

SOLAR Hot Water STORAGE

Residential Tanks with Integrated Heat Exchangers

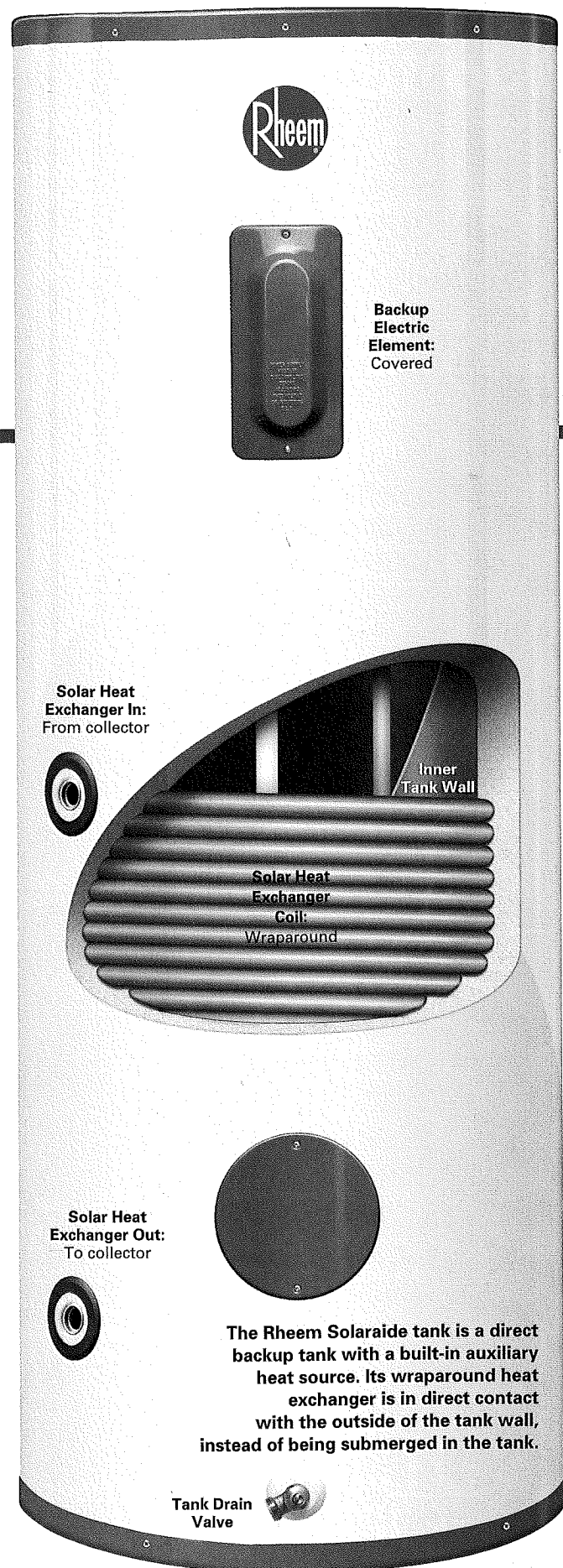
by Brian Mehalic

A critical component of a solar thermal system is the storage tank—essentially a “Btu battery” where heat energy is stored. Storage allows the system to provide hot water at any time of day, whether the sun is shining or not, since solar production typically does not coincide with the peak periods of hot water demand, usually mornings and evenings.

The amount of storage needed depends on the number and habits of those using the hot water. For domestic solar hot water production, storage tanks usually range in size from 60 to 120 gallons. And since most people don’t want to have to take cold showers during long, cloudy spells, tanks are commonly paired with a backup heat source, either electric or gas.

Integrated Heat Exchangers

There are numerous types of solar hot water systems but most use heat exchangers (see “Solar Hot Water Simplified” in *HP107* and “Solar Hot Water: A Primer” in *HP84*). Usually, and nearly always in climates with the potential for freezing, domestic/potable water does not go through the solar collector loop—instead, a heat transfer fluid (HTF), usually propylene glycol or distilled water, is used in a closed-loop solar circuit. The HTF is pumped through the collectors, where it picks up heat, and then flows through a heat exchanger, where that heat is transferred to the water stored in the tank. Often the heat exchanger is integrated into the storage tank, either as coils submerged in the water, or wrapped around and in contact with exterior of the tank wall (see “Fundamentals of Solar Heat Exchangers” in *HP128*).

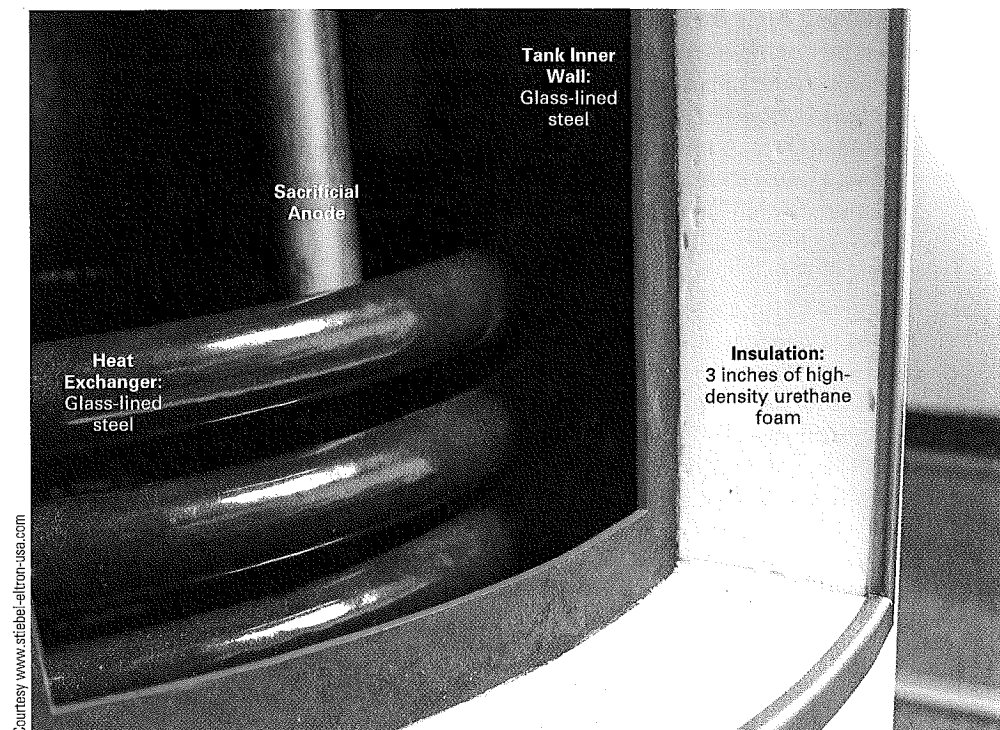


The Rheem Solaraide tank is a direct backup tank with a built-in auxiliary heat source. Its wraparound heat exchanger is in direct contact with the outside of the tank wall, instead of being submerged in the tank.

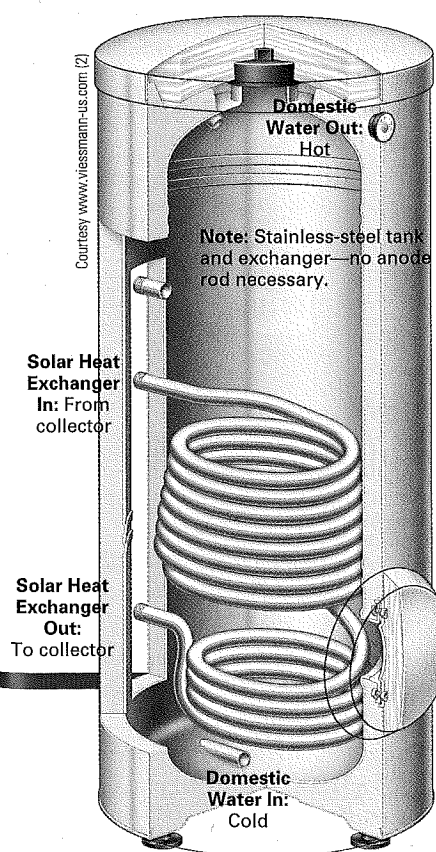
System Applicability
Storage tanks with integrated heat exchangers come in many varieties suitable for a range of applications. Many have an integrated backup heat source—typically one or more electric elements—or else have additional heat exchangers for a boiler or other external water heater.

These tanks are well suited for closed-loop glycol systems or, when paired with an external reservoir tank, for single-pump drainback systems. Additionally, they can function as a drainback tank, with the HTF filling the tank and fluid from a space-heating system circulating through the exchanger, picking up heat.

A Critical Distinction
Heat exchangers are either single- or double-walled, and this is a very important factor in choosing the



A cutaway view of a Stiebel Eltron glass-lined tank with a submerged, glass-lined heat exchanger.

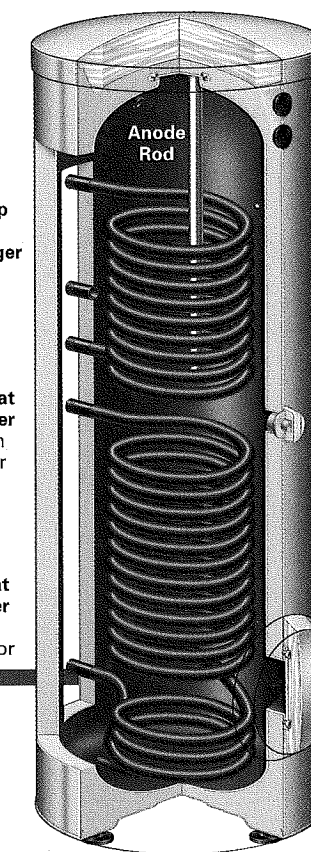


appropriate tank. A single-walled exchanger is typically a coil of pipe submerged in the tank, with only one thickness of pipe wall between the HTF and potable water. A double-wall exchanger adds a second layer of pipe to reduce the likelihood of contamination of potable water by the HTF. Double-wall exchangers will also often have airspace between the two walls. The airspace is typically filled with a thermally conductive paste but is not sealed—so if a leak occurs, fluid will accumulate and then drip out, providing a visual indication of the leak.

The 2006 Uniform Solar Energy Code requires the extra “layers” in a double-wall exchanger. Other plumbing codes are less clear, with some permitting

Left: This Veissmann storage-only tank has no integrated backup heat source.

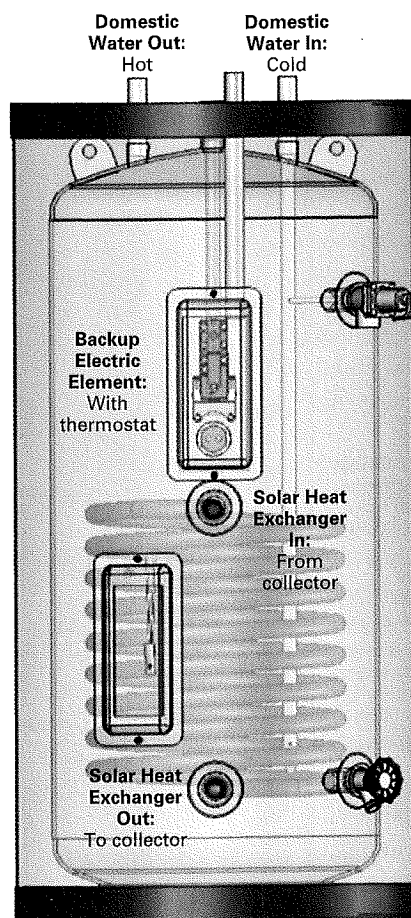
Right: A Veissmann indirect backup tank with two heat exchangers: a lower unit for solar and an upper exchanger for backup.



single-wall exchangers when using HTFs that are generally recognized as nontoxic. Although propylene glycol is generally recognized as safe by the U.S. Food and Drug Administration and is used as a food additive, it is impossible to guarantee that the highly toxic and more readily available ethylene glycol (a common automotive antifreeze) won't be added to the system at some point. There have been many instances of old drainback systems being "serviced" and ending up with an unknown type of glycol in them. The codes used by your local jurisdiction will determine which type of exchanger you must use. Replumbing is no fun, and tanks are expensive, so contact your inspector and do your research before you buy.

Tank Types

There are three main types of tanks with built-in heat exchangers: storage-only, indirect backup, and direct backup. Several models can fit into multiple categories.



Storage-only is the most basic type of integrated heat exchanger tank. Commonly referred to as indirectly heated, these tanks have a single heat exchanger—often a coil submerged in the lower half of the tank. Heated fluid—either from solar collectors, or in another common application, a boiler—passes through the heat exchanger and warms the water in the tank. When used in a solar thermal system, a backup source—either a second water heater tank or an instantaneous water heater capable of receiving preheated water—would be added (see "Sizing Solar Hot Water Systems" in *HP118*).

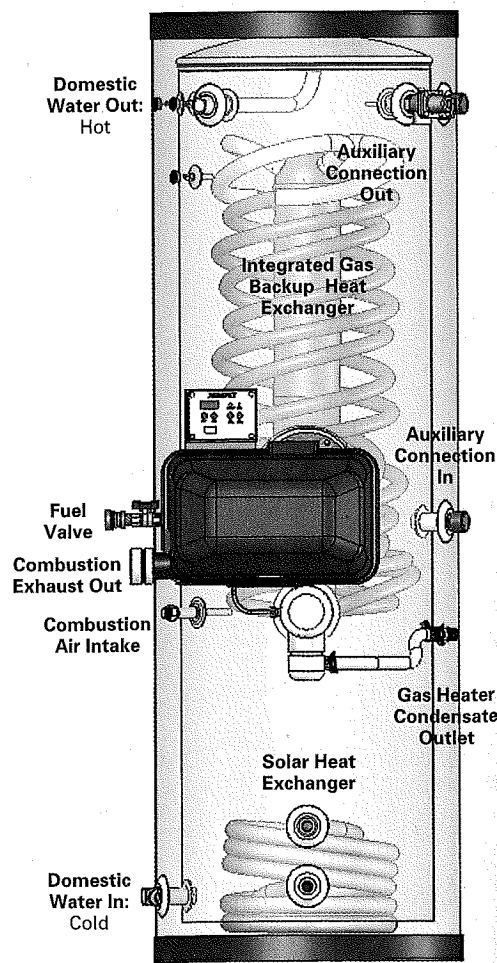
Indirect backup tanks have two heat exchangers: one in the bottom of the tank and another in the upper portion of the tank. The bottom exchanger is for the heated incoming solar fluid, while the upper heat exchanger introduces heat from a boiler or other backup source. As such, they are a popular choice for systems that already have a boiler for space heating. The second, upper coil can also be plumbed differently and utilized in other ways: instead of receiving heat from a boiler, it can supply heat to a radiant floor loop, or to a recirculating loop to keep hot water always available at the tap. The upper loop could also be used as a heat dump, sending heat to an auxiliary load such as a hot tub, pool, or buried coil to prevent the tank from overheating during high-temperature, low-use periods. Additional pumps and controllers would be required for these configurations.

Direct backup tanks have an auxiliary heat source built into the tank, allowing them to function as single-tank systems (see "Single-Tank Solar Water Systems" in *HP124*). Most often the backup consists of one or two electric elements—though there is at least one model that combines an integrated exchanger with a gas backup system in a single tank.

Left: A common submerged heat exchanger with direct electric element backup by Heat Transfer Products.

Right: Heat Transfer Products' Phoenix Ultra is a unique combination of a solar heat exchanger with integrated gas backup, and an auxiliary connection for air handlers or radiant heating.

Standard electric-only hot water tanks usually have two electric elements: one in the upper part of the tank and one in the lower—thereby, increasing the amount of water that is heated directly. But many solar tanks with direct electric backup only have a single element, located in the upper third of the tank, which only heats 20 to 40 gallons of water. While a single element will use less electricity than a double-element tank, it will also provide less backup capacity and take longer to heat. This detail is sometimes overlooked until the user ends up taking a cold shower during a period of little sun, and should be a strong consideration if hot water use tends to be concentrated, such as multiple showers taken in succession. For systems with high demand, several tanks feature *multiple* backup options—either two electric elements or an electric element paired with a second heat exchanger loop for indirect boiler backup.



Understanding the Tables

The solar thermal industry has experienced a renaissance in recent years. As was the case in the late 1970s and early 1980s, there are many manufacturers offering a wide range of components and prepackaged systems. If you want to design your own system, choosing from the range of tanks, collectors, and components available, you must have a thorough understanding of how these parts function and integrate.

Often, the type of tank will be dictated by other factors such as boilers or hot water tanks that are already in service; the availability of backup energy sources; and the type of freeze protection utilized in the solar loop. System demand also plays a key role in determining tank size, further narrowing the number of tanks to select from. Tanks are listed in the table by type (storage-only, indirect, and direct backup), and then by manufacturer and capacity. The specifications featured are current as of this writing, but it is always wise to verify specs with the manufacturer before purchasing.

Tank Material

Glass or enamel-coated steel is the most common tank material, both for solar tanks and hot water tanks in general. Most manufacturers have proprietary names and techniques for their coating processes, such as Vitraglas or Thermoglaze. Coated steel is the most economical tank material, but all coated surfaces have imperfections, which can worsen during shipping and handling. So all the glass- or enamel-lined tanks in the charts include sacrificial anode rods. These magnesium or aluminum rods are typically threaded into the tank from the top, and offer a surface that is more prone to corrosion by waterborne copper particulates than the wall of the tank. The anode will have to be disintegrated before the tank wall suffers any corrosion, and, depending on water quality, should be replaced every five to 10 years. (See "Extending Tank Life: Anode Rods" sidebar.)

Another popular—although expensive—option is stainless steel. Often approaching twice the cost of coated steel, stainless tanks come with a longer warranty, weigh a little less, and do not require anode rods because of their inherent resistance to corrosion and mineral buildup. Stainless tanks typically have higher maximum temperature ratings, and are considered to be hygienic, since the lack of pores or cracks discourages the buildup of microorganisms, which can occur in lined tanks that have suffered corrosion.

Stone-lined tanks are another time-tested choice, though perhaps currently less popular. The stone liner absorbs water and holds it as an inert, noncorrosive layer against the steel tank wall. The cost is comparable to other lined tanks, but tanks may weigh up to 1.5 times more than glass-lined tanks, potentially increasing shipping costs.

Another tank material, though not available on any of the tanks in the following charts, is polybutene or polybutylene, a type of plastic used to make seamless tanks that are impervious to rust and corrosion.

Extending Tank Life: Anode Rods

All coatings used on steel tanks have imperfections and they get worse from rough handling, like during shipping. Once water finds its way through the imperfections to the steel wall, corrosion begins. To resist corrosion, lined steel tanks (not stainless or titanium) benefit from the addition of a sacrificial anode rod. The anode rod gives any copper in the system (from home piping) the chance to attack it instead of the steel lining. Only after the anode rod has disintegrated does the copper go to work on the steel tank through the imperfections. Most anode rods are made of magnesium—which, depending on the water quality, may give water an unpleasant odor. In these situations, aluminum is typically substituted.

Anode rods all have life spans that are dependent on local water quality. In some cases, even with hard water, lined steel tanks last for 25 years. (Albuquerque is one place—my solar storage tank is 24 years old.) In other locations, their life span can be 10 to 15 years. Anode rod replacement every five to 10 years extends the life of any lined steel tank—perhaps indefinitely if the rod is always replaced before the previous one is completely gone.

—Chuck Marken

Heat Exchanger Specs

Note that the listed specifications are for the *solar* heat exchanger in the lower loop *only*, as it is the common component between the tank types. For indirect backup tanks with two heat exchangers, the second, *boiler* exchanger in the upper loop is usually the same size or slightly smaller. Manufacturers specify ratings for backup heat sources in Btu per hour.

The majority of heat exchangers are submerged coils, directly immersed in the lower section of the tank, and most of these are single-wall. Typically, exchangers with a higher surface area-to-volume ratio will perform better (assuming the total surface area is similar). This is not the case with double-wall exchangers, which usually have less volume at the same exterior dimensions, equaling a higher ratio, but are less efficient than comparably sized single-wall versions.

Wraparound exchangers that are not submerged, but are in contact with the exterior of the tank wall, are harder to compare, but their efficiency most closely approximates that of a submerged, double-wall exchanger.

System design is a significant factor in how efficiently any exchanger will perform—if the pump circulates too fast or too slow, the collectors will not be able to deliver their maximum heating capability. Likewise, if the collector-to-storage ratio is not properly sized, systems can overheat or, conversely, not reach a high enough temperature to prevent backup heaters from turning on.

(continued on page 78)

Solar Storage Tank Specifications:

Storage-Only & Indirect Backup

Storage-Only	Model	Tank Capacity (Gal.)	Tank Material	Heat Exchanger (Hx) Type	Hx Material	Hx Walls	Hx Volume (Gal.)	Hx Surface Area (Ft.2)	Hx Surface-to-Volume Ratio
Bradford White www.bradfordwhite.com	PowerStor SW-2-65-L	60	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	PowerStor SW-2-80-L	75	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	PowerStor SW-2-120-L	116	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	PowerStor 2 DW-2-65-L	64	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	PowerStor 2 DW-2-80-L	75	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	PowerStor SS RTV-75-L	75	Stainless	Submerged Coil	Stainless	Single	1.60	10.0	6.25
	PowerStor SS RTV-119-L	119	Stainless	Submerged Coil	Stainless	Single	4.60	21.3	4.63
Stiebel Eltron www.stiebel-eltron-usa.com	SB 150 S	39	Enamel	Submerged Coil	Enamel-Coated Steel	Single	1.90	12.1	6.37
	SB 200 S	52	Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.70	14.3	5.30
	SBB 300 S	81	Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.70	16.1	5.96
	SBB 400 S	109	Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.90	18.3	6.31
Viessmann www.viessmann-us.com	Vitocell-V 100 CVA-200	53	Ceraprotect Enamel	Submerged Coil	Enamel-Coated Steel	Single	1.45	10.8	7.45
	Vitocell-V 100 CVA-300	79	Ceraprotect Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.60	16.1	6.19
	Vitocell-V 100 CVA-450	125	Ceraprotect Enamel	Submerged Coil	Enamel-Coated Steel	Single	3.30	20.5	6.21
	Vitocell-V 300 EVI-200	53	Stainless	Submerged Coil	Stainless	Single	2.64	14.0	5.30
	Vitocell-V 300 EVI-300	79	Stainless	Submerged Coil	Stainless	Single	2.91	16.0	5.50
	Vitocell-V 300 EVI-450	125	Stainless	Submerged Coil	Stainless	Single	4.00	20.5	5.13

# of Hx	Hx Max. Pressure & Temp.	Tank R-Value	Standby Losses (Btu/Day)	Backup Source	Water Connection (In.)	Hx Connection (In.)	Cold Water Inlet	Size Diam. x H (In.)	Weight (Lbs.)	Price	Warranty (Yrs.)	Made In
1	150 psi 240°F	R-16	9,613	—	3/4	1	Top	22 x 60	196	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	9,013	—	3/4	1	Top	24 x 60	224	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	9,293	—	3/4	1	Top	29 x 64	355	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	8,973	—	3/4	3/4	Top	22 x 60	196	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	9,013	—	3/4	3/4	Top	24 x 60	224	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	7,510	—	3/4	3/4	Bottom	24 x 64	117	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 240°F	R-16	14,300	—	1 1/4	1	Bottom	31 x 60	315	Unstated	Life, Tank & Hx; 6, Parts	USA
1	150 psi 203°F	R-14	6,500	—	3/4	3/4	Bottom	21 x 51	190	\$1,083	5, Unlimited	Slovakia
1	150 psi 203°F	R-14	4,434	—	3/4	3/4	Bottom	21 x 63	226	1,219	5, Unlimited	Slovakia
1	150 psi 203°F	R-14	6,500	—	1 In. Adapter	1 In. Adapter	Bottom	28 x 67	292	1,904	5, Unlimited	Germany
1	150 psi 203°F	R-14	7,500	—	1 In. Adapter	1 In. Adapter	Bottom	30 x 73	371	2,063	5, Unlimited	Germany
1	150 psi 230°F	R-10	5,800	—	3/4	1	Bottom	24 x 56	214	1,727	8, Unlimited	Germany
1	150 psi 230°F	R-10	7,500	—	1	1	Bottom	28 x 69	333	1,994	8, Unlimited	Germany
1	150 psi 230°F	R-10	9,600	—	1 1/4	1	Bottom	36 x 77	399	2,503	8, Unlimited	Germany
1	220 psi 392°F	R-18	5,500	—	1	1	Bottom	26 x 56	168	3,595	Residential Lifetime	Germany
1	220 psi 392°F	R-18	6,800	—	1	1	Bottom	28 x 70	220	5,197	Residential Lifetime	Germany
1	220 psi 392°F	R-18	9,200	—	1 1/4	1 1/4	Bottom	39 x 70	245	6,335	Residential Lifetime	Germany

Indirect Backup	Model	Tank Capacity (Gal.)	Tank Material	Heat Exchanger (Hx) Type	Hx Material	Hx Walls	Hx Volume (Gal.)	Hx Surface Area (Ft.2)	Hx Surface-to-Volume Ratio
Bradford White www.bradfordwhite.com	EcoStor S-DC-DW2-55R6SW	55	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	EcoStor S-DC-DW2-70R6SW	70	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	EcoStor S-DC-DW2-110R6SW	110	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	PowerStor SS RTV-75D-L	75	Stainless	Submerged Coil	Stainless	Single	1.15	7.6	6.61
Buderus www.buderussolar.net	Logalux SM300	77	Thermoglaze	Submerged Coil	Thermoglaze Steel	Single	2.00	13.0	6.50
	Logalux SM400	103	Thermoglaze	Submerged Coil	Thermoglaze Steel	Single	2.50	14.0	5.60
Heat Transfer Products www.htproducts.com	Superstor Contender SSC-50SB	50	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Superstor Contender SSC-80SB	80	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Superstor Contender SSC-119SB	119	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
Stiebel Eltron www.stiebel-eltron-usa.com	SBB 300 Plus	81	Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.70	16.1	5.30
	SBB 400 Plus	109	Enamel	Submerged Coil	Enamel-Coated Steel	Single	2.90	18.3	5.96
	SBB 600 Plus	163	Enamel	Submerged Coil	Enamel-Coated Steel	Single	3.50	26.9	7.69
Viessmann www.viessmann-us.com	Vitocell-B 100 CVB-300	79	Ceraprotect Enamel	Submerged Coil	Stainless	Single	2.60	16.1	6.19
	Vitocell-B 100 CVB-450	125	Ceraprotect Enamel	Submerged Coil	Stainless	Single	3.60	20.5	5.69
	Vitocell-B 300 EVB-300	79	Stainless	Submerged Coil	Stainless	Single	2.90	16.1	5.55
	Vitocell-B 300 EVB-450	125	Stainless	Submerged Coil	Stainless	Single	3.90	20.5	5.26

# of Hx	Hx Max. Pressure & Temp.	Tank R-Value	Standby Losses (Btu/Day)	Backup Source	Water Connection (In.)	Hx Connection (In.)	Cold Water Inlet	Size Diam. x H (In.)	Weight (Lbs.)	Price	Warranty (Yrs.)	Made In
2	150 psi 250°F	R-16	12,117	2nd Hx (Boiler Loop)	3/4	1	Top	22 x 60	210	Unstated	6, Tank & Parts	USA
2	150 psi 250°F	R-16	12,618	2nd Hx (Boiler Loop)	3/4	1	Top	24 x 60	236	Unstated	6, Tank & Parts	USA
2	150 psi 250°F	R-16	15,422	2nd Hx (Boiler Loop)	3/4	1	Top	29 x 63	340	Unstated	6, Tank & Parts	USA
2	150 psi 240°F	R-16	7,511	2nd Hx (Boiler Loop)	3/4	3/4	Bottom	24 x 64	130	Unstated	Life, Tank & Hx; 6, Parts	USA
2	232 psi 320°F	R-12	7,200	2nd Hx (Boiler Loop)	C: 1 1/4, H: 1	1	Bottom	27 x 58	317	\$2,200	Limited Lifetime	Germany
2	232 psi 320°F	R-14	9,600	2nd Hx (Boiler Loop)	C: 1 1/4, H: 1	1	Bottom	34 x 61	445	3,200	Limited Lifetime	Germany
2	150 psi 180°F	R-17	<5,007	2nd Hx (Boiler Loop)	3/4	1	Top	23 x 47	187	1,275	7, Limited	USA
2	150 psi 180°F	R-17	<8,011	2nd Hx (Boiler Loop)	1 1/2	1	Top	23 x 72	286	1,528	7, Limited	USA
2	150 psi 180°F	R-17	<11,917	2nd Hx (Boiler Loop)	1 1/2	1	Top	27 x 64	367	1,888	7, Limited	USA
2	150 psi 203°F	R-14	6,500	2nd Hx (Boiler Loop)	1 In. Adapter	1 In. Adapter	Bottom	28 x 67	339	2,177	5, Unlimited	Germany
2	150 psi 203°F	R-14	7,500	2nd Hx (Boiler Loop)	1 In. Adapter	1 In. Adapter	Bottom	30 x 73	412	2,360	5, Unlimited	Germany
2	150 psi 203°F	R-14	10,000	2nd Hx (Boiler Loop)	1 In. Adapter	1 In. Adapter	Bottom	37 x 69	544	3,636	5, Unlimited	Germany
2	150 psi 320°F	R-10	7,800	2nd Hx (Boiler Loop)	1	1	Bottom	28 x 69	352	2,836	8, Limited	Germany
2	150 psi 320°F	R-10	9,500	2nd Hx (Boiler Loop)	1 1/4	1	Bottom	36 x 77	452	4,159	8, Limited	Germany
2	220 psi 392°F	R-18	7,200	2nd Hx (Boiler Loop)	1	1	Bottom	28 x 70	251	5,532	Residential Lifetime	Germany
2	220 psi 392°F	R-18	9,200	2nd Hx (Boiler Loop)	1 1/4	1 1/4	Bottom	39 x 65	275	6,648	Residential Lifetime	Germany

Solar Storage Tank Specifications:

Direct Backup & Multiple Backup

Direct Backup

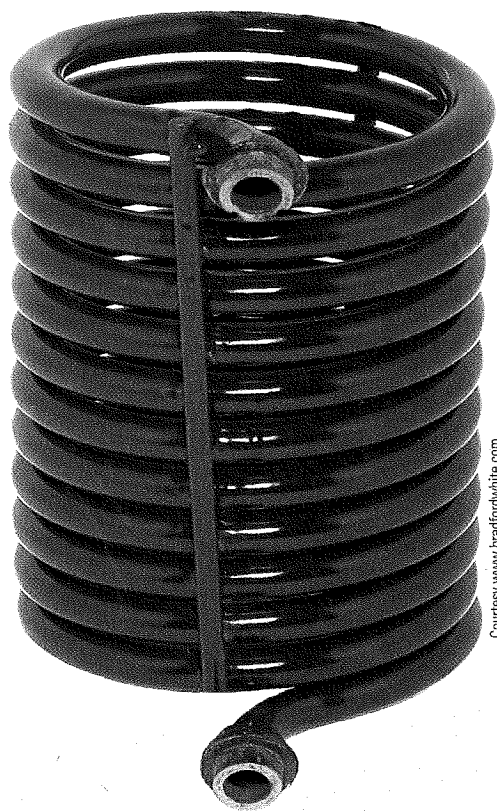
	Model	Tank Capacity (Gal.)	Tank Material	Heat Exchanger (Hx) Type	Hx Material	Hx Walls	Hx Volume (Gal.)	Hx Surface Area (Ft.2)	Hx Surface-to-Volume Ratio
Bradford White www.bradfordwhite.com	EcoStor SC S-SW2-60R6DS	60	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	EcoStor SC S-SW2-75R6DS	75	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	EcoStor SC S-SW2-115R6DS	115	Vitraglas	Submerged Coil	Glass-Coated Steel	Single	2.50	14.2	5.68
	EcoStor SC S-DW2-60R6DS	60	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	EcoStor SC S-DW2-75R6DS	75	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
	EcoStor SC S-DW2-115R6DS	115	Vitraglas	Submerged Coil	Glass-Coated Steel	Double	2.50	14.2	5.68
Heat Transfer Products www.htproducts.com	Superstor Contender SSC-50SE	50	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Superstor Contender SSC-80SE	80	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Superstor Contender SSC-119SE	119	Enamel	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Phoenix Ultra PH-80S	80	Stainless	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
	Phoenix Ultra PH-119S	119	Stainless	Submerged Coil	Cupronickel	Single	2.00	15.0	7.50
Rheem www.rheem.com	Solaraide HE 81V80HE-1	80	Rheemglas	Wraparound	Copper	Double	2.20	3/4 In. x 120 Ft. Tank Contact	—
	Solaraide HE 81V120HE-1	120	Rheemglas	Wraparound	Copper	Double	2.20	3/4 In. x 120 Ft. Tank Contact	—
Thermomax / K-TAM www.solarthermal.com	Solar Super Tank SST 60	60	Stainless	Submerged Coil	Stainless	Either	1.36	7.9	5.61
	Solar Super Tank SST 80	80	Stainless	Submerged Coil	Stainless	Either	2.04	9.8	4.91
	Solar Super Tank SST 119	119	Stainless	Submerged Coil	Stainless	Either	2.04	9.8	4.91
Vaughn www.vaughncorp.com	S65SRWHX 2045	65	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S80SRWHX 2045	80	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S120SRWHX 204545	119	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S65SRWHX 4045	65	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S80SRWHX 4045	80	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S120SRWHX 404545	119	Hydrastone	Flanged, Removable	Copper	Either	0.20	20 ft2, Submerged, Finned	—

Multiple Backup

	Model	Tank Capacity (Gal.)	Tank Material	Heat Exchanger (Hx) Type	Hx Material	Hx Walls	Hx Volume (Gal.)	Hx Surface Area (Ft.2)	Hx Surface-to-Volume Ratio
Thermomax / K-TAM www.solarthermal.com	Solar Super Tank SST 60 DB	60	Stainless	Submerged Coil	Stainless	Either	1.36	7.9	5.61
	Solar Super Tank SST 80 DB	80	Stainless	Submerged Coil	Stainless	Either	2.04	9.8	4.91
	Solar Super Tank SST 119 DB	120	Stainless	Submerged Coil	Stainless	Either	2.04	9.8	4.91
	Solar Super Tank SST 119 TC	120	Stainless	Submerged Coil	Stainless	Either	2.72	17.7	6.54
	Solar Super Tank SST 80DB OG	80	Stainless	Submerged Coil	Stainless	Either	1.36	7.9	5.61
	Solar Super Tank SST 119DB OG	120	Stainless	Submerged Coil	Stainless	Either	2.72	13.1	4.85
Vaughn www.vaughncorp.com	S80SRWHX 4045TB	80	Hydrastone	Flanged, Removable	Finned Copper	Either	0.20	20 ft2, Submerged, Finned	—
	S120SRWHX 404545TB	119	Hydrastone	Flanged, Removable	Finned Copper	Either	0.20	20 ft2, Submerged, Finned	—

# of Hx	Hx Max. Pressure & Temp.	Tank R-Value	Standby Losses (Btu/Day)	Backup Source	Water Connection (In.)	Hx Connection (In.)	Cold Water Inlet	Size Diam. x H (In.)	Weight (Lbs.)	Price	Warranty (Yrs.)	Made In
1	150 psi 250°F	R-16	13,218	1 or 2 4,500 W Electric	3/4	1	Top	22 x 60	210	Unstated	6	USA
1	150 psi 250°F	R-16	13,519	1 or 2 4,500 W Electric	3/4	1	Top	24 x 60	236	Unstated	6	USA
1	150 psi 250°F	R-16	16,123	1 or 2 4,500 W Electric	3/4	1	Top	29 x 63	340	Unstated	6	USA
1	150 psi 250°F	R-16	13,218	1 or 2 4,500 W Electric	3/4	1	Top	24 x 60	210	Unstated	6	USA
1	150 psi 250°F	R-16	13,519	1 or 2 4,500 W Electric	3/4	1	Top	24 x 60	236	Unstated	6	USA
1	150 psi 250°F	R-16	16,123	1 or 2 4,500 W Electric	3/4	1	Top	29 x 63	340	Unstated	6	USA
1	150 psi 180°F	R-17	<5,007	4,500 W Electric	3/4	1	Top	23 x 47	175	\$1,097	7, Limited	USA
1	150 psi 180°F	R-17	<8,077	4,500 W Electric	1 1/2	1	Top	23 x 72	237	1,350	7, Limited	USA
1	150 psi 180°F	R-17	<11,917	4,500 W Electric	1 1/2	1	Top	27 x 64	336	1,711	7, Limited	USA
1	150 psi 180°F	R-17	<8,011	130 KBtu or 199 KBtu Gas	1 1/2	1	Bottom	36 x 72	245	5,512-6,229	7, Limited	USA
1	150 psi 180°F	R-17	<11,917	130 KBtu or 199 KBtu Gas	1 1/2	1	Bottom	40 x 74	415	5,967-6,670	7, Limited	USA
1	150 psi 185°F	R-17	6,600	4,500 W Electric	3/4	3/4	Top	25 x 69	222	Unstated	6	Mexico
1	150 psi 185°F	R-17	7,800	4,500 W Electric	3/4	3/4	Top	29 x 62	380	Unstated	6	Mexico
1	150 psi 175°F	R-18	<12,017	1-in. Electric Port	3/4	1	Bottom	27 x 66	200	2,739	10	Canada
1	150 psi 175°F	R-18	<16,022	1-in. Electric Port	1	1 1/4	Bottom	27 x 77	230	3,231	10	Canada
1	150 psi 175°F	R-18	<23,833	1-in. Electric Port	1 1/4	1 1/4	Bottom	33 x 77	360	4,113	10	Canada
1	500 psi 180°F	R-16	<4,296	4,500 W Electric	3/4	3/4	Bottom	26 x 47	271	1,600	7	USA
1	500 psi 180°F	R-16	<5,287	4,500 W Electric	3/4	3/4	Bottom	26 x 58	321	1,800	7	USA
1	500 psi 180°F	R-16	<7,865	2 4,500 W Electric	3/4	3/4	Bottom	28 x 68	408	2,200	7	USA
2 Lower	500 psi 180°F	R-16	<4,296	4,500 W Electric	3/4	3/4	Bottom	26 x 47	271	2,400	5	USA
2 Lower	500 psi 180°F	R-16	<5,287	4,500 W Electric	3/4	3/4	Bottom	26 x 58	321	2,600	5	USA
2 Lower	500 psi 180°F	R-16	<7,865	2 4,500 W Electric	3/4	3/4	Bottom	28 x 68	408	3,200	5	USA

# of Hx	Hx Max. Pressure & Temp.	Tank R-Value	Standby Losses (Btu/Day)	Backup Source	Water Connection (In.)	Hx Connection (In.)	Cold Water Inlet	Size Diam. x H (In.)	Weight (Lbs.)	Price	Warranty (Yrs.)	Made In
2	150 psi 175°F	R-18	<12,016	2nd Hx + 1-in. Electric Port	3/4	1	Bottom	27 x 66	194	\$3,167	10	Canada
2	150 psi 175°F	R-18	<16,022	2nd Hx + 1-in. Electric Port	1	1 1/4	Bottom	27 x 77	215	3,589	10	Canada
2	150 psi 175°F	R-18	<24,034	2nd Hx + 1-in. Electric Port	1 1/4	1 1/4	Bottom	33 x 77	380	4,677	10	Canada
3	150 psi 175°F	R-18	<24,034	2 Hx + 2. 1-in. Electric Ports	1 1/4	1 1/4	Bottom	33 x 77	380	5,634	10	Canada
2	150 psi 175°F	R-18	<16,022	2nd Hx + 2. 1-in. Electric Ports	1 1/4	1	Bottom	27 x 77	260	4,113	10	Canada
2	150 psi 175°F	R-18	<24,034	2nd Hx + 2. 1-in. Electric Ports	1 1/4	1 1/4	Bottom	33 x 77	360	5,106	10	Canada
2	500 psi 180°F	R-16	<5,287	2nd Hx + 4,500 W Electric	3/4	3/4	Bottom	26 x 58	321	2,800	5	USA
2	500 psi 180°F	R-16	<7,865	2nd Hx + 2 4,500 W Electric	3/4	3/4	Bottom	28 x 68	408	3,400	5	USA



Courtesy www.bradfordwhite.com

A glass-coated heat exchanger coil by Bradford White.

Maximum Pressure & Temperature

Nearly all tanks are tested to at least 300 psi and rated for 150 psi working pressure on the water side. The temperature and pressure-relief valve (required both by code and manufacturer's instructions) offers protection against the tank overheating or exceeding its working pressure rating. Ratings for heat exchangers have a much wider range, with some models capable of withstanding significantly higher pressures and temperatures. In high-temperature conditions, glycol systems often need to circulate the heat-transfer fluid to avoid stagnation and overheating.

Insulation R-Value, Standby Losses

Once you've captured the solar energy in the tank, you immediately begin to lose it through the tank walls—eventually triggering backup heating systems. Most of the tanks listed here are well-insulated; those that lose fewer Btu per day are better insulated. Manufacturers publish standby losses either in Btu per day or °F per hour. To facilitate comparison, all °F per hour loss figures have been converted to Btu per day.

Port Sizes & Location

Most of these tanks use standard-sized fittings, though some include adapters to transition from metric ports (particularly those manufactured abroad). Replacement adapters can be difficult to come by, so before beginning the installation, always verify that all the fittings listed on the tank installation guide are provided. Manufacturers may also supply additional fittings with their tanks, such as temperature and

pressure-relief valves, dielectric unions, and thermowells for thermometers. These fittings are not listed in the table, but since they are often needed, their additional cost can be significant. Tank manufacturers provide schematics showing what fittings are required, as well as a listing of what is included with the tank.

High demand/flow systems can require pipe sizes larger than the typical $\frac{3}{4}$ inch, and many of these tanks do have larger connections on both the water and heat exchanger ports. However, you may end up using quite a few copper reducer bushings and spending extra time if everything is plumbed in $\frac{3}{4}$ inch, and your tank comes with larger ports.

Heat exchanger connections are normally located on the lower sidewall of the tank, with the input port (from collector) about midtank, in line with but above the output to the collector. If the tank has a second heat exchanger, its ports are usually on the same side as the solar exchanger ports. Many of these tanks have cold-supply connections located on or near the bottom of the tank, unlike the majority of non-solar tanks. Plan accordingly so you don't end up with a circuitous piping layout.

Size & Weight

Moving a 120-gallon tank with two heat exchangers is no easy task. Even empty, these larger tanks can weigh more than 300 pounds. Placing the tank is also the most likely time for damage to occur, so consider your lifting plan and space constraints carefully. When replacing an existing tank, remember that solar storage tanks are somewhat larger than standard tanks and may require more room.

Warranty

All warranties are not created equal, so read the fine print. Warranties differ for residential and commercial applications, and include specific requirements for code compliance and installation. Most offer repair or replacement for a defect, but warranties may be void if it is proven that the maximum pressure and/or temperature ratings were exceeded. In some cases, the warranty is only valid for the original owner and cannot be transferred.

Access

Brian Mehalic (brian@solarenergy.org) is a NABCEP-certified PV installer, with experience designing, installing, and servicing PV, thermal, wind, and water-pumping systems. He instructs and develops curricula for Solar Energy International and lives in Prescott, Arizona.

Further Reading:

- "Solar Hot Water: A Primer," by Ken Olson, *HP84*
- "Solar Hot Water Simplified," by John Patterson, *HP107*
- "Sizing Solar Hot Water Systems," by Carl Bickford, *HP118*
- "Simplifying Solar Thermal," by Dan Gretsche, *HP124*
- "Single-Tank Solar Water Systems," by John Patterson, *HP124*
- "Solar Water Heating Systems Buyer's Guide," by Chuck Marken, *HP125*
- "Fundamentals of Solar Heat Exchangers," by Chuck Marken, *HP128*

