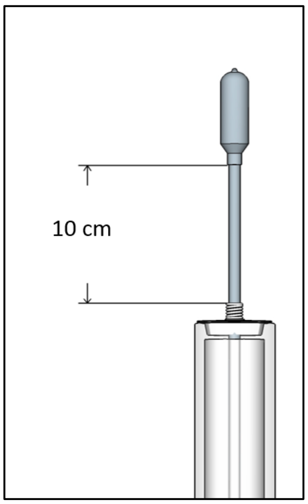

Figure 14 Heat pipe exposed

4. Coat the heat pipe bulb with heat transfer paste; this can be applied using a piece of foam insulation.
5. Take the evacuated tube from the box and guide the heat pipe into the inside of the header port.

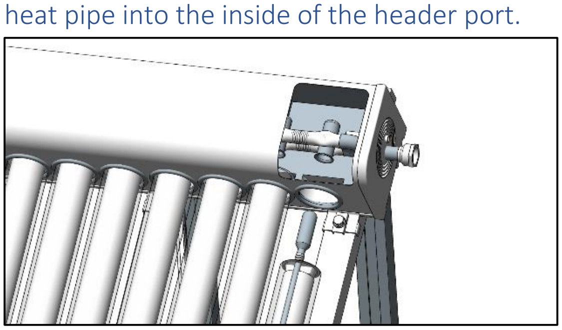

Figure 15 Guiding heat pipe into manifold

6. Push the heat pipe in full depth.

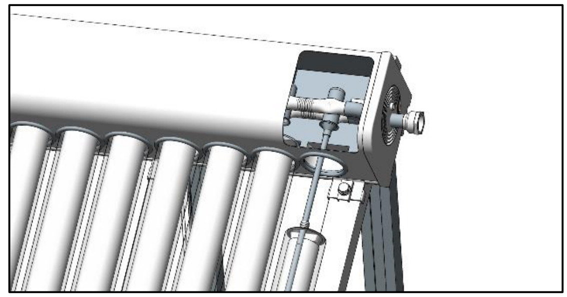

Figure 16 Pushing heat pipe into manifold

7. Use a damp cloth to lubricate the outer surface of the evacuated tube and the rubber ring in the manifold to minimize friction during insertion.
8. Insert the evacuated tube using a slight twist and pushing action.

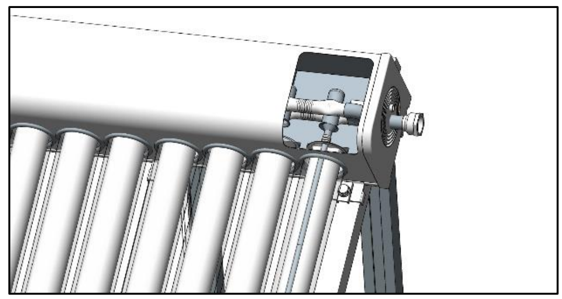

Figure 17 Inserting tube into manifold

9. Repeat steps 2-6 for the remainder of the tubes and collectors.
10. Using provided tube clips, secure the evacuated tubes into the bottom track of the frame. Always secure each tube clip before installed the next tube.
11. Wipe down each evacuated tube with a damp cloth to ensure a polished and clean installation.

7.5 OTHER SYSTEM COMPONENTS

7.5.1 EXPANSION TANK

Expansion tanks should always be installed downstream of a non-return valve. This ensures that water is able to flow into it from both directions. If it were installed upstream, it would only function for half of the system and could cause significant damage to the unprotected side.

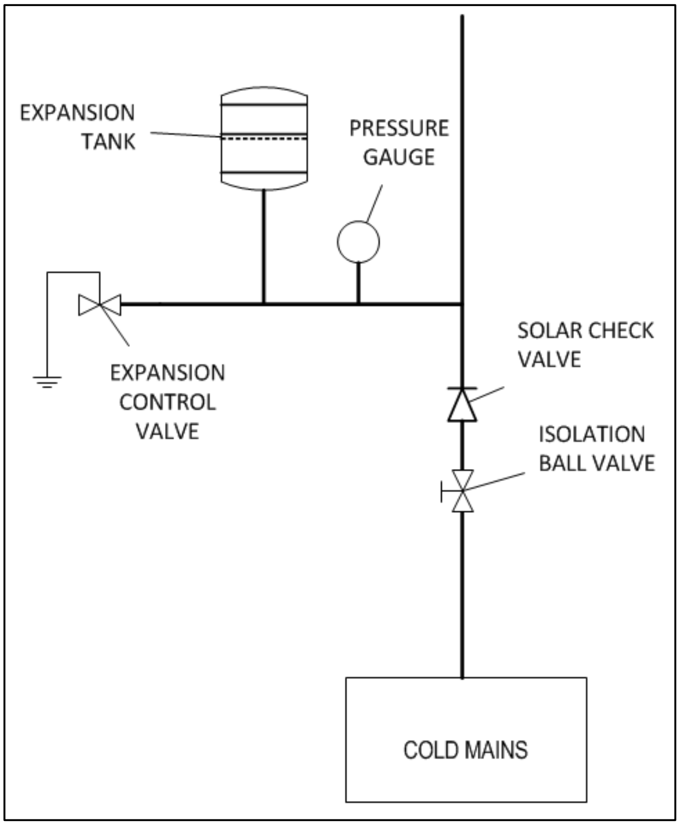

Figure 18 Diagram showing the expansion tank relative to the non-return valve

CHAPTER 8: AUXILIARY HEATING

8.1 BOOSTING EXPLAINED

If the solar contribution during the day is not enough to raise the water to a suitable temperature the auxiliary booster can provide additional heating. During sufficiently sunny weather, the solar collectors, when sized appropriately, will normally be able to offset significant hot water usage during that period, but during winter months and overcast days boosting may be required.

8.1.1 AUXILIARY HEATERS

Refer to the relevant specific product installation manuals for details not covered in this manual

8.3 WATER HEATING REQUIREMENTS

It is a legal requirement that water be heated on a regular basis to kill Legionella bacteria that can lead to Legionnaires disease. The minimum heat requirements are in the table below.

Table 18 Minimum Heat Requirements

Type of Apricus System Installed	Minimum Heat Requirements
Gas Boosted Systems	70°C boost if less than 55°C each time water is used
Glass-lined Bottom element electric boosted system	Once per week to 60°C for 32 minutes
Mid element electric boosted system	Once per day to 60°C

CHAPTER 9: POST INSTALLATION

To ensure optimal operation and to maintain the integrity of Apricus solar hot water systems, commissioning is an essential process. Ensure that each of the following processes is carried out prior to leaving the site.

SYSTEM OPERATION CHECK

Given good sunlight, the evacuated tubes will begin to produce heat after a 5-10 minute "warm up" period. There should be an observable increase in the temperature reading at the roof sensor on the controller. When there is an 8°C temperature differential between ROOF and TANK sensors the circulation pump should turn on.

After initial completed installation of collector, watch the operation of the pump and controller for at least 5 ON/OFF cycles or 15 minutes as the system stabilises. This process may take longer in overcast or cold conditions.

IMPORTANT
When replacing damaged tubes follow all relevant OH&S policies. Protective clothing is to be worn at all times. WEAR thick leather gloves if handling the heat pipe. WEAR safety glasses at ALL times when handling the glass tubes.

CHECKLIST PRIOR TO LEAVING INSTALLATION SITE

- System check: Check all connections for leaks and that all components are installed as per this manual.
- Take photos of all system components for warranty purposes. This should include photos of the plumbing lines to and from the tank, collector and sensor port connections.
- Note down the Tank Serial Number
- Note down the Apricus System Model Number
- Note down the Collector Serial Number
- Fill out the installation record form supplied for system warranty and service issues.
- Submit your Installation Record Form via
  Email: warranty@apricus.com.au
  OR
  Online: www.apricus.com.au
- Complete the rebate form for the system prior to leaving the site, this will require the installer's signature.

CHAPTER 10: APPENDIX

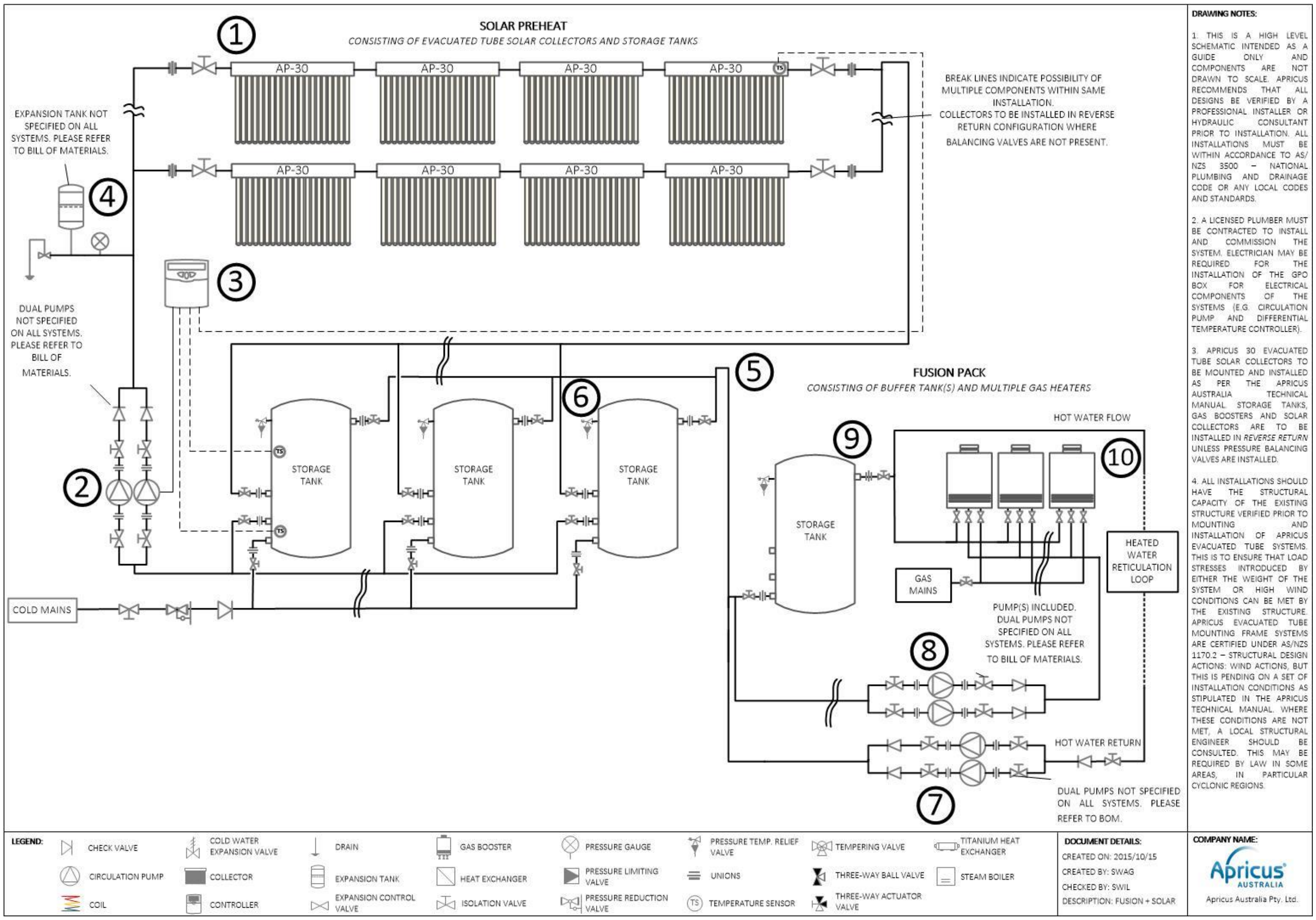

Figure 19 Typical Gas boosted solar CHW system.

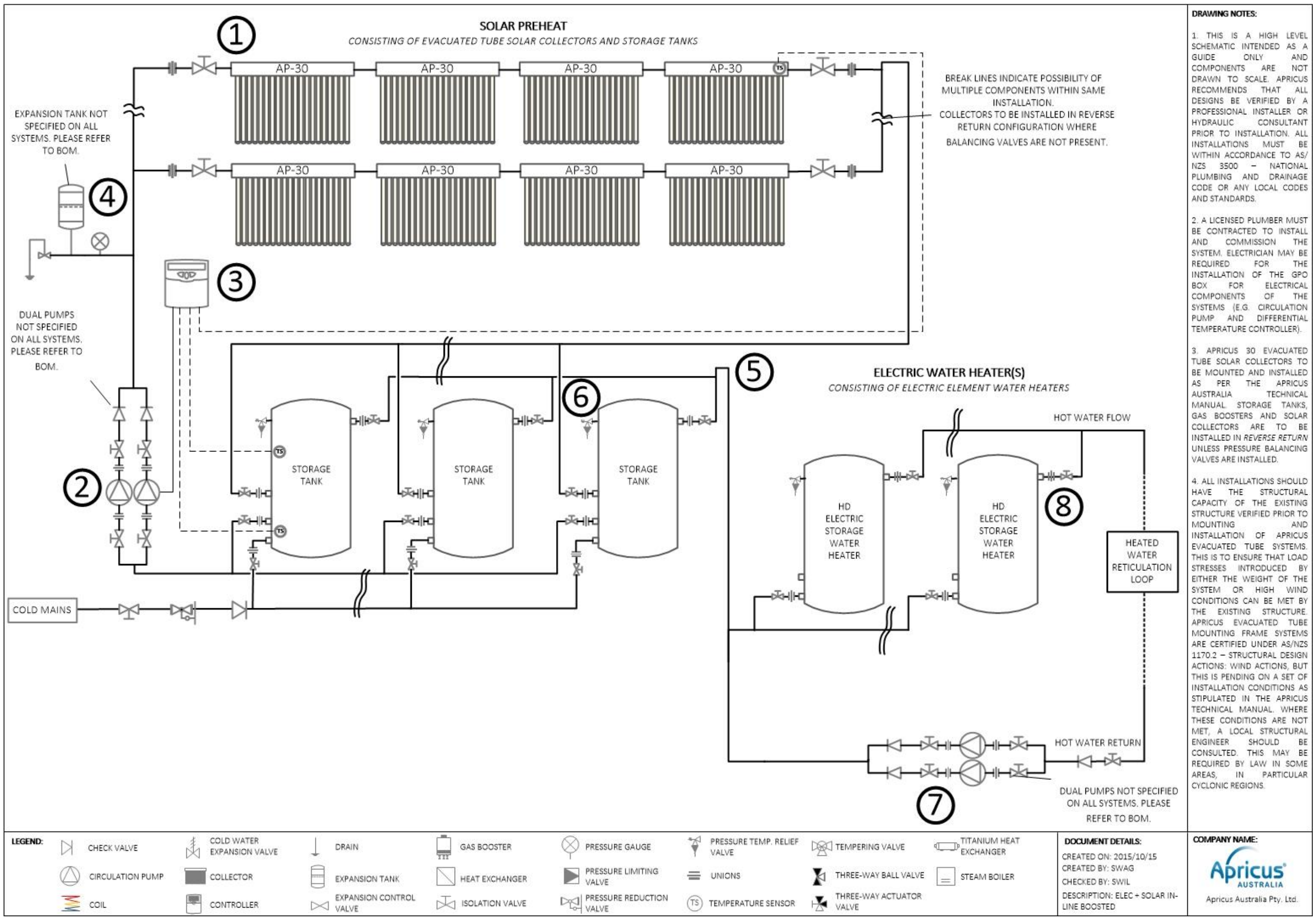

Figure 20 Typical Electric boosted solar CHW system