How to harness the sun’s energy and create hot water with a Solar Thermal System
Introducing Ritter XL Solar

Ritter XL Solar Thermal Systems have been optimized through more than 20 years of research and development and are the results of market-leading German engineering.

Ritter XL Solar has over 60,000 installations worldwide and a 50% share of the Evacuated Tube Collector Market in Europe.

Ritter Group USA won the Intersolar Award for the Best Solar Project in North America in 2012!
Ritter XL Solar Thermal Systems have several key attributes.

- Top quality German engineering and design (customized for every install)
- Thermos-style tube collectors capture heat efficiently
- Flow-through pipes maximize collection and temperature gain
- Highly reflective mirrors attached to solar collectors increase yields and minimize sensitivity to collector orientation
- Water, not glycol, is used as the heat transfer medium in the AquaSystem®, delivering better performance and simpler piping
- Higher temperature water can be produced at selectable temperatures
- Systems can function like a second boiler
- Systems come with 24/7 monitoring & require minimal maintenance
- Collectors are designed to withstand adverse weather conditions and perform at a high level for over 20 years

Ritter XL Solar Collectors come with the highest ratings from the Solar Rating & Certification Corporation (SRCC) and deliver superior performance along with higher incentive payments.

Ritter Group USA stands behind the manufacturing of its collectors with a 10-year warranty.
Ritter XL Solar Collectors

This guide will go through each step of a Ritter XL Solar Thermal System.

Start From the Top

In solar thermal systems, collectors (usually placed on rooftops) gather heat from the sun. Pipes deliver that heat to a water storage tank where hot water is available to be used.

Collector output is the most important factor for determining the overall efficiency of a system, so Ritter XL Solar has developed the highest performing solar collectors on the market.
Solar Collectors

The first step in a solar thermal system is to capture energy from the sun.

Timeline of Solar Thermal Innovation

Flat Plate Collector
- Perform well direct sunlight
- Perform worse in other conditions
- Loose heat

Heat Pipe Collector
- Thermos-like vacuum tubes eliminate heat loss
- Rely on glycol and heat exchangers for each type

Ritter XL Solar Collector
- Flow-through pipes connect each vacuum tube
- Highly reflective parabolic mirrors maximize collection
- Introducing AquaStystem® allows water to be used as a heat transfer fluid
- The highest output temperature are possible

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This is the design and functionality of a basic solar collector.

**Inlet Connection**

**Collector Housing** - made from aluminum alloy or galvanized steel - fixes and protects the absorber plate.

**Flow Tubes**

**Insulation** - to the bottom and side of the collector to reduce loss of heat.

**Glass Cover** - protects the absorber plate and limits heat loss.

**Absorber Plate** - with chrome absorbing coating to maximize heat-collecting efficiency.

**Outlet Connection**

**Collector Functionality**

Flat plates absorb the most heat in optimum direct sunlight. They also have the greatest heat losses.
The liquid inside each heat pipe does not “flow through” the rest of the system. Instead, heat exchangers must remove the energy from each pipe.
1) Solar energy is absorbed by the vacuum tube
2) Heat is absorbed by the heat pipe
3) Vapor rises to the top
4) Heat is transferred from each heat pipe

Inside look

Heat transfer within the heat pipe design

Design Comparison

Flat plates and vacuum tube collectors in indirect sunlight

Vacuum tubes reflect much less light than flat plates.

Ritter XL Solar improves that design and captures even more radiation!
Ritter XL Solar Collector Design

Ritter XL Solar Collectors use vacuum tubes with flow-through pipes instead of heat pipes. The tubes are made of double-wall glass that works like a thermos flask.

- Air is evacuated from the area between the tubes to form a vacuum that is an excellent insulator and eliminates heat loss
- Like in a thermos flask, the heat can be stored for a long time
- High water temperatures are possible, even in winter, because heat is not lost to the atmosphere
- A pipe runs through the tube that (unlike the heat pipe design) does not rely on heat exchangers, expansion joints, and thermal seals, increasing reliability and the collection of solar energy
The vacuum tubes are backed by highly reflective parabolic mirrors.

The mirrors catch sunlight from all angles and direct that solar energy into the vacuum tubes.

This helps Ritter XL Solar Collectors achieve the highest output ratings under the widest set of weather conditions and maximize yields in poor weather.

The results are measurable – 91% of the surface of a vacuum tube in a Ritter XL Solar Collector is optically active – compared to no more than 75% optical activity for systems that don’t use reflectors.
Advantages of Parabolic Mirrors (CPC)

This design element allows Ritter XL Solar Collectors to maximize energy capture under varied conditions at any time of the day.

Ritter XL Solar Collectors are designed for the real world, where the sun isn’t always shining brightly directly overhead.

The parabolic mirror ensures that indirect light (like in the morning) and diffuse light (like on cloudy days) are captured efficiently.

Other types of collectors simply cannot do this.
Ritter XL Solar Collector Design

Let’s look inside a Ritter XL Solar Collector.

Water absorbs heat as it passes through U-shaped pipes inside the vacuum tubes.

Vacuum Tube
Absorber Layer (between inner and outer glass tubes)
Heat Transfer Plate
Absorber Pipe
Highly Reflective CPC Mirror
Ritter XL Solar Collector Design

Let’s look inside a Ritter XL Solar Collector.
Ritter XL Solar Collectors puts out 88% more energy than very good flat plate collectors.

* This calculation is based on a solar irradiation of 400 Watts per square meter, which is the mean annual solar irradiation in Mid Europe. An ambient outdoor temperature of 50 °F (10 °C) is used, along with a supply temperature of 158 °F (70 °C).
This graph compares the size of solar collectors needed to heat water to 113°F.

In this example, in an ideal south-facing orientation, you would need a nearly 50% larger area of flat plate collectors to produce the same energy as Ritter XL Solar Collectors.

Flat plates perform worse at offset orientations. When facing east, nearly double the area of flat plates are needed to produce the same amount of energy as Ritter XL Solar Collectors.

Ritter XL Solar Panels outperform flat plates even more when heating higher temperature water!
Most solar thermal systems use glycol as a heat transfer medium. Ritter XL Solar Systems use another liquid that you are probably more familiar with... Water!

Collector output goes a long way toward determining the overall efficiency of a system. However, the advantages of Ritter XL Solar Systems go beyond the collectors.

Water is widely recognized as the best heat transfer medium. Glycol is used in other systems because it doesn’t freeze at 32 °F. Ritter XL Solar introduced the innovative AquaSystem® in 2004 to maximize on water’s advantages and avoid glycol’s disadvantages. Protection against frost is guaranteed with the AquaSystem.

Water in the system does not overheat like glycol, so Ritter XL Solar systems can process heat up to (248 °F) 120 °C!

Market Innovators
Ritter was the first company in the sector to use water as a heat transfer fluid.
### Water vs. Glycol

Let’s compare the basic characteristics of water and glycol at 104 °F (glycol properties are worse at lower temperatures).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Water</th>
<th>Glycol Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Heat Capacity</td>
<td>100%</td>
<td>88%</td>
</tr>
<tr>
<td>Kinetic Viscosity</td>
<td>100%</td>
<td>380%</td>
</tr>
<tr>
<td>Heat Conductivity</td>
<td>100%</td>
<td>62%</td>
</tr>
<tr>
<td>Heat Transfer Coefficient</td>
<td>100%</td>
<td>25%</td>
</tr>
<tr>
<td>Pressure Loss</td>
<td>100%</td>
<td>142 - 485%</td>
</tr>
<tr>
<td>Reynolds Number</td>
<td>100%</td>
<td>25%</td>
</tr>
<tr>
<td>Chemical Durability</td>
<td>Extremely Consistent</td>
<td>Less Consistent (oxidation, cracking, clotting, &amp; separation)</td>
</tr>
<tr>
<td>Gross Price</td>
<td>100%</td>
<td>&gt; 240%</td>
</tr>
<tr>
<td>Purchasing</td>
<td>Water Tap</td>
<td>Retail Market</td>
</tr>
<tr>
<td>Filling</td>
<td>Water Tap</td>
<td>Special Devises</td>
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<tr>
<td>Disposal</td>
<td>Drainage</td>
<td>Dumpsite</td>
</tr>
<tr>
<td>Danger of Freezing</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Operating With Water...

- Is environmentally friendly
- Allows direct connection to the in-house heating network
- Shrinks the diameter of pipes, dramatically reducing the cost of piping and insulation
- Reduces storage tank sizes
- Removes the risk of overheating
- Eliminates the cost of antifreeze and associated running costs
- Considerably reduces the cost and time for installation, commissioning, and repairs
- Ensures a long operation life with almost constant performance
- Minimizes maintenance costs and downtime
- Minimizes running costs in general

Operating With Glycol...

- Reduces the energy production of a solar thermal system by 15% (compared to water)
- Demands larger, more-expensive pipes and insulation
- Requires additional equipment such as heat exchangers, de-aerators, motorized valves, pumps, heat dissipation loops, and controllers (all potential failure points)
- Adds risks associated with thermal stagnation
- Adds the possibility of accidental poisoning

Glycol is an added expense on installation and needs replaced 4 or 5 times over the life of the solar thermal system, costing tens of thousands of dollars.
This line graph shows how water inside the Ritter XL Solar System is kept from freezing.

On nights when temperatures get closer to freezing, the system’s pump cycles on and off to send warmer water into the system. If the temperature drops below the target temperature, the pump will remain on to ensure that the system does not freeze.

Frost detection guaranteed!

The Ritter XL Solar System self-monitors around the clock. If there is a risk of frost, a pump switches on to distribute energy back into the pipes to prevent the system from freezing up. Based on the Frost Protection Algorithm, the pump is activated at regular intervals for a few seconds to maintain temperatures. If the risk of frost increases, so do the intervals.

Self-diagnosing controllers manage Frost Protection, so it happens automatically. A battery backup ensures that the pump will run even in the event of a power failure.

**The AquaSystem® comes with a 10-year guarantee against frost damage!**
In this example, frost Protection only uses 3.5% of the collector’s yield.

That’s a thin slice of pie!

Frost protection makes it possible for the system to use water instead of glycol. Water transfers heat better than glycol, which allows for greater thermal yields (increasing the size of the pie).

More pie!
Controllers in Ritter XL Solar Systems do more than Frost Protection.

Controllers Alert & Correct

- Throughput deficiencies
- Air in the system
- Reversed pipe connections
- Defective or incorrectly-placed sensors
- Losses in pressure
- Power supply issues
- Other operation faults

Controllers Are Accessible Through Web Monitoring

- Graphically display stored measurements and modify controller settings to tailor the system’s output to your needs
- View valve measurements, set-point valves, and output status
- Receive error messages via email
Systems using glycol instead of water need many extra parts. These are the typical fittings found on roofs for heat pipe and flat plate collectors.

Choice of Heat Transfer Fluid Affects Pipe Design
These are the typical fittings found on roofs with Ritter XL Solar Collectors. The AquaSystem® requires simpler piping, lower up-front costs for pipes and fittings, and fewer pieces to maintain.
An important distinction of the Ritter XL Solar System is that it only transfers hot water at the desired temperature. When enough heat has built up in the collector, a pump is switched on and heat is transferred into the water storage tank. The system never delivers lukewarm water to the storage tank - only hot water at the temperature your business requires.

Letting temperatures build up in the solar thermal system allows it to operate like an additional boiler. Year-round supply temperatures up to 248°F (120 °C) are possible.

Water from the tank can be taken directly for high temperature operations or mixed with cooler water to produce lower temperatures. This process increases the amount of hot water that one tank can produce.

Intermittent pump operation saves electrical energy. Compared to conventional systems, approximately 50% of pump running time and pump energy is saved over the year.
Comparing Hot Water Output

How does the Ritter XL Solar System compare to others?

In this example, both systems start with 4.7 kWH of energy.

When the sun rises, both systems hold the same amount of energy.
Comparing Hot Water Output

What happens when the same amount of heat is added to both systems?

Conventional

Water Tank

122°F

72°F

Ritter XL Solar

Water Tank

136°F

131°F

122°F

68°F

Add 2 kWh of solar energy

Add 2 kWh of solar energy

The conventional system provides lots of lukewarm water. The Ritter XL Solar System delivers usable hot water - right from the start!
Better World Energy has reviewed various solar thermal options and decided that the state-of-the-art solar collectors and AquaSystem® offered by Ritter XL Solar are the very best solution.

**Choosing Ritter XL Solar**

- Top quality engineering and design
- Manufactured in Germany
- Reliable results from an industry leader
- Systems functions like a second boiler, delivering the temperature water that you choose (and at higher temperatures than other systems can produce)

**The Sky is the Limit for Ritter XL Solar**

- Thermos-style tube collectors capture heat efficiently
- Through pipes maximize collection and temperature gain
- Highly reflective mirrors increase solar yields
- Water is used as the heat transfer medium
Ritter Group USA is a subsidiary of the Ritter Group, established in Germany in 1988. Ritter is the world’s largest company in the evacuated tube market and an integrated manufacturer with extensive engineering and R&D departments.

Better World Energy is a California Corporation formed in 2010 behind a simple mission — to make the world a better place through better energy sources. We represent Ritter Group USA for installations of Ritter XL Solar Thermal Systems.