Technical Bulletin

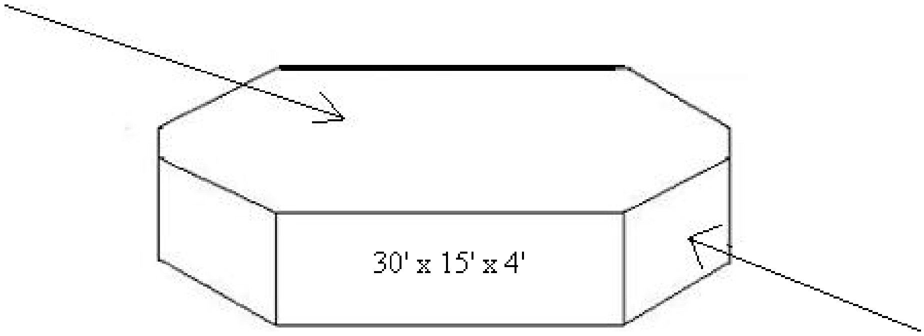
We estimate
40% of electric heaters sold in 2003
Were under sized!!

1.5-kW per 1000-gallons has always been the ‘rule of thumb guide’ for calculating the size of heater required to heat a pool of a known volume, which in theory should heat from tap temperature to swimming temperature in 48 hours (two days), assuming a 12.5˚C lift is required and no loss of heat occurs. However in reality heat loss will inevitably occur, so this simple equation works well for pools with a volume of 7000-gallons and above, but doesn’t work nearly so well when applied to small above ground pools.

Why? = Volume To Surface-Area *Ratio*

This ratio compares the volume of water contained by a pool to the amount of surface area i.e. any surface that will radiate heat.
We are using the two main surfaces the top surface of the pool, and its walls.

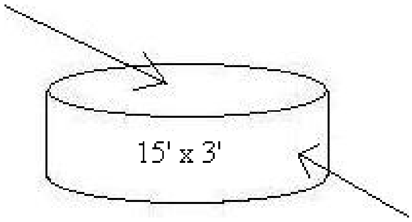
Surface Area = 401.7 ft²



Wall Area = 269.9 ft²

Volume = 9592-gallons / 43,547-litres
Volume to Surface-Area Ratio = 14.2 gallons per ft²

Surface Area = 177.0 ft^2



Wall Area =141.0 ft^2

Volume = 2752-gallons / 12,494-litres

Volume to Surface-Area Ratio = 9.3 gallons per ft^2

The volume to surface-area ratio of a small splasher pool is much lower than that of a larger pool, and the non-insulated walls of an above ground pool can increase the exposed surface-area by two thirds. For example a 15’ x 3’ above ground pool (shown above), approximately 3000-gallons, has a surface-area of 177-ft^2 (Solar cover insulated) and a wall area of 141-ft^2 (not insulated).

If the 1.5-kW per 1000-gallon ratio is applied to this pool i.e. if a 4.5kW heater is installed, the maximum temperature that can be achieved is 9.6˚C above average ambient air temperature. This will take 84 hours during an average month of May, in the south of England and will only achieve a maximum temperature of 24.8˚C. This is the point where the heat bleed factor from the pool is exactly equal to the output of the heater, so no further temperature gain is possible. 24.8˚C is not warm enough for a small above ground pool when used for play rather than exercise, 28-29˚C is considered more comfortable. Only during the higher average ambient air temperatures of June and July would a 28˚C water temperature be achievable for the 15’ x 3’ pool using the 1.5kW per thousand-gallon ratio.

However, if a heater in the ratio 2-kW per 1000-gallons were installed i.e. a 6-kW heater, a temperature of 28˚C would be easily achievable, between the months of May and September **with dramatically reduced heat up times, and reduced running costs for out of season occasional use!**

Applying a heat bleed equation, and using our example of a 15’ x 3’ pool with a 4.5kW heater (using the ratio 1.5kW per 1000-gallons). At 8˚C above ambient air temperature the heat bleed factor would be in the region of 1.2-kW/per 1000-gallons, so only leaving an available 0.3-kW/per 1000-gallons to lift the temperature of the water.

However, if a 6-kW heater were installed (the next heater size up in Elecro’s range), giving a ratio of 2-kW per 1000-gallons (heat bleed remains the same at 1.2-kW per 1000-gallons), but there would now be 0.8-kW/per 1000-gallons available to lift the temperature of the water.

This equates to almost **three times** greater available power which means heat up times are disproportionately quicker, one third of what they would be with the slightly smaller heater.

As above ground pools get bigger in size, the volume to surface-area ratio increases, so dispensing with the need to 'up-size' a heater

A pool of approximately 10,000-gallons i.e. an oval 30' x 15' x 4' has a volume to surface-area ratio of 14.2-gallons/per ft^2. So a heater of 1.5-kW per 1000-gallons will produce approximately the same results as the 3000-gallon 15' x 3' pool with a heater ratio of 2-kW/per 1000-gallons.

The chart below shows the volume to surface-area ratio for some common size pools & the size of heater that would be required to optimise efficiency & comfort.

	Pool Dimension	Volume When Filled to 6" Bellow Top Rim	Total Surface-Area	Volume To Surface-Area Ratio	Minimum Recommended Heater Size
Measurement	ft	UK Gallons / (Litres)	ft^2	gallons / ft^2	(Exact Power Required)
	Round Pools - Diameter				
	12' x 3'	1761gal / (7994)ltr	207.3 ft^2	8.4	4.5kW (3.6kW)
	15' x 3'	2752gal / (12494)ltr	294.5 ft^2	9.3	6kW (5.3kW)
	15' x 4'	3854gal / (17492)ltr	340.9 ft^2	11.3	9kW (6.4kW)
	18' x 4'	5548gal / (25187)ltr	452.4 ft^2	12.2	9kW (8.3kW)
	Oval Pools - L x W x D	UK Gallons / (Litres)	ft^2	gallons / ft^2	(Exact Power Required)
	16' x 10' x 3'	2157gal / (9792)ltr	223.0 ft^2	9.6	4.5kW (4.2kW)
	24' x 12' x 4'	5605gal / (25446)ltr	473.0 ft^2	11.8	9kW (8.4kW)
	30' x 15' x 4'	9592gal / (43547)ltr	671.6 ft^2	14.2	15kW (14.4kW)

Summary

As the overall volume of a pool increases by a relatively smaller rise in surface area, the need to 'up-size' a heater is reduced. This is because although there is a larger volume of water there is also a relatively smaller surface area to suffer heat losses, thus enabling the heater to allow more of it's power to be focused on raising the temperature of the pool, rather than replacing heat lost via the larger surface areas.

This can also be applied in reverse:

As the overall volume of a pool decreases by a relatively smaller reduction to surface area, the need to 'up-size' a heater is increased. This is because although there is a lower volume of water there is also a relatively larger surface area to suffer heat losses, thus preventing the heater from focusing its power on raising the temperature of the pool and diverting it to replace heat lost via the larger surface areas.