CHAPTER 7

Maintenance and Trouble Shooting

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7. MAINTENANCE AND TROUBLESHOOTING

A good solar hot water system that is well installed should give years of trouble-free service. Any unit, however, will require some maintenance. Maintenance can take the form of:

- preventative maintenance – undertaking action before something goes wrong
- trouble shooting – identifying the need for repairs or maintenance after problems present themselves.

See AS NZS 3500.4 (Section 12 – Operation and Maintenance).

7.1 Preventative maintenance

Preventative maintenance is maintenance that is carried out to prevent breakdown or failure of any equipment. The idea is that the maintenance is carried out *before* the equipment starts giving trouble or before it stops working normally.

With solar hot water systems the frequency of preventative maintenance activities will vary enormously from one district to the next. Some manufacturers recommend a service (preventative maintenance) every five years.

In districts with a good water supply (low concentration of dissolved salts and little sediment in the water) this is probably too often. In districts of extremely corrosive (salty) water or water containing a lot of sediment it is probably not often enough. Another factor that will affect the frequency of maintenance will be the amount (volume) of hot water used. A system that has to provide perhaps 50 litres of hot water a day should last much longer than one providing 300 litres a day.

Any national company that installs solar hot water systems throughout all of Australasia has the option of attempting to match its maintenance schedules to different water supplies or producing a maintenance schedule that will suit the conditions found in most parts of Australasia. Most companies opt for the latter: maintenance that applies to all situations in Australia, regardless of water quality.

Many installers or maintenance plumbers ignore manufacturers' maintenance schedules and base maintenance on their experience. They perceive the suggested maintenance schedules to be inappropriate for local conditions. In choosing this path they may negate the manufacturers' warranty.

Another aspect of preventative maintenance is the question: Does failure matter? Is it important? It may be cheaper to wait for failure rather than paying for maintenance. In some circumstances, such as hotels, motels, aged-care accommodation and restaurants, failure of the hot water system may be something to be avoided at all costs. If a continuous supply of hot water is critical, a back-up system may be desirable. Some maintenance that can be carried out will extend the life of hot water systems.

The causes of failure are:

- wear or failure of components
- corrosion of components of the system
- deposition of sediment within the system.

7.1.1 Valves

PTR valve

The most common valve requiring replacement will be the pressure temperature relief (PTR) valve. It is suggested that this valve should be ‘lifted’ or ‘eased’ every six months. This is to ensure that it works freely. It is advised to replace it every five years. Lifting the valve will often cause it to bind on salts deposited on the moving shaft, and the valve then never seats properly again and so has to be replaced. It is for this reason that many plumbers advocate not touching it, but if it does not work, then pressures within hot water storage tanks may become too high and cause damage.

Float valves

In gravity feed tanks, the float valve will eventually wear out and first requires a new washer and later a replacement valve. The timing for such maintenance will vary so much that it is probably not worth doing anything on a regular basis but rather effecting repairs when leakage is noticed.

Expansion valve on the cold supply

Where fitted, an expansion valve should result in the PTR valve having a longer life. If the expansion valve is seen to be constantly leaking, it should be replaced. If in a particular district failure occurs at a set time interval, then replacement on a timed schedule might be considered.

Leakage from expansion and PTR valves

These valves are designed to release water as it expands within the storage tank, so a litre or so leakage per day is common. Leakage may need to be directed away from metal roofs to avoid corrosion.

Non-return valve

If the cold supply pipe feels warm some distance from the storage tank, it is likely that the non-return valve needs replacing, but this is not common.

Isolating valve

It is common for the isolating valve to not cut off totally, so that even when turned off hard, water still passes through the valve, and even if just a drip, the flow of water from the hot water system cannot be stopped. Depending on the type of valve, a new washer or a total valve replacement may be required.

7.1.2 Corrosion and scale formation

Valves

In districts where the water is highly corrosive, the failure of valves will probably be due to corrosion, not mechanical failure or mechanical wear. The failure of valves will probably be frequent in these areas compared with

locations using good water. There is not much that can be done about it. Replacing corroded valves is an expense of running the system.

Sacrificial anodes

Stainless steel tanks are not fitted with protective/sacrificial anodes. A few copper tanks, and all glass/vitreous enamel-lined tanks, are fitted with anodes.

Where water is corrosive, the anode will need to be replaced every few years. Refer to the section on anodes in the manufacturer's information booklet for the correct replacement type. Water quality needs to be known. In good water districts, the anode may last for 10 to 15 years before it is eaten away, particularly if only small quantities of hot water are used. In other districts, a three- to five-year life might be expected. A five-year inspection is good policy.

Heating elements

Where scale is a problem, electric heating elements will get a build-up of scale on the outside of the element. This scale acts as an insulator. The thicker the scale gets, the hotter the element gets and eventually the element will burn out. Where this is known to be a problem it is definitely a case for action *before* the element fails, so that the hot water supply is not interrupted.

In some locations, scale may be such a problem that dissolving the scale off with a solution of hydrochloric acid may be considered.

Longer electric elements are available so the intensity of heat inside the element is reduced even as scale forms on the element, so that the elements last longer before failing.

7.1.3 Sediment

Even the purest of water supplies will carry some sediment. The sediment will be deposited in the bottom of the hot water storage tank and perhaps in the bottom header of the solar collectors. A small quantity of sediment is not a problem, but a significant build-up can cause corrosion and odours, especially if the sediment contains organic material that decomposes in the tank.

Flushing sediment out of a tank is not easy. Draining the tank will usually leave the sediment sitting on the bottom of the tank. To stir up the sediment, it may be possible to poke a thin bent pipe attached to a hose through one of the top connections and spray it round inside the tank, allowing the dirty water to flow out a lower connection.

A far more effective method is to have a small quantity of water in the tank and then shake the tank about, stirring up the sediment inside and letting it run out one of the connections. While effective at dislodging the sediment it may also result in damaging the tank. The connecting pipes (and wires in an electric system) need to be disconnected. In most cases it is not worth the effort.

7.2 Trouble shooting – problems

A telephone call from an owner is the most common way for an installer to discover that there is a problem. The examples below show some of the issues that might relate to solar hot water installations.

Consider each of the problems and suggest a possible reason for the problem and a solution. In some cases there may be many reasons for the problem.

7.2.1 Dripping noise

“I hear dripping on the roof at night and it drives me mad because it prevents me from sleeping. I am sure it is the solar hot water system.”

Possible cause:

- A leaking valve is likely:
    - a PTR valve on a close coupled storage tank that does not have a pipe to carry away the expansion water
    - a frost protection valve that is opening perhaps too early (at too high a temperature), or perhaps it is operating normally.
- Leaking pipe work or a leaking storage tank is another possibility.

7.2.2 High electricity bill

“Judging by our electricity account I don’t think that the solar section of our water heater is working.”

Possible causes:

- Customers are using more hot water than they realise (a water-use audit or even metering may be useful to determine actual hot water use).
- The anti-freeze has drained out of the collectors.
- The circulating pump or controller of a pump circulating system has failed.
- Air is trapped inside and preventing or restricting water circulation. This can occur with a pump circulation system or a thermosiphon circulation system. In a pump circulation system, the air eliminator valve may have failed, or circulating pump speed may need to be increased. In a thermosiphon system the usual reason is that there is a section of the connecting pipe (usually the hot water pipe to the tank) that does not slope upwards towards the tank creating a high spot where the air is trapped.
- Pump and sensors are mounted incorrectly and flow is very restricted.
- The timing of the supplementary heating is wrong. Supplementary heating may be coming on during the morning just before the sun starts to heat the collector. Supplementary heating should be timed to come on only at the end of the day once the sun has gone down.

7.2.3 Very high electricity bill

“All of a sudden we have found that our electricity account has been far higher than it was before. We are wondering whether it is something to do with the solar hot water system.”

Possible causes:

- As with the previous questions, it is possible that the collectors are not heating the water.

- The following problem actually happened. The solar hot water had an electric 800 watt heater for frost protection. The thermostat failed in the 'on' position meaning that the electric element was running 24 hours a day, 365 days a year. 0.8kW x 24 x 365 = 7008 kWh. At 15c/kWh the cost would be $1051 a year more than if the heater was not being used at all. This failure could happen to the thermostat for the main element but the system PTR valve would probably open as it overheated.

7.2.4 We run out of hot water too quickly – even after a sunny day

"This has not been a problem previously."

Possible causes:

- This sounds a bit like problem 7.2.2. It is possible that instead of solar heated water the only water that is being heated is by an electric element located part way up the tank, and no water is being heated by the solar collectors.
- Electric element or thermostat has failed.

7.2.5 Frost damage

"We had a severe frost last night and water is now pouring out of the cracked glass of our solar collectors."

Possible cause:

- There is only one possible cause. The collectors were not adequately frost protected. There is a whole section (Section 5.2) in these notes on frost protection.

7.2.6 Frost damage

"We had a severe frost last night and water is now pouring out of the joints (connections) between our solar collectors."

Possible cause:

- As with the previous problem, the frost protection is inadequate, but in this case it would appear that it is the connectors between the collectors that were not adequately insulated.

7.2.7 Water is only warm

"We get really hot water to start off with but then it is only warm. This is particularly so when we run a bath."

Possible causes:

- This sounds like a storage tank with a mains pressure coil in it. The first lot of water coming out is the same temperature as the water surrounding the coil in the tank. As water passes through the coil it is not adequately heated, especially if it passes through quickly as would be the case if a bath is being filled with the tap on full flow. If hotter water is required the only way is to slow down the flow of the hot water.
- The tempering valve may be malfunctioning. Perhaps the pressure of hot and cold water is not the same.

7.2.8 Hot water in the kitchen, bathroom cool

“Sometimes the water in the bathroom is only warm, yet in the kitchen it is very hot. At other times the water in the bathroom is quite satisfactory.”

Possible cause:

- As with the previous problem, it sounds like an issue with the tempering valve. Tolerances of the moving parts are fine so even a small quantity of sediment can cause a tempering valve to malfunction.

7.2.9 My wood heater does not heat the water very much

“I have a hot water system connected to solar and a wood-fired room heater. On overcast days in autumn and spring, the water is not hot enough. There is no other heating.”

Possible cause:

- This is a common problem. The heater in autumn and spring will not have to do much heating as the weather is not cold. Therefore it does not put much heat into the hot water and on overcast days without any solar input there is simply not enough hot water produced. Some other form of boosting (gas or electricity) is really the only practical option.

7.2.10 Not enough hot water – ever

“We never seem to have enough hot water now that we have a solar system.”

Possible cause:

- The solar hot water system was not sized according to the owner’s requirements; rather it was sized according to what the seller of the system wanted to sell. The problem is common where solar dealers want to sell 300 litre close coupled systems because that is what they have in stock. For large families, a 300 litre system is inadequate, particularly on overcast days when all of the hot water has to be produced by the heating of an electric element halfway up the tank, giving 150 to 200 litres of hot water. A larger storage volume of hot water is required or the solar system can become a pre-heater for an instantaneous booster unit, or a gas or electric storage unit.

7.2.11 Hot water not hot enough

“Our solar heated water is never very hot, even in summer.”

Possible causes:

This may be the same problem as the previous one, but there is no suggestion that there is not enough hot water, just that it isn’t hot enough.

- It suggests that the storage tank is of adequate size but that there is an inadequate area of collectors. However, even if the collectors are of inadequate area, the boost system using gas or electricity should bring the water up to an adequate temperature. Perhaps the thermostat needs adjusting.

- It is possible that heat losses from the connecting pipe work or the storage tank itself are too great, so that the hot water temperature being delivered to the taps is reduced too much.
- If the boosting of the hot water is by the use of an instantaneous hot water system there are two likely causes:
    - The boosting unit is too small. In order to keep costs down it is not uncommon for an installer to install a small (cheaper) unit. The flow rate may be 16 litres/minute whereas 26 litres/minute is required. The solution is to accept a slower rate of flow from the hot taps *or* replace the hot water boost unit with a larger one.
    - Instantaneous hot water units require plenty of gas. The *rate* of gas usage is high and the pipes from the gas meter or LPG regulator may be too small. The only way to overcome this problem is to install larger diameter gas pipes. This problem often occurs when a gas storage unit is replaced by an instantaneous gas unit. The storage gas unit requires 26MJ/hour. The Instantaneous system may require between 140 to 200MJ/hour.

7.2.12 Cool water in the morning

“Late in the day the water from our solar hot water system is very hot. In the morning it is not nearly as hot. It seems we must be losing a lot of heat from the water in the storage tank over night. Is there something wrong with the insulation?”

Possible causes:

Regardless of how well a storage tank is insulated, there will be some heat loss overnight.

- There may be something wrong with the insulation. Unfortunately some tanks (especially some older in-ceiling tanks) are not well insulated and lose a lot of heat.
- It may be that reverse thermosiphon is occurring at night and heat is being lost through the collectors.
- It is possible that heat is being lost through thermosiphon occurring in the pipes connecting the collectors to the hot water storage tank. If they are not well insulated they will lose heat.
- Often heat is transferred from the hot layer of stratified water in the storage tank to the cold lower layers of water. This transfer may occur due to conduction through the water or through the walls of the storage tank. It happens particularly with a close coupled system tank, due to the wide profile of the tank.
- Some hot water may have been pumped through the collectors to avoid frost damage.

7.2.13 After summer holidays we have no hot water

“After we come home from a summer holiday, we don’t have hot water after a few overcast days.”

Possible cause:

- There is an ‘over temperature’ safety thermostat which switches off the electric booster element if the temperature gets too high. A reset button needs to be pressed to switch it on again.

7.2.14 Our hot water emits bubbles of air

“We have a hot water tank in the ceiling. When we run a bath the water comes out OK to start off with and then it starts to spit and bubble sending out a mixture of air and hot water.”

Possible cause:

- It sounds as though the cold water is not entering the bottom of the hot water storage tank fast enough, and as the level in the tank falls, air is being drawn down the hot water delivery pipe. A better cold supply is required, either to the head tank or to the bottom of the hot water storage tank.

7.2.15 Solar central heating

“I have a solar hot water system and I am very happy with it. I have heard that it is possible to use it for house heating as well. Is that possible?”

Possible cause:

- While this is not really a problem, it could be. Solar hot water systems that are sized to provide most of the hot water needs in summer will need boosting in winter when there are less hours of solar radiation available. Solar contribution for the extra hydronic space heating needs will therefore be limited. The addition of extra solar collectors will increase available winter heating, but will result in likely over-heating in summer. New technologies such as solar cooling – when commercially available for residential use – will be able to utilise this extra solar collection in summer to provide building cooling, an ideal match of cooling demand with days of high sunshine. Many keen sales people will convince solar hot water owners that it is possible to heat their houses by adding hydronic (hot water) heating to their solar system. In most cases the solar contributes little, or more usually nothing, to the house heating and the heating is undertaken entirely by the gas boosting section of the system. It stands to reason that if an ordinary solar hot water system needs boosting on sunny days in winter, there is not going to be enough heat from the sun to provide house heating as well as domestic hot water.

7.2.16 Heat pump unit runs all night

“In frosty weather my heat pump hot water system seems to run all night. Is this normal?”

Possible cause:

- This is quite normal. The heat that lifts the temperature of the hot water comes from the air. If the air is very cold, it has less heat in it than warmer air. It still has heat in it but it takes longer to heat the water and so more electricity is required. To reduce the electricity used the heat pump should run during the warmer parts of the day. There are two ways to achieve this:
    - Try to use as little hot water at night as possible.
    - Install a timer on the power point into which the hot water system is plugged. Set it so that it only turns on during the warmer part of the day; say 10am to 5pm. Provided this gives enough hot water, the electricity saved will soon pay for the cost of the timer.

7.2.17 Water dripping from under the eaves

“The hot water tank is in the ceiling and the overflow pipe has water running out of it all the time.”

Possible causes:

- The most usual reason is that the float valve in the head tank needs a new washer or the whole valve needs replacing.
- The tank may have a leak. The leak may be caused by:
    - old age causing the tank to simply corrode. It needs to be replaced since repairs are seldom satisfactory.
    - a leak around a connecting nipple, the electric boost element or a thermostat. Repairs may be possible.
    - the air vent has become blocked, perhaps with a wasp’s nest. If water is drawn off faster than cold enters the tank, the tank collapses, creasing the copper walls of the tank, and causing leakage. Again, repairs are rarely satisfactory.

Key points

- Preventative maintenance is maintenance carried out to prevent breakdown or failure of a solar water heater. The recommended maintenance schedule will vary with water quality and the volume of hot water used, but because of the wide variation in these, manufacturers might recommend a schedule such as 5 years to cover all situations.
- Scheduled maintenance can prevent or reduce:
    - wear or failure of components
    - corrosion of components of the system
    - deposition of sediment within the system.
- As with any water heater, problems can occur. Troubleshooting can help to establish the likely cause and best solution to these problems.