EnergyIdeas Clearinghouse

Energy Efficiency FACTSHEET

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What Goes into an Energy-Efficient Spa or Hot Tub?

(Besides a happy owner)

This factsheet provides information to prospective and current owners about the features of an energy-efficient spa – also called a hot tub – so they can make informed decisions when they are ready to buy or upgrade.

Many people start out purchasing a spa with the lowest retail price. Often this has an immediate and profoundly negative effect on their monthly electric bill. Fortunately, there are features that buyers can consider that will reduce energy use and lower their operating costs.

There were approximately 3.4 million portable spas[1] in the U.S. in 2000 according to the National Spa and Pool Institute. These spas consume an average of 2,514 kWh per year, making the average cost of heating the spa more than $250 a year (at 10 cents/kWh). According to a spa study by the Davis Energy Group,[2] if you own a spa, it is the biggest electrical consumer in the house.

Until recently, unbiased information on spa energy use was very difficult to find. Consumers Union (publisher of *Consumer Reports*®) has not rated spas. After a careful search we were able to find one study, *Thermal Performance Test of Spas*,[3] from which test data is shown in Table 1 (see page 3).

California, with about 1/8 of the hot tubs in the U.S., now regulates spa energy use (Title 20, Appliance Efficiency Regulations). As a result, a hot tub testing program[4] is underway at California Polytechnic University (Cal Poly). *We will update this factsheet with the results as they become available* (see www.energyideas.org/pubs.aspx). Other states are considering similar standards and, while the new California standard is not especially stringent, in the future it should eliminate the least efficient spas and provide a consistent standard by which to compare spas on the market.

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How Spas and Hot Tubs Use Energy

To understand how to reduce operating costs, it's a good idea to know how spas and hot tubs use energy. They typically use electric energy to heat and continuously circulate the water, and a very small amount of electricity for lighting. Over 95% of the time tubs are covered and unused, yet this is when 75% of their energy use occurs. Thus, energy conservation starts with a good look at this "steady state" mode and at reducing heat losses from the cover and walls. While most of the energy used in spas goes into the heater, the energy used for pumping is also significant.

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When the cover is removed and the tub is being used, heat losses increase six-fold or more. If the jets are activated and a couple of people get into the tub, evaporative heat losses from the surface increase even further, and pumps for the high-speed jets use many times the energy of circulating pumps. If an air pump or bubbler is activated, heat losses increase beyond the capacity of most heaters and water temperatures begin to drop.

Features to Consider When Choosing a Spa or Hot Tub

When considering the energy efficiency of a spa or hot tub, the key elements to look at are the cover, insulation of the tub walls, and pump system efficiency.

The Cover

The insulation value of the cover and the tightness of its seal to the tub are the most important construction details that determine overall energy consumption. Designing a cover that is well insulated, provides a good air seal, and is light enough to be handled by a single person is a real challenge. The warm humid air trapped between the cover and the surface of the water is rich in energy – a small air leak in the seal will increase evaporation from the surface of the water, bypassing the cover's insulation and increasing heat loss from the tub. The insulation in the cover should be good-quality closed-cell foam that will not absorb water. It should be supported adequately so it does not sag in the middle, and be easily removable by a single person.

Some covers absorb water as the cell structure in the insulation breaks down in the presence of chemicals used in the tub. If the manufacturer offers a "premium" or "upgraded" cover offering a longer useful life and higher R-value, it is usually a very good investment. If you currently own a tub and notice an increase in the weight of the cover from water saturation, it's time to replace it – waterlogged insulation loses effectiveness and wastes costly energy.

Tub Walls

Spa and hot tub walls are usually insulated, but not always to optimum levels so they can be a significant source of energy loss. Thermal insulation can perform two different functions – reduction of heat losses and, if the manufacturer uses rigid foam insulation, physical support of the tub. As insulation thickness increases, the benefit derived from each additional unit of insulation decreases relative to its cost. These diminishing returns lead us to the optimum insulation thickness – somewhere around six inches, depending on the average ambient temperatures and energy costs.

Some spas and hot tubs use a two-inch layer of rigid foam insulation and fill the rest of the cavity with fiberglass insulation; this saves a few dollars, until it gets wet. Once it gets wet, the insulation value drops very close to zero and the result will be a significant increase in your electrical bill.

Pumps

The circulator pump(s) move water through a filter and heater continuously during steady-state operation. Some tubs employ a two-speed motor, with the same pump used for low-speed circulation in steady-state mode and for high-speed operation when using the jets. These pumps are not usually very efficient in any mode – but particularly in steady-state mode

Table 1. Preliminary Spa Energy Performance Results

Product Name	Volume*		Measured Watts*	Standby Watts	CA Title 20 pass /fail**
	Liters	Gallons			
Beachcomer, 740	1474	389.4	200	266.6	pass
Sundance Cameo	1434	378.9	260	261.8	pass
Coast Spas, Lanai Silver	1719	454.2	352	295.4	fail
Arctic Spas, Kodiak SS-1	1478	390.5	199	267.1	pass
Hotspring, Vanguard	1288	340.3	135	243.7	pass
Arctic Spas, Coyote C-60	1579	417.2	193	279.2	pass
Cal Spas, Atlantic	1476	390.0	503	266.9	fail
Arctic Spas, Kodiak SS-2	1579	417.2	149	279.2	pass

* Data from Thermal Performance Test of Spas, Advanced Materials, Advanced Research Council, Inc., Edmonton, Alberta CANADA, 2004.

** We will update this factsheet with additional results as they become available: *www.energyideas.org/pubs.aspx*

because the motor is very lightly loaded and running at low efficiency most of the time. Since these are air-cooled motors, getting rid of the waste heat from the motor in the summer is a problem too.

Some manufacturers use separate pumps for circulation and jets. While initial costs are slightly higher, this helps optimize the circulation pump and can yield good savings during steady-state operation.

Potential Savings

A few studies have looked at the potential for reducing spa energy use.[5, 2] In the Davis study the long-term savings of several efficiency measures were estimated:

- Improvements in spa covers were estimated to save 10%, or about 250 kWh annually - the same amount of energy as improvements to tub insulation.
- More efficient pumping systems will save even more – 15%, or about 375 kWh/yr.
- Improved controls can save an estimated 5%, or 125 kWh/year.

If you are paying .085/kWh for electricity, you can save $21/year with spa covers, another $21/year with tub insulation, $32/year with improved pumping systems, and about $11/year with improved controls. Other than replacing the cover, these improvements in efficiency will only be available at the time of purchase – so make sure you take advantage of them.

More efficient pumping systems would include a separate pump for continuous circulation. Improved controls would incorporate control schemes to save energy by setting back tank temperature and minimizing other electrical uses.

For more information, check out the publication Hot Tub and Pool Conservation Tips at *www.energyideas.org/documents/factsheets/spatips.pdf*

Endnotes

1 A portable spa is a pre-fabricated unit, designed to be installed above ground and usually electrically heated.

2 *Codes and Standards Enhancement Initiative for PY2004: Title 20 Standards Development, Analysis of Standards Options for Portable Electric Spas*. Prepared by the Davis Energy Group and Energy Solutions, San Francisco CA, Pacific Gas & Electric, 2004.

3 *Thermal Performance Test of Spas*, Advanced Materials, Advanced Research Council, Inc., Edmonton, Alberta, Canada, 2004.

4 "Hot Tub Energy Efficiency Testing Begins (Update)," Spring 2008.
www.apsp.org/clientresources/documents/hot tub-testing-begins.pdf
The test used by Cal Poly consists of bringing the spa to 102°F in a 60°F room and holding it there for four hours. The test starts at the end of the first heat cycle and ends at the end of the last heat cycle after 72 hours has elapsed. At the end of the test the total energy use is divided by the total number of hours. The result, in watts, can be no more than 5 x $V^{2/3}$ (where V is the volume of the spa in gallons).

5 *Opportunities for Appliance and Equipment Efficiency Standards in Texas*, American Council for an Energy Efficient Economy and Appliance Standards Awareness Project, September 2006.
www.seco.cpa.state.tx.us/zzz_sa/sa_codes-appliancestandards.pdf

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The *Energy*Ideas Clearinghouse provides information on a broad range of energy technologies. *Energy*Ideas is operated by the WSU Extension Energy Program and sponsored by regional utilities through the Northwest Energy Efficiency Alliance.

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