Solar Thermal "Reverse Cycle" Daytime Heater / Summer Night Cooler

The roof heater is thermal rather than photovoltaic, i.e. it has a solar black heating element rather than solar cells. Warm and cool cycles are controlled by pre-set timers that are switched seasonally between winter daytime heating and summer night cooling. Warm or cool air is drawn from the roof space into a filtered inlet box, ducted through the external roof box and into the selected rooms. In winter the heater warms the rooms each day so that the bedrooms and hall can be warm by noon with no additional heating. In summer the roof space cools down overnight faster than the air in the rooms of the house. The summer timer draws the roof air to cool the house down overnight, balancing your home environment and budget.

The unit is operated by the ON switch and ← → (west-east) switch in the hall. The ON switch directs power to a timer on an 80-watt variable duct fan in the roof space. This circulates air through the roof box and into the main bedroom and/or one of the two front rooms. The ← → switch operates a zone valve in the roof space, which directs air into the selected front room. The timers are in a bag hung in the ceiling hatch, and can be changed on a stepladder without climbing into the roof.

The ON switch in the hall is a manual control for the whole system. Turn it on and leave it on during any sunny weather cycle. For days or weeks you may not need to turn the unit off. While ON it uses 60 W power (optimised for a small family) only in the times indicated on the timer.

- In fine or slightly overcast weather in winter, leave the unit ON for daytime heating. The timer will turn on the fan (10 am – 4pm April – August).
- In winter overcast, leave the unit off until the weather improves.
- If the unit has been switched off and the sun returns, leave it for around half an hour before switching ON. The unit will release a warmer outflow of heat temporarily stored as the roof box heats up.
- Change the seasonal timer to summer and turn ON for night cooling (10 pm – 6am November – February). On clear summer nights, the roof space cools down faster than the rooms so the unit brings in cool air. Open some windows to blow out warm air. The fan is quiet and has been hung so to not vibrate the roof.

The bedroom outlets can be set to HI or LO by opening the main bedroom outlet hatch and adjusting the folded-down part of the valve. This has three settings:

- HI into the main bedroom (main bedroom valve fully open) or
- LO shared between the main bedroom and the selected front room, or
- HI into the selected front room (main bedroom valve fully closed)

The ON switch, timer and main bedroom valve are a manual temperature control suited to your preferences and activity in the house and timed to operate at the best times of day/night. If you are away for an extended period, you can turn it off and leave it off, or you can set your own timer, e.g. a day-week timer that will turn the fan on for the morning you arrive home. If you have indoor plants or stay-home pets you should leave the unit on to keep the house warm or cool while you are away.

The heater should NOT be set for daytime heating in summer if people are living in those rooms. HI can be too warm even in autumn/spring in the smaller south ← room. HI ← can be useful for a laundry drying room. The outlet diffusers can be removed for direct airflow, ducted lower into the space or closed off.

The night cooler should definitely NOT be run in winter, not just for the unwanted cooling but to avoid drawing in winter smoke from the town air. The summer timer has to be changed in winter, or the unit left off, to avoid this happening by accident. If the night cooler turns on in winter, turn off and change the timer.

The heater is most effective in late summer to early winter then spring to early summer and can usually be left ON in those seasons. Some months obviously need no heating or cooling. Some months are too hot or cold for a solar-passive system to make much difference. You can leave the unit off; the timers have a recharging battery with up to six months "off" life and need no maintenance, but may need replacement after perhaps five years as they are a digital item.

Maintenance

The heater is built for extended use over the expected life of the house. Only the **seasonal timers** may need replacement in the medium term. The **roof-mounted heat/cool box, duct fan and heating plate** are constructed of thermal-durable materials and solar-black paintwork rated for long summer exposure. The **glass cover** is a durable roofing grade. **Flexible ducting** is durable if not mishandled and can be manually shifted for working around the unit in the roof space.

The duct fan can be turned up or down from the family-optimised setting. If the system operation seems to be at low pressure or has poor effect, check that the roof space ducting is intact, particularly near the external outlet/inlet, and the pump has not been turned down. Check that the heating plate surface is in good condition.

The glass cover is self-cleaning of dust. In extended drought periods, the glass may need to be wiped clean at the start of winter. The roof unit can be accessed for cleaning or inspection with normal roof safety precautions. The roof-mounted box and glass are not too hot to touch even in summer, but the enclosed heating plate can reach high temperatures, around 90^{o}C measured in high-summer high-noon tests with the unit turned off (no cooling airflow).

The **seasonal timers** provided in the roof space are set for winter 10am-4pm and summer (DS) 10pm-6am, and must be switched around in the roof space at the change of winter/summer seasons. This can be done by an average-height person on a step ladder to the roof hatch without climbing into the roof. Just **unplug the timer and change it with the timer in the bag**. Those times have been optimised by lived experience in this house of the best heating/cooling periods.

The roof space duct inlet has a **filter box** with dust fabric that should be vacuum cleaned every few years. **Caution**: climb into the roof and use the level working space around the ceiling hatch to access the filter box. Watch your feet, use both hands and if possible get some assistance to unhook the stays and lower the filter box, re-hook and remove the filter panel. Take the filter material down to vacuum-clean, then replace in the roof space filter box and then re-hang the box. You will see that **the filter box is a falling-object hazard if you let go of the stays while hanging.** The stays and pulleys, as-new, are rated in excess of any risk of breakage while in use but should be inspected for deterioration due to heat. The filter fabric in the main bedroom outlet can be easily accessed for vacuum cleaning.

The **glass cover** can be opened by a roofing contractor if the plate needs to be re-painted, perhaps every fifteen years. You are recommended to the best solar-black sprayable touch-up paint of your era. The system was installed in 2018.

Home User's Personal Certification

The health and well-being of this family has improved in the years following installation, and we clearly saw the improvement in cold-damp-mildew spots in the south-facing rooms. The main and southwest bedrooms in particular are very much warmer, the southeast bedroom less so as it is larger and at the most distant end of the ducting, but still noticeably warmer on the HI → setting. The front rooms have high ceilings; small fans and flexible ducting can be added to bring the air down.

There is no evidence whatsoever that the roof space has bad or dusty air for circulation in the house. The air inlet to the roof space is via the normal openings of a roof's eaves and corners to the outside air. The filter fabric is rated for dust, not smoke particles, and is odourless and non-volatile in warm or cool air.

We noticed that the heater is less effective on very cold sunny days and the cooler is less effective on hot overcast nights, however with 3 years' lived experience we can recommend the unit for day-time heating and night-time cooling for up to 9 months of the year. On many clear summer nights we even turned the cooler down.

Mr Con Asciak, Director of SolrHeat Pty Ltd (concept design, production, precision workshop fabrication, on-site construction and installation)

Dr Mike Evans, UNE Physics and Electronics (design optimisation, theoretical modelling, installation testing, home use, this home user manual)