

U.S. Department of Energy - Energy Efficiency and Renewable Energy Energy Savers

Solar Water Heating System Freeze Protection

Solar water heating systems, which use liquids as [heat-transfer fluids](#), need protection from freezing in climates where temperatures fall below 42°F (6°C).

Don't rely on a collector's and the piping's (collector loop's) insulation to keep them from freezing. The main purpose of the insulation is to reduce heat loss and increase performance. For protecting the collector and piping from damage due to freezing temperatures, you basically have two options:

- Use an antifreeze solution as the heat-transfer fluid.
- Drain the collector(s) and piping (collector loop), either manually or automatically, when there's a chance the temperature might drop below the liquid's freezing point.

Using an Antifreeze Solution

Solar water heating systems that use an antifreeze solution (propylene glycol or ethylene glycol) as a heat-transfer fluid have effective freeze protection as long as the proper antifreeze concentration is maintained. Antifreeze fluids degrade over time and normally should be changed every 3–5 years. Since these systems are pressurized, it is not practical for the average homeowner to check the condition of the antifreeze solution. If you own this type of system, have a solar heating professional check it periodically.

Draining the Collector and Piping

Solar water heating systems that use only water as a heat-transfer fluid are the most vulnerable to freeze damage. "Draindown" or "drainback" systems typically use a controller to drain the collector loop automatically. Sensors on the collector and storage tank tell the controller when to shut off the circulation pump, to drain the collector loop, and when to start the pump again.

Improper placement or the use of low-quality sensors can lead to their failure to detect freezing conditions. The controller may not drain the system, and expensive freeze damage may occur. Make sure that the sensor(s) have been installed according to the manufacturer's recommendations, and check the controller at least once a year to be sure that it is operating correctly.

To ensure that the collector loop drains completely, there should also be a means to prevent a vacuum from forming inside the collector loop as the liquid drains out. Usually an air vent is installed at the highest point in the collector loop. It is a good practice to insulate air vents so that they do not freeze. Also make sure that nothing blocks the airflow into the system when the drain cycle is active.

Collectors and piping must slope properly to allow the water to drain completely. All collectors and piping should have a minimum slope of 0.25 inches per foot (2.1 centimeters per meter).

In integral collector storage or "batch" systems, the collector is also the storage tank. Placing large amounts of insulation around the unglazed parts of the collector and covering the glazing at night or on cloudy days will help to protect the collector from cold temperatures. However, water in the collector can freeze over extended periods of very cold weather. The collector supply and return pipes are also susceptible to freezing, especially if they run through an unheated space or outside. This can happen even when the pipes are well insulated. It is best to drain the entire system before freezing temperatures occur to avoid any possible freeze damage.

See [Heat-Transfer Fluids for Solar Water Heating Systems](#) to learn more about the different types of heat-transfer fluids.

For more information about residential solar systems, see:

- [Solar Water Heaters](#)

- [Solar Space Heating Systems](#)
- [Heat Exchangers for Solar Heating Systems](#)

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