DOE Federal Energy Efficiency Regulations
Affecting Dedicated Purpose Pool Pumps (DPPPs)

New DOE Rules: Why Hydraulic Horsepower Matters

Hydraulic Horsepower, Not Rated Horsepower, Defines the Performance of Pool Pumps

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INTRODUCTION

The United States Department of Energy (DOE) has spoken, and a new rule of the pool is in place. As of July 19, 2021, all Dedicated Purpose Pool Pumps (DPPPs) must meet new energy efficiency standards. The purpose of the regulation is to encourage the use of more energy efficient pumps.

When the new rule goes into effect, all pumps manufactured for use in (and imported into) the United States on or after July 19, 2021 will have to meet a minimum efficiency threshold. Pumps made, sold, or installed before July 19, 2021 are not affected – meaning distributors and dealers can continue to sell their current inventory.

The pumps affected by the regulation – DPPPs — include self-priming and non-self-priming pool filter pumps, waterfall pumps, pressure cleaner booster pumps, pool pumps with integral sand or cartridge filters (as are typical for use with small inflatable pools), and pumps used for storable and rigid spas (hot tubs). There are some exceptions and technicalities defining which pumps need to meet which standards; these will be described later.

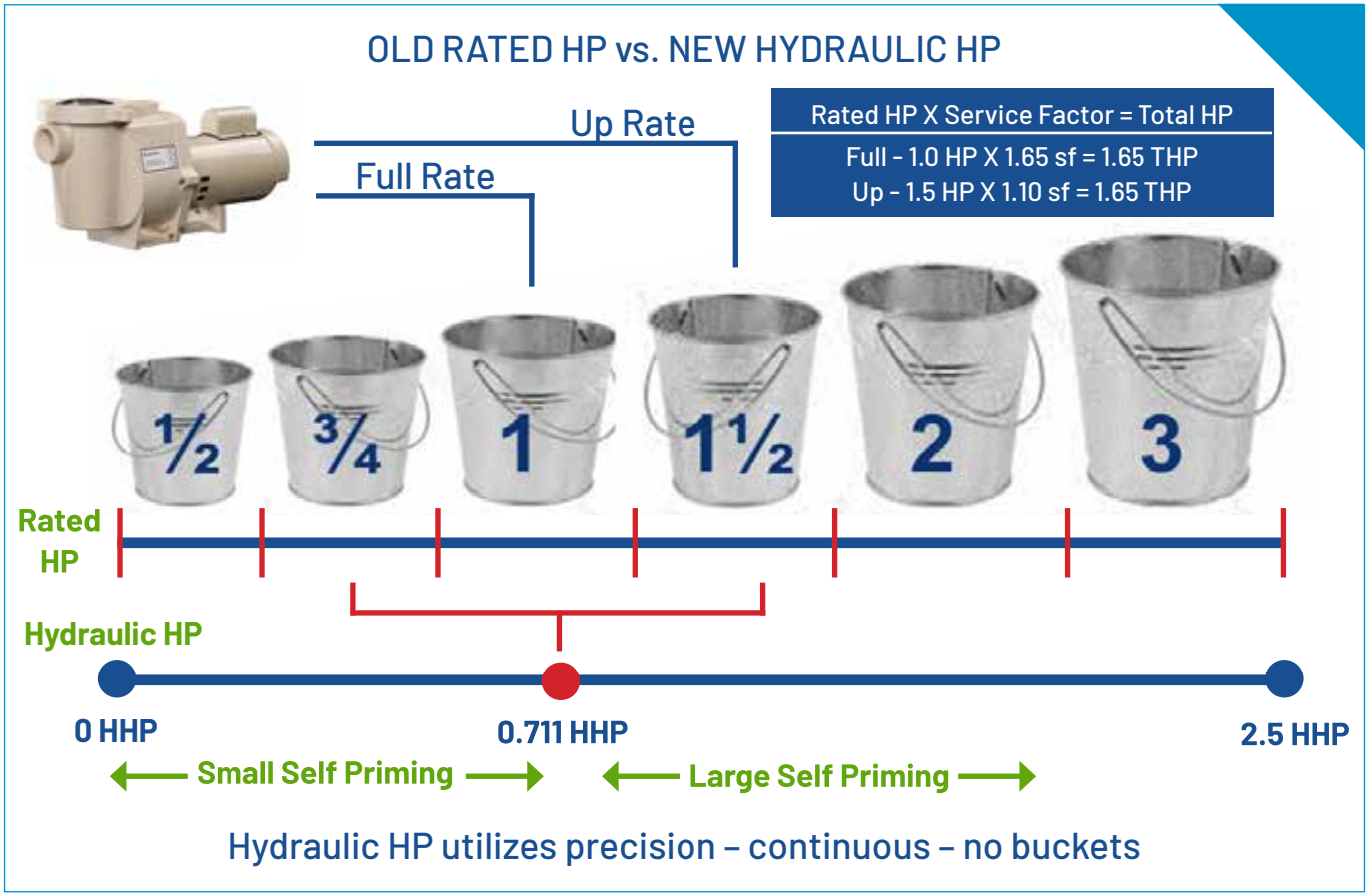
THE MUST KNOWS: PERFORMANCE AND LABELING

As with any new regulation, there will be new terminology to learn so you are looking for the right information on the labels when comparing pumps. For this regulation, it is especially mission-critical to understand the language around horsepower and performance, as there may be conflicting claims that muddy the waters.

> ***"This regulation is not so concerned with rated horsepower as a way to classify and compare pumps. Rather, its focus is on hydraulic horsepower (HHP) – a better indicator of performance…An important clarification, because rated horsepower does not directly correlate to the pump's performance."***

Historically, pool pumps have been divided into size-like categories based on their rated horsepower, which is loosely related to the motor's horsepower. So, when we've talked about a "one-horse" or a "half-horse" pump in the pool industry to date, we've been talking about rated horsepower. Every pump to date has been labeled with its rated horsepower, a motor horsepower, and a service factor. This has resulted in a very wide variance in performance numbers and ratings because there has never been a way to define rated HP – it is a non-standardized value. This will explain the range of rated HPs you'll find among the different 1-HP pumps currently on the market.

The new regulation is not concerned with rated horsepower as a way to classify and compare pumps. Rather, its focus is on hydraulic horsepower (HHP) – a better indicator of performance. It requires testing that measures how much work is done by the pump's wet end moving water, and how much energy it takes to do that work (which is measured in HHP). An important clarification, because although "rated" and "hydraulic" horsepower may sound the same, rated horsepower does not directly correlate to the pump's performance.



The old method of identifying pump sizes was rated horsepower. Going forward, the DOE regulation will require HHP ratings, which are more useful because HHP is a better indicator of a pump's performance.

The challenge? Though Hydraulic Horsepower is your most important "need-to-know" information, the DOE is not insisting it be listed on the label. That's right. Not only will the new DOE regulation result in the removal of "rated" HP from the pump's label, listing the most important measure of performance – HHP – is not required at all. Instead, it requires that all pumps are labeled with the Total Horsepower (THP) of the motor. THP is calculated by multiplying the motor HP rating by it service factor. Under the new DOE regulation pool pump motors must have a service factor of 1.

This adjustment to labeling requirements was made in hopes of making it possible for people to better compare pump motors without the confusion historically linked to the business of motors being full-rated or up-rated. However, despite its good intentions, this new requirement will likely only add to the confusion.

Pentair will voluntarily be putting HHP on all of our pump labels, in addition to the DOE-required THP and WEF. Because the number that more accurately indicates a pump's performance is what the wet end of the pump can do. So think HHP, because looking at just motor horsepower alone is not an apples-to-apples comparison.

Some pumps may not be required to meet performance requirements, though they may still need to be labeled. An example would be three-phase pool filter pumps with less than 2.5 HHP.
In general, when it comes to pool filter pumps, three-phase pumps are exempt from performance requirements because the DOE minimum performance requirement applies only to single-phase pumps. Additionally, pool filter pumps greater than 2.5 HHP (approximately 5 THP) are exempt from both performance and labeling requirements.

With this baseline understanding of the "must knows," let's further define key terms.

KEY TERMINOLOGY

1. Flow rate—how much water leaves the pump and moves through the plumbing and at what rate, measured in gallons per minute (GPM).

2. HHP (Hydraulic Horsepower)—the amount of hydraulic power produced by the pump's wet end. While not required, Pentair will voluntarily label pumps with HHP.

3. THP (Total Horsepower) or SFHP (Service Factor Horsepower)—the pump's motor rating, determined by the total HP created at the motor shaft. Each pump must be labeled with its THP.

4. WEF (Weighted Energy Factor)—a measure of the pump's energy efficiency that takes into account both how much water is pumped and how much energy it takes to pump that amount of water. The higher the WEF, the more efficient the pump. Each pump must be labeled with its WEF.

None of these terms on its own will help you choose the best pump for any given pool. Let's explore what each of these factors really tells you about pump performance.

FLOW RATE

Typically measured by a flow meter in gallons per minute (GPM), this is the volume and rate at which water leaves the pump. Other pool equipment, such as heaters, sanitizers, water features and filters, require a certain amount of flow to do their jobs properly. The required flow varies, and as water moves through the system, it encounters resistance. How much resistance depends on pipe size and configuration, dirt load in the filter, and other factors — some related to system design (equipment choices, plumbing) and some related to use (is the filter dirty or clean?). Understanding how much resistance a pump will need to overcome is an important factor when determining the flow required by the system, and how much flow a pump is capable of generating is critical when selecting a pump.

HHP

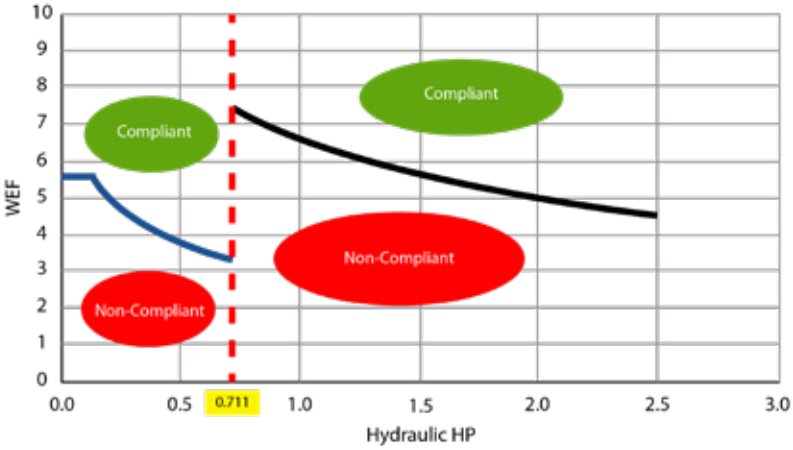
Hydraulic horsepower defines pump performance. It is directly proportional to flow. Hydraulic horsepower is tested on a standardized Curve C system friction curve.

The calculation for HHP is:

$$HHP = \frac{Flow\ rate\ (gpm) \times Total\ head\ (ft)}{3960}$$

> ***"Inadequate HHP can lead to poor water clarity, unnecessary consumption of chlorine and other water care products, and increased wear and tear on the pump."***

Making sure you size your pump appropriately to your pool is very important; if your pump is undersized, you won't have enough flow to do the work. Inadequate HHP can lead to poor water clarity, unnecessary consumption of chlorine and other water care products, and increased wear and tear on the pump. Which translates to more frequent filter cleaning, reduced product longevity, and a pool that's more open to potential water quality problems.



Minimum efficiency requirements (WEF) for pumps at various HHP. This demonstrates that single-speed pumps with HHP of 0.711 or more (to the right of the dotted line) must have higher WEF scores to comply. It also shows why selecting a pump based on WEF alone could result in an undersized (low HHP) pump.

HHP is also important because the new DOE efficiency requirements (represented by WEF) are directly tied to this rating. Self-priming pumps with HHP less than 0.711 need to meet significantly lower efficiency requirements, while pumps that are more powerful (with HHP ratings at or above 0.711), need to perform at higher efficiency.

THP

THP is a measure of the total HP created at the motor shaft. It represents potential output, not actual output. This matters when selecting a pump because the motor's potential power should be appropriately matched (sized) to the wet end (measured in HHP). Put another way, THP may or may not correspond with HHP because HHP is a measure of what the wet end can do, while THP is a measure of what the pump's motor can do. So, it is possible to have two pumps — one with a 1-hp (THP) motor, the other with a 2-hp (THP) motor — that have the same HHP. Despite their different THP ratings, these two pumps will produce the same flow. That is, the larger motor doesn't get you more flow, and flow is what you need.

WEF

A pump's WEF score will tell you how efficiently the pump operates. WEF (Weighted Energy Factor) is a more useful way to measure a pump's efficiency than Energy Factor because WEF represents real-world conditions. However, energy efficiency is not the only determining factor when it comes to buying the best pump for the job. Looking only at a pump's WEF score is like taking only gas mileage (MPG) into account when buying a car.

WEIGHTED ENERGY FACTOR (WEF)

ENERGY STAR

WORK / ENERGY

- Miles per gallon (mpg)
- Gallons pumped per watt-hour (gal/Wh)
- (1000 gal/kWh)

MILES DRIVEN / GALLONS CONSUMED

GALLONS PUMPED / kWh CONSUMED

Weighted Energy Factor measures how efficiently a pump works by telling you how many gallons are pumped per kWh of energy, just like a car's gas mileage rating tells you how far you can drive on one gallon of gas.

PUMP CLASSIFICATIONS (EQUIPMENT CLASSES)

The new DOE rule defines different pump classifications with different performance and efficiency requirements for each. The different requirements are based on the pump's performance characteristics, not on how the pump is used.

The testing required will measure HHP and energy consumed to give the WEF rating. Testing is also required to determine the pump's priming capability, which in turn dictates how the pump is classified and what minimum performance requirements it must meet.

What we typically call an in-ground pump will be classified as self-priming. Self-priming pumps will be further categorized as large and small, and each category will have its own efficiency requirements.

> ***"Variable-speed pumps will easily meet (the large self-priming pool pump) requirement. However, it is unlikely that current available single-speed or two-speed pumps will be able to."***

LARGE SELF-PRIMING POOL PUMPS

This class of pool pumps have HHP between 0.711 and 2.5. Pumps with HHP ratings in that range will typically have THP ratings between about 1.2 and 5.0. Variable-speed pumps will easily meet this requirement. However, it is unlikely that currently available single-speed or two-speed pumps will meet the new requirement.

SMALL SELF-PRIMING POOL PUMPS

These are pool pumps with HHP below 0.711. Pumps with these lower HHP ratings will typically have THP ratings around 1.2 or lower. Many of today's single-speed pumps with very efficient motors are expected to meet this requirement.

WATER FEATURE AND SPA BOOSTER PUMPS

Pumps sold or marketed as water feature and spa booster pumps have all the physical attributes and performance characteristics of self-priming pool filter pumps are therefore classified as such and must comply with the minimum performance requirements of self-priming pumps (described in the two paragraphs above). This regulation is not application specific.

ABOVEGROUND POOL PUMPS

These pool pumps are referred to in the DOE regulation as non-self priming — pumps that do not achieve a prime at 5 feet in 10 minutes. Some single-speed pumps with moderately efficient motors will meet this requirement.

PRESSURE CLEANER BOOSTER PUMPS

Pressure cleaner booster pumps need to have a minimum WEF score to comply with the new regulation. Most single-speed pressure cleaner booster pumps with moderately efficient motors will also meet this requirement.

WATERFALL PUMPS

Waterfall pumps do not need to meet the new DOE performance requirements. This is not because we use them for waterfalls; rather, it's because these ultra low-head pumps operate at a maximum 1800 RPM and 30 feet of head. With these performance characteristics, they cannot be used as pool filtration pumps, so they do not need to meet the new energy efficiency standards. They do, however, need to be tested and labeled with a WEF and THP.

INTEGRAL SAND AND CARTRIDGE FILTER PUMPS

Those that cannot be plumbed to bypass the filter and are typically used with small inflatable pools — are not required to meet the new DOE performance or labeling requirements. However, they are required to have a manufacturer-supplied timer that automatically turns off the pump after 10 hours.

PUMPS FOR STORABLE AND RIGID HOT TUBS

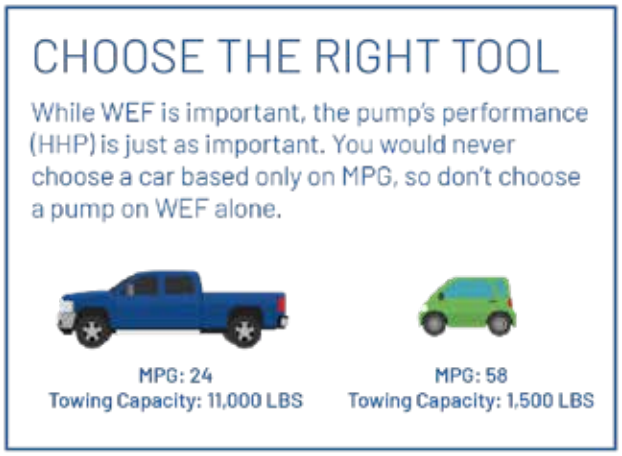
These pumps are not required to meet the new DOE performance or labeling requirements.

PUMP PERFORMANCE: A HELPFUL ANALOGY

Each pool needs a pump that is powerful enough to meet its particular demands while also being as energy efficient as possible. Every pool environment comes with its own demands. A pool with water features (waterfalls, bubblers, laminars, etc.) will require more flow than one without. And, different water features place different demands on a pool. Everything from pipe size and number of elbows in a system to the kind of filter and other inline equipment the pool uses must be taken into account when selecting a pump.

Which brings us back to WEF.

Some pumps with very high WEF scores can't circulate enough water for every pool. WEF is similar to miles per gallon in an automobile. Some cars with very high MPG ratings can't haul a trailer or carry a family of four. WEF is important, but so is performance. Also, small differences in WEF ratings are not meaningful, which is also true of small differences in MPG. That is, a car rated at 31 MPG does not meaningfully outperform one at 30 MPG. Similarly, there is no meaningful difference between a pump with a 7.1 WEF score and one rated at 7.0.



Further, a high WEF rating for one pump isn't necessarily a high WEF rating for every pump. Again, to use the MPG analogy, a good gas mileage rating for a rugged four-wheel-drive truck would not be a good gas mileage rating for a small hybrid car.

VARIABLE SPEED: THE RIGHT PUMP FOR THE REGULATIONS

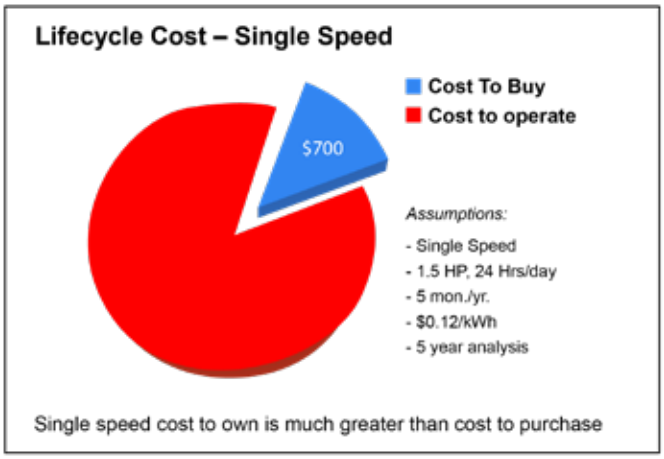
Variable-speed pumps are the ideal choice for anyone who wants to maximize energy efficiency without compromising performance. They can run at high speeds for high-demand tasks like running jets or large waterfalls, while also being able to operate at lower — more energy-efficient — speeds for less demanding tasks like circulating pool water. When they run at low speeds, they are also remarkably quiet. Further, by working only as hard as they have to, variable-speed pumps can last longer than single-speed pumps. This is because single-speed pumps can run at only one speed and are therefore sized to do the hardest job in the system, which is probably not simple circulation with a clean filter. In other words, single-speed pumps are always running at full speed when they're on.

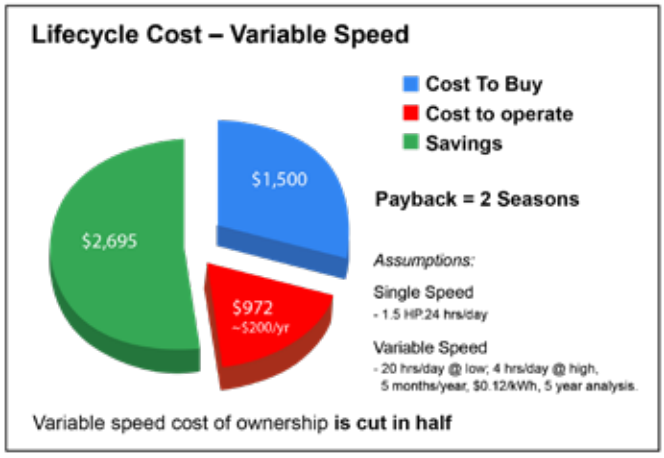
> ***"Variable-speed pumps are the ideal choice for anyone who wants to maximize energy efficiency without compromising performance...Cost savings are also significant."***

Cost-savings are also significant. The initial purchase price of variable-speed pumps is higher than single-speed pumps. However, the savings in operational costs over time are significant and should not be overlooked. The energy cost to operate a single-speed pump in one year may be higher than the purchase price, while the energy cost to operate a variable-speed pump for one year may be a fraction of its purchase price. In the example shown in the pie charts below, the assumed energy cost (which will vary from region to region) is $900/year for a single-speed pump and $200/year for a variable-speed model.

COMPARISON OF PURCHASE PRICE AND OPERATIONAL COSTS

For specific savings in your market, use the Pentair Energy Calculator, found at www.pentair.com/pumpregulations





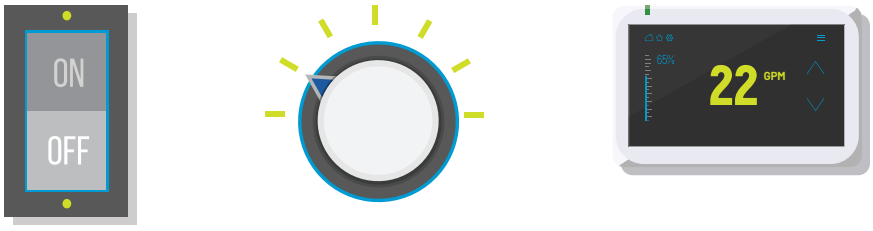
A pump's purchase price is a small percentage of its cost to operate. So when considering operating cost over time, you can save significantly more with a variable-speed pump.

VARIABLE-SPEED VS. VARIABLE-FLOW

The term "variable-speed" can imply that these pumps vary their speed automatically. They do not. Rather, they can be programmed to run at so many different speeds that the options seem infinitely variable. Most variable-speed pumps do not automatically adjust their speed to respond to system demand.

For responsive pump output, the only options on the market today are IntelliFlo VSF and IntelliPro VSF pumps. These pumps have the unique ability to change pump speed in response to system demand — for example, as a filter loads during the normal course of a filter cycle, the pump increases its speed so it continues to meet the flow demand of the system. A dirty filter demands more power to move water through it than a clean one, and a variable-flow pump can handle this demand increase automatically.

Another car analogy will help illustrate the difference between variable-speed and variable-flow. Think about how you control temperature in a car. Some cars have temperature controls with 3 settings — off, low, high. This would be like a two-speed pool pump, which can also be set at off, low, or high. Another step up in temperature control technology is a dial that isn't limited to off/low/high but can vary the amount of air coming out in response to manual adjustments of the dial. This is like a variable-speed pump (although variable-speed pumps can be programmed to run at set speeds at set times). The next step up in temperature control technology requires only that the user set the desired temperature; from that data point, the system responds by moving more or less air to achieve the set point. This is what variable-flow technology does.



Temperature controls are a useful way to understand the difference between two-speed, variable-speed, and variable-flow pumps.

WHAT IT ALL MEANS

Under the new DOE regulation requiring that pumps of a particular size (measured in HHP) meet minimum performance standards, many pumps on the market today will become obsolete.

Higher flow pumps — those with HHP greater than or equal to 0.711 — will need to meet higher WEF requirements. The vast majority of pumps used in the industry today are these higher flow pumps. In fact, most of Pentair's single-speed pumps perform at or above the 0.711 HHP threshold, so they will be transitioned to variable-speed to meet the higher WEF requirements.

IT'S HHP NOT RATED HP THAT DEFINES THE PERFORMANCE OF YOUR PUMP

Product	Rated HP	Average HHP
Manufacturer A's 1 HP Pumps	1	0.972
Manufacturer B's 1 HP Pumps	1	0.553

Lower flow pumps — those with HHP less than 0.711 — will still be available in higher efficiency single-speed models to comply with the new WEF requirements for small, self-priming pumps.

This is where variable-speed and flow technology comes in. Variable-speed and flow pumps provide the best option for higher flow applications that meet the new stringent standards. They help reduce energy costs for the consumer and provide additional important benefits such as remarkably quiet operation, longer pump life, and reduced wear and tear on other equipment (heaters, filters, etc.).

HOW ENERGY STAR FITS IN

Along with the new DPPP regulation, the Environmental Protection Agency (EPA) also provides ENERGY STAR ratings for pool pumps. Pumps that meet a certain threshold qualify for ENERGY STAR ratings and all of the benefits that come with that, such as rebates, tax credits, and other incentives to buy more energy efficient pumps.

ENERGY STAR 2.0 requirements for pool pumps were introduced in January 2019.

Just as Pentair has variable-speed and flow pumps that currently meet ENERGY STAR 2.0 requirements, they will also have pumps that meet the (ENERGY STAR) 3.0 requirements when they go into effect July 19, 2021.

Pentair has been strongly committed to the ENERGY STAR program since pool pumps were first incorporated into it in 2013. Pentair has received the ENERGY STAR'S Partner of the Year recognition seven times - every year since the program started rating pool equipment.

CONCLUSION

While it is tempting to view new regulations as restrictive, this new DOE regulation represents an opportunity to improve pump and system performance for more swimming pools because it requires that all pumps meet higher energy efficiency standards, with higher performing pumps having higher efficiency requirements.

Further, these standards will be best met with the leading technologies for pool pumps — variable-speed and flow. By working only as hard as they need to, these kinds of pumps yield higher performance and lower energy consumption, saving money on energy bills while improving circulation, operating at extremely low noise levels, and increasing equipment longevity.

RESOURCES

Pentair Pump Landing Page URL
Pentair Energy Calculators URL
DOE URL
ENERGY STAR URL