Glossary of Solar Terms

This glossary contains important general solar terms and those specific to the Roth Solar Systems.

2 in 1 Piping System - Two flexible stainless steel corrugated tubes with a sensor wire, all insulated by elastomeric EDPM with a UV-resistant covering. Tubing is typically used in the solar loop between solar pump station and solar array.

Absorber – The collector component that absorbs energy from the sun and converts it to thermal energy. For high absorption rates it is coated with a selective surface coating.

After Heating – A method to add heat from a non-solar source, such as an electric heating element or fuel-fired boiler, to raise the temperature of water in a storage tank to the required set point for end use.

Ambient Temperature - The temperature of outside air surrounding solar collector.

Angle of Azimuth - Deviation in degrees from true Polar South (0^0) in the northern hemisphere. A collector facing Southwest or Southeast would have an angle of azimuth of 45^0.

Angle of Inclination - The angle up from a horizontal plane. Straight up would have an angle of inclination of 90^0.

Annual Solar Savings - The amount of money saved by employing a solar energy system vs. purchasing electricity or fuel to generate energy to heat water. The cost of energy used to operate the solar energy system should be deducted from the gross savings to obtain an accurate amount.

Anode (Sacrificial) - A rod placed inside the storage tank with the purpose of creating a galvanic cell in which magnesium or zinc will be corroded more quickly than the metal of the tank, giving the tank a negative charge and preventing corrosion.

Antifreeze Solution — A mixture of propylene glycol, water and additives for corrosion and high temperature. This fluid is circulated in the solar loop to transfer heat energy from the collector to the storage tank or heat exchanger.

Aperture - Area through which solar radiation is

Attachment Set - Mounting frame and hardware used to secure collectors to a base such as a roof, wall or the ground.

Back-up Energy System - A system employed to add energy to the DHW or heating system in the event the solar energy system cannot produce enough energy to maintain the set point temperature.

Boiler Drain/Fill Valve - Drain cocks installed in a solar or hydronic heating system to allow either portions or all of the system filled or drained.

Borosilicate Glass - A glass made with silica and boron oxide. This mixture give the glass greater strength and heat resistance. A majority of solar vacuum tubes are made from this material.

BTU (British Thermal Unit) - The amount of energy needed to raise 1 pound of water 1^0F. **Btu/hr** is amount of Btu's generated or transferred in one hour.

BSPP Thread - British Standard Pipe Parallel thread. Uses a gasket to seal fittings.

Charging Pump - A pump used to pressure test, fill and pressurize a closed solar loop.

Check Valve - Allows flow of fluid in one direction only. A weighted check valve deters thermo-siphoning.

Collector Efficiency - The ratio of solar radiation captured to the amount of thermal energy transferred to the solar fluid in the collector. Incoming fluid temperature and collector standby loses greatly effect this ratio.

Collector Gross Area - Total area of the collector including outside frame. This figure is used in ASHRAE ratings. For evacuated tube collector the outside perimeter is used to determine the gross area. Spaces between the collectors and the header are included.

Collector Net Aperture Area - The area through which solar radiation is admitted and transferred to the absorber. Spaces between tubes are not considered in determining aperture area of vacuum tube collectors. The area between the tubes of vacuum tube collectors with CPC reflectors, such as those supplied by Roth Industries, is included in aperture area measurement.

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Collector Tilt - The angle a collector is positioned from horizontal. (Angle of Inclination).

Counter Flow Heat Exchanger - A heat exchanger where two fluids flow in opposite directions for heat energy transfer.

CPC Reflectors (Compound Parabolic Concentrators) - Aluminum reflectors placed underneath and between evacuated tubes to reflect and focus solar radiation on the tube.

Design Heating Load - The amount of Btu/hr (kW/hr) needed to maintain set indoor temperature of a building at the design outdoor temperature.

Design outdoor temperature - The temperature in a region at which 97.5% of the time during the heating season the outdoor temperature is at or above. Determined by ASHRAE data collection over many years.

DHW (domestic hot water) - Water that is heated for use in washing, bathing and cleaning.

Differential Controller - A control device that activates or deactivates the circulator in the solar loop based on the difference in temperature of the solar fluid in the collector and in the storage tank.

Diffuse Solar Radiation - Solar radiation received indirectly as a result of scattering due to clouds, fog, haze, moisture, dust, pollution or other obstructions in the air or ground.

Direct Solar Radiation - Solar radiation received directly from the sun in a straight line.

Drain Back Solar System - A closed loop system in which the solar fluid in the collector and solar loop drains into a tank or reservoir whenever the circulator is deactivated to protect the collector and solar loop from freezing. Newer designs use a heat exchanger in the tank or reservoir to separate the solar fluid from the DHW.

Drain Down Solar System - An open loop system where solar fluid, typically water, is drained completely from the collector and solar loop when freezing conditions occur. This system is very problematic and is not recommended.

Electromagnetic Radiation - A traveling wave motion resulting from changing electric or magnetic fields. The wave range is from short waves like X-rays and gamma rays to mid range waves like visible light to long waves like radio waves. Energy from the sun travels to the Earth in the form of these waves in the UV, visible light and Infrared range.

Energy Payback Period (Also called **Return on Investment (ROI)**) **-** The time required for a solar energy system to produce enough monetary savings from energy use to offset the purchase price for the system.

Evacuated Tube Solar Collector - A solar collector consisting of parallel rows of glass tubes connected to a header. The air in each tube is removed to eliminate heat loss through convection and radiation. Is more efficient in low solar radiation periods. Can produce higher temperatures which can be used in industrial processes and space heating.

Expansion Tank - A high temperature bladder tank able to hold excess fluid caused by thermal expansion of the solar fluid and flashing of the collectors during periods of stagnation.

Fire stopping - A passive fire protection system of various components used to seal openings and joints in fire-resistance rated wall and/or floor assemblies.

Flash Point - Temperature at which a portion of the solar fluid in the collector changes to a vapor. The expansion tank must be large enough to accept any liquid pushed out of collectors by the vapor.

Flat Panel Solar Collector - an insulated housing with a glass cover (glazing) and an absorber plate. Solar radiation is absorbed and then converted to thermal energy which is then transferred to the solar fluid that circulates through the collector in copper tubes.

Flow meter - Indicates flow rate of solar fluid in the solar loop.

Full Sun - The amount of solar energy received at the Earth's surface at solar noon on a clear day. (Approx. 1 kW/m^2 ($317Btu/ft^2$))

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Heat Conducting Paste - a thermally-conductive paste that aids in transferring heat between components. Typically used in sensor wells to allow temperature sensors to read temperatures of solar fluid more accurately.

Heat Dump - A device used to dissipate excess heat energy from the solar loop. Particularly needed in the summer months when solar radiation is high and the need is low. Pools, unit heaters, fin tube baseboard elements and earth loops are examples of heat dumps.

Heat Exchanger- A device used to transfer heat from one fluid to another where the fluids are physically separated. Typical solar heat exchangers include flat plate, coil in tank, tube in shell and tube in tube.

Heat Transfer - Heat energy travels from areas of high energy (hot) to areas of low energy (cold). Heat energy is transferred by conduction, convection, and radiation.

High Temperature Collector - A solar collector designed to operate at temperatures above 180^0F (82^0C). Flat plate and evacuated tube collectors are high temperature collectors.

Indirect Solar System - An active, closed loop system utilizing a solar heat transfer fluid with an antifreeze solution to transfer heat energy from the collector to a storage tank using a heat exchanger. System is used in colder climates where a possibility of freezing exists.

Inlet Fluid Parameter - A factor in determining collector efficiency. Based upon the entering temperature of the solar fluid, ambient temperature and insolation of the collector. The higher the value the more severe the outside conditions.

Insolation - The total amount of solar radiation (irradiance), both direct, diffuse and reflective, reaching a specific surface per unit of time. Usually expressed as watts per square meter per hour ($W/m^2/hr$) or Btu per square foot per hour ($Btu/ft^2/hr$).

Installed Height - The height of the collectors from grade level.

Irradiance - Total direct, diffuse and reflective solar radiation that strikes a surface. (W/m^2 or Btu/ft^2)

Isolation, Bypass Valve - A valve used to separate a device or partial system from the main system. For example, they are used to isolate an expansion tank for pressure testing or bypass the solar storage tank from a secondary DHW tank.

Kilowatt Hour (kW h) - A unit of energy equal to 1000 watts generated in one hour. (1 kW h = 3412 Btu/h)

Lightning Protection - equipment and measures used to ensure that the solar system is protected from lightning strikes and induced charges. The system may use dedicated grounding devices or be attached to an existing lightning protection system.

Low Iron Tempered Glass - The most appropriate glazing material for glazed solar panels due to its high strength and longevity. In addition, low iron content glass has the highest transmission and lowest reflectivity of solar energy.

Low Temperature Collector - Generally operated at temperatures below 110^0F and uses pumped liquid or air as the transfer medium. They usually contain no glazing or insulation and are often made of plastic or rubber.

Magnetic Declination- Angle between true north and magnetic (compass) north. Declination is positive when magnetic north is east of true north. This deviation is caused by magna flows deep in the Earth. This angle changes slightly over time.

Mineral (Rock) Wool Insulation - Used as an insulating material in both flat plate housings and evacuated tube headers. Made by spinning molten rock into intertwined fibers.

MSDS (Material Safety Data Sheet) - a form with data regarding the properties of a particular substance. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures.

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Nocturnal Cooling (Recooling) - The process whereby an overheated storage tank is cooled to it's preset operating temperature by circulating the solar fluid through the collector at night.

Polycarbonate - Commonly known by the trademarked name, Lexan, they are a particular group of thermoplastic polymers. They are easily molded and have a high temperature and impact resistance factor.

Pressure Drop - The loss of static pressure of a fluid in a system due to friction from inside walls of pipe, fittings, valves. Flow rate and type of fluid are major factors in amount of pressure drop in a system.

Propylene Glycol - An environmentally friendly, food grade antifreeze used in solar systems.

Psi (Pounds per square inch) - It is the pressure resulting from a force of one pound-force applied to an area of one square inch: 1 psi approximately equals 6,894 Pa, Pascal (Pa) is the SI unit of pressure. Unit used for pressure drop.

Pyranometer - An instrument that measures global insolation (direct and diffuse solar radiation) on a flat surface.

RTD (Resistance Temperature Detector) - A temperature sensor that measures electrical resistance at different temperatures of a substance. They are most often made of platinum (Pt). The resistance is measured in ohms. The BW, BW/H and BW/H - Comfort solar controls use RTD sensors (Pt1000) to measure the temperature of the solar collectors, storage tank, heat exchangers and back up energy systems.

Sacrificial Anode - See Anode

Selective Surface Coating - A material with high absorbance and low emittance properties applied to or on the surface of solar absorbers. Coatings provide a degree of absorption of over 90%.

Sensor Well - An enclosed tube designed to allow the insertion of a temperature sensor. Wells can be inserted into a fluid stream or attached to the outside of a pipe or vessel containing the fluid.

Shear Force - A force acting perpendicular to a fastener or member which would shear it off if higher than the member's or fastener's shear strength.

Smooth Tube Heat Exchanger - An immersed-tube heat exchanger that does not employ fins to help conduct heat. Roth storage tanks employ smooth-tube heat exchangers.

Snow Load - Force exerted on solar collectors and attachment sets due to weight of accumulated snow.

Solar Altitude Angle - See Angle of Inclination

Solar Array - a number of solar collectors mounted and connected together so as to provide a single thermal output from the solar radiation falling on them.

Solar Azimuth Angle - See Angle of Azimuth

Solar Collector - See Evacuated Tube Solar Collector and Flat Panel Solar Collector

Solar Controller - A programmable electronic device designed to receive inputs from sensors and operate pumps and valves to transfer energy from the collector array to the storage tank and from the storage tank to a secondary system, as well as to protect the solar system. See also Differential Controller.

Solar Fraction - The percentage of a building's seasonal or annual energy requirements that can be met by a solar energy system.

Solar Heat Transfer Fluid - Fluid in a solar energy system that collects thermal energy from the solar array and disperses that energy to another fluid through a heat exchanger. See also Antifreeze Solution

Solar Irradiation - See Irradiance

Solar Loop - System of piping, fittings, valves and control devices designed to circulate solar heat transfer fluid from the collector array to the heat exchanger and back to the collector array.

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Solar Noon - That moment of the day that divides the daylight hours for that day exactly in half. It is the time, at a specific location, when the sun reaches its highest, apparent point in the sky; equal to true or due, geographic south. Solar noon may be quite a bit different from 'clock' noon.

Solar Pump Station - Device use to circulate and regulate solar heat transfer fluid. Contains a circulator, flow meter and regulator, flow check valves, air vent, temperature gauges, pressure gauge, pressure relief valve, fill/drain valves, isolation valves and port for expansion tank.

Solar Radiation - A general term for the visible and near visible (ultraviolet and near-infrared) electromagnetic radiation emitted by the Sun.

Solar Storage Tank - Vessel used to store thermal energy collected from the solar energy system. Tank is typically filled with water and the thermal energy is transferred through heat exchangers.

Solstice - The two times of the year when the sun is apparently farthest north and south of the Earth's equator; usually occurring on or around Jun. 21 (summer solstice in northern hemisphere, winter solstice for southern hemisphere) and Dec. 21 (winter solstice in northern hemisphere, summer solstice for the southern hemisphere).

SRCC (Solar Rating and Certification Program) - Organization that certifies solar collectors and solar energy systems. Performance and structural testing is performed by independent contracted laboratories. Federal, state, local government and utility grants and programs usually required this certification.

Stagnation - A condition that can occur in a solar collector if the solar heat transfer fluid does not circulate when the sun is shining on the collector. Temperatures can exceed 350^0F (176^0C).

System Charging - Process of pressure testing, filling and pressurizing solar loop.

Tempering Valve - In DHW supply, this valve mixes heated water with cold incoming water to supply fixtures with a preset temperature. Often referred to as an anti-scald valve. This valve is required when heating DHW with a solar energy system.

Tensile Force - A force acting in-line with a fastener or member, placing it in tension, which would pull it apart if above its tensile strength. Tensile force acts in opposite direction than compressive force (which would buckle or crush the member).

Thermo-siphoning - the passive convection or flow of a fluid through a pipe that is caused by density changes due to differences in temperature from one point in the pipe to another. Thermo-siphons are particularly prevalent in vertical loops of pipe carrying liquids where one side of the loop is exposed to a warmer temperature than the other.

Unglazed Solar Collector - Unglazed collectors are usually made of black plastic that has been stabilized to withstand ultraviolet light. Since these collectors have no glazing, a larger portion of the Sun's energy is absorbed. However, because they are not insulated a large portion of the heat absorbed is lost, particularly when it is windy and not warm outside. This type of collector is popular for pool heating.

Whips - Insulated, flexible stainless steel tubing (1m, 3.26ft.) installed on supply and return connectors of solar array and used to connect them to solar loop piping. The compensator allows piping to expand and contract and mounting hardware to move slightly under loads and thermal expansion without placing undue stress on collector fittings.

Wind Loads - Forces exerted on collector array and attachment sets from the lift created by wind blowing against and over the collector array.

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Units of Measure -

BTU - British thermal unit

°C - degrees Celsius

°F - degrees Fahrenheit

ft - foot/feet of distance

ft^2 - **s**quare ft.

Kg - kilogram

kW - kilowatt

Nm - Newton meter (Torque)

Lb - pound force or weight

m - meter

m^2 - **s**quare meter

mm - millimeter

Pa - pascal

psi - pounds per square inch

psig - pounds per square inch, gauge

w - watt