

IPSSA PUMP & MOTOR SURVEY

JUNE 2012

ENERGY EFFICIENCY STUDY AND PERFORMANCE GUIDE
MANUFACTURED MULTI-SPEED REPLACEMENT MOTORS



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COLUMN DESCRIPTIONS

- * Label= Nameplate nomenclature
- * SFhp= Maximum watt hp load for safe operation
- * One Watt Horsepower =746 watts
- * Volts= Input voltage
- * amps= rms amperage draw
- * RMS Watt= actual RMS watt draw
 - * As compared to amps x voltage RMS is a more accurate measurement of energy usage.

Column Descriptions

- * $\text{kWh} = \text{watts}/1000 = \text{kW} \times \text{hrs} = \text{kWh}$ to move 1000 gallons.
- * Standby= amps required to operate the standby mode. Single speed energy at standby was a T104 mechanism.
- * RPM= motor rpm to achieve the required flow rates
 - * The Emerson motor controller did not have an rpm display.

Column Descriptions

- * Outlet psi= pressure on the 2" outlet pipe, prior to the flow control valve.
- * Outlet gpm= gallons per minute measured after the flow control valve. Accurate to + - 3%
- * Outlet fps=Measured after the flow control valve in feet per second. Accurate to + - 3%.

Column Description

- * Volute Vac= vacuum pressure measured prior to the impeller at the pump volute or pump pot. Measurement is in Hg.
- * Volute PSI= pounds per square as measured after the impeller at the pump volute or pump pot.
- * Suction gpm= measured prior to the pump volute inlet. Measurement is + - 3%
- * Suction fps= measured at feet per second of water movement. Measured prior to the pump volute inlet.

Column Description

gal to watt= calculated to determine the amount of water moved for each watt of energy used. The result indicates water moved per 1 watt

TDH= Total Dynamic Head

The result of volute vacuum and volute psi.

$\text{vac} \times 1.13 = \text{Vacuum of feet head}$

$+ \text{psi} \times 2.31 = \text{Pressure of feed head}$

equals Total Dynamic Head

Often referred to system resistance.

Page 17 of the IPSSA Training Manual Part 2-equipment

Power Factor=The effort required to move the motor shaft in rotation as opposed to the energy watt input. Perfect Power Factor is 1.0

Pump/Motor Survey 2012

Observations

- * 1. Tool for installers to demonstrate the energy usage expected from multi-speed pumps and multi-speed manufactured replacement motors.
- * 2. EF= Energy Factor. A term often used to indicate the efficiency of a particular pump system. This is the calculated result of $\text{gpm} \times 60 / \text{watts}$. It is only used to demonstrate efficiency, has no value in calculating consumer energy costs. The higher the numeric value the more efficient the system.
- * 3. Gal per watt. This term is simply $\text{gpm} / \text{watts}$ and can be used to calculate consumer energy costs, to a very exact result. It is more exact because the gal to watt result is rounded up 4 points passed the decimal. Again the higher the value the better the efficiency.
- * 4. kWhr= kWhr to move 1000 gallons at the specified flow rate,
 $15,000 \text{ gal pool} = 15 \times .3606 = 5.41 \text{ kWhr @ 1 pool volume turnover}$.
The lower the value the better the efficiency.
- 5. The survey will provide information that is useful in educating the consumer on the value of multi-speed technology and the cost savings that is possible.

Pump/Motor Survey 2012

Observations

- * 6. The survey shows a direct relationship between impeller size and rpm required to achieve a given gpm. This was no surprise to us, but, we expected a greater difference. ***Does this mean you should upgrade the impeller when installing a multi-speed pump??***
- * 7. The 40 gpm flow rate values are the greatest demonstration that low flow for a longer period will result in energy savings and costs reduction to the consumer.
- * When you can take the same system from 5.41kWhr to 1.47kWhr and maintain water quality it's gotta be a winner.

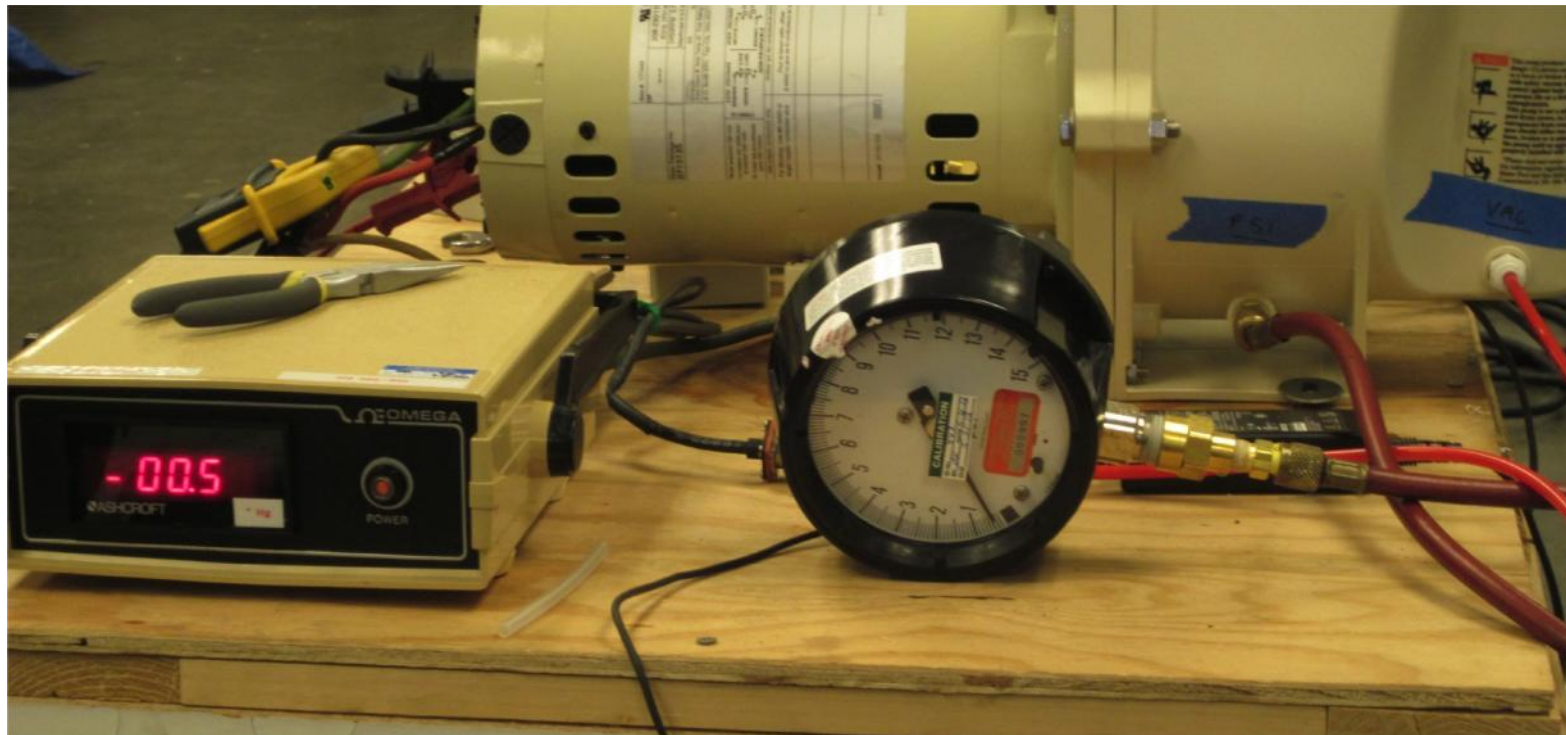
Pump/Motor Survey 2012 Observations

- * What's next:
- * 1. Publish the survey with some observation notes in the IPSSAN. More than one article and with the 2009 study.
- * 2. Release the survey with comment to Pool & Spa News.
- * 3. Release the survey with comment to Service Industry News.
- * 4. Forward the survey with comment to the CEC and CEE with a cc: to PG&E. Basically demonstrating that we, as a group, are on board with education and research.

Pump/Motor Survey 2012

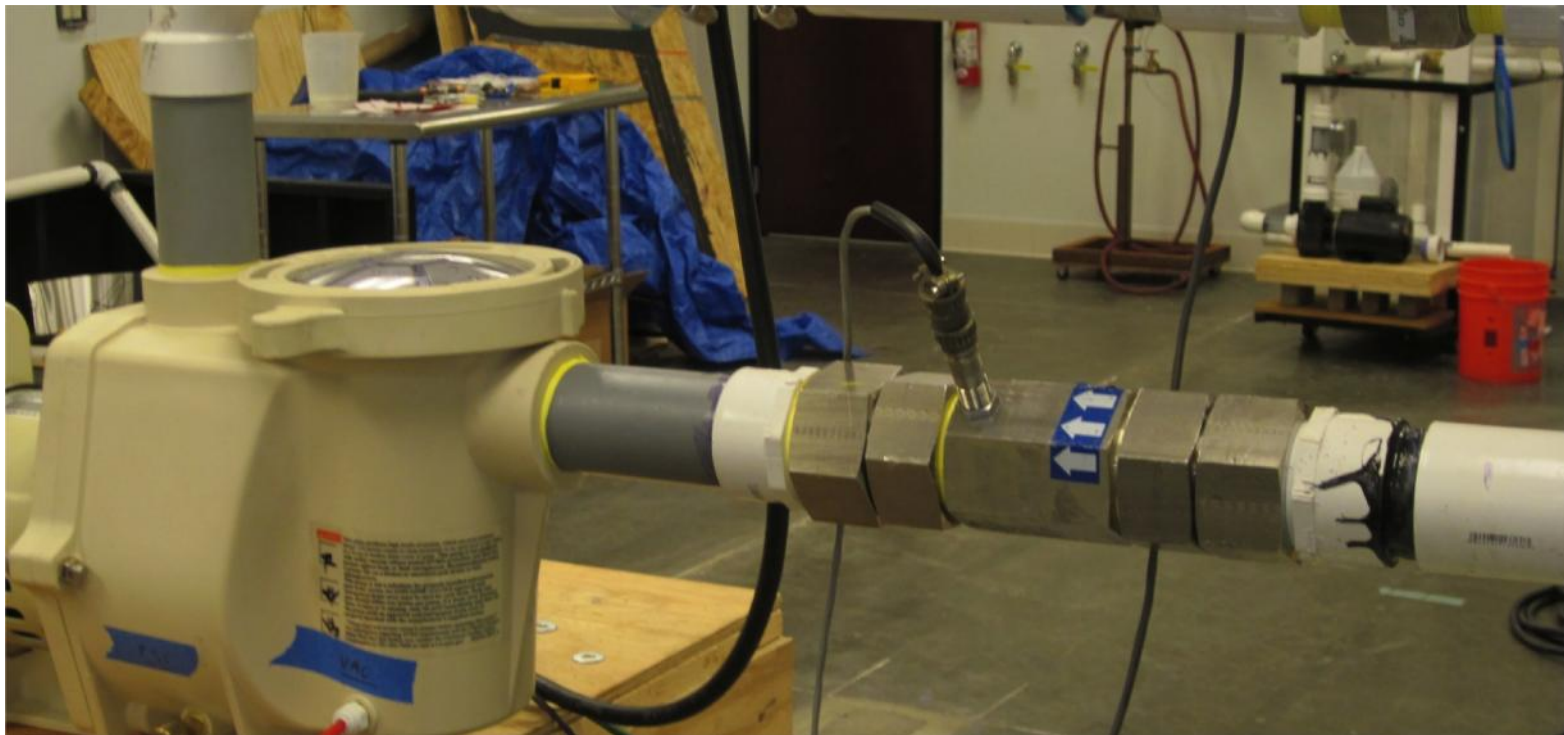
- * 5. Formal letter to those manufactures that contributed to the survey along with the final survey document.
- * A.O. Smith Century
- * Emerson Nidec
- * Pentair
- * 6. Others that may be interested in the results:
- * FPSIE
- * Distribution-Pool Electrical Products, PoolCorp (SCP) & ?????
- * NSPF
- * APSP
- * NSF
- * IAPMO
- * UL

IPSSA Pump & Motor Survey 2012



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2012



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* Legal Stuff

- * 1. Testing of all pumps and motors was completed at IAPMO laboratory Ontario, CA.
- * 2. Documents contained in this summary are the property of IPSSA, Inc., all rights reserved.
- * 3. Information from the IPSSA survey was determined under specific conditions that may not exist at the location you are attempting to evaluate.



| Manufacture Unit | EF | SFhp | volts | amps | RMS Watts | kWhr** | standby @240v | RPM | Outlet PSI | Outlet gpm | Outlet fps | Volute Vac | Volute PSI | suction gpm | Suction fps | gal per watt | TDH | Pwr Fac |
|--|-------|------|-------|-------|-----------|--------|---------------|------|------------|------------|------------|------------|------------|-------------|-------------|--------------|-------|---------|
| Pentair OEM SS 1.0 hp | 2.67 | 1.65 | 241 | 7.28 | 1789 | 0.3606 | 0.012 A | *** | 11.8 | 79.5 | 8.12 | 18.2 | 13.2 | 78.1 | 7.98 | 0.044 | 51.06 | 0.993 |
| Pentair OEM SS .75 hp | 2.8 | 1.25 | 241 | 6.78 | 1581 | 0.3541 | 0.012 A | *** | 11.4 | 73.9 | 7.55 | 17.1 | 13.3 | 73 | 7.46 | 0.046 | 50.05 | 0.97 |
| Pentair OEM Multispeed | | 3.96 | | | | | | | | | | | | | | | | |
| 1.0 hp flow rate | 3.35 | | 241 | 6.08 | 1424 | 0.2935 | 0.38A | 2745 | 12.1 | 79.5 | 8.12 | 18.4 | 13.1 | 77.5 | 7.91 | 0.056 | 51.05 | 0.983 |
| 0.75 hp flow rate | 3.91 | | 241 | 4.87 | 1135 | 0.2523 | 0.38A | 2530 | 10.1 | 74 | 7.55 | 16.3 | 11.4 | 70.7 | 7.22 | 0.065 | 44.75 | 0.979 |
| Century MRM Multispeed | | 2.7 | | | | | | | | | | | | | | | | |
| 1.0 hp flow rate 2hp imp | 3.43 | | 242 | 5.8 | 1389 | 0.3005 | 0.33A | 2975 | 12.1 | 79.3 | 8.09 | 18.1 | 13.3 | 80.3 | 8.2 | 0.057 | 51.18 | 0.991 |
| 1.0 hp flow rate 1hp imp | 3.12 | | 241 | 6.38 | 1528 | 0.3254 | 0.33 A | 3350 | 12 | 79.4 | 8.11 | 17.8 | 13.2 | 77.4 | 7.9 | 0.052 | 45.76 | 0.992 |
| 0.75 hp flow rate 2hp imp | 4 | | 240 | 4.6 | 1097 | 0.2505 | 0.34 A | 2700 | 10 | 73.2 | 7.47 | 15.8 | 11.1 | 71.9 | 7.34 | 0.067 | 43.5 | 0.991 |
| 0.75 hp flow rate 1hp imp | 3.73 | | 240 | 4.94 | 1182 | 0.2793 | 0.34 A | 3050 | 10.1 | 73.4 | 7.49 | 15.2 | 11.1 | 70.7 | 7.22 | 0.062 | 42.82 | 0.992 |
| Nidec MRM Multispeed | | 2.7 | | | | | | | | | | | | | | | | |
| 1.0 hp flow rate 2hp imp | 3.53 | | 240 | 5.71 | 1347 | 0.2841 | 0.41 A | * | 11.5 | 79.2 | 8.08 | 17.4 | 13 | 79.6 | 8.12 | 0.059 | 49.69 | 0.986 |
| 1.0 hp flow rate 1hp imp | 3.34 | | 241 | 5.92 | 1408 | 0.3023 | 0.40 A | * | 11.3 | 78.3 | 7.99 | 17.2 | 12.8 | 78.1 | 7.97 | 0.056 | 49 | 0.988 |
| 0.75 hp flow rate 2hp imp | 3.86 | | 241 | 4.86 | 1146 | 0.2668 | 0.40 A | * | 10.2 | 73.7 | 7.52 | 15.7 | 11.4 | 73.7 | 7.52 | 0.064 | 44.08 | 0.982 |
| 0.75 hp flow rate 1hp imp | 3.7 | | 241 | 5.21 | 1214 | 0.2741 | 0.41 A | * | 10 | 74.8 | 7.63 | 15.7 | 11.4 | 74.6 | 7.61 | 0.062 | 44.08 | 0.985 |
| High Speed Evaluation--Multispeed Full High RPM | | | | | | | | | | | | | | | | | | |
| Pentair Multispeed | 2.16 | | 239 | 10.55 | 2508 | 0.4554 | 0.38 A | 3450 | 15 | 90.4 | 9.23 | 22.2 | 17 | 98.7 | 10.08 | 0.036 | 64.36 | 0.991 |
| Century MRM MS 2hp imp | 2.52 | | 241 | 8.83 | 2097 | 0.4086 | 0.33 A | 3450 | 14.5 | 88.1 | 8.99 | 22.7 | 16.5 | 93.1 | 9.5 | 0.042 | 63.77 | 0.997 |
| Century MRM MS 1hp imp | 2.92 | | 241 | 6.99 | 1672 | 0.3362 | 0.34 A | 3450 | 12.5 | 81.3 | 8.3 | 18.1 | 13.5 | 81.7 | 8.34 | 0.049 | 51.64 | 0.995 |
| Nidec MRM MS 2hp Imp | 2.59 | | 240 | 8.64 | 2056 | 0.3837 | 0.40 A | * | 14.5 | 88.6 | 9.04 | 21 | 16.5 | 92.3 | 9.42 | 0.043 | 61.18 | 0.992 |
| Nidec MRM MS 1hp imp | 2.97 | | 240 | 6.91 | 1650 | 0.3407 | 0.41 A | * | 12.2 | 81.7 | 8.34 | 18.2 | 13.3 | 80.7 | 8.24 | 0.050 | 51.29 | 0.99 |
| Low Flow gpm Evaluation--Multispeed @40 gpm flow rate | | | | | | | | | | | | | | | | | | |
| Pentair Multispeed | 11.91 | | 241 | 1.15 | 202 | 0.1039 | 0.37 A | 1390 | 2.5 | 40.1 | 4.09 | 5.8 | 3.1 | 41.1 | 4.19 | 0.199 | 13.72 | 0.842 |
| Century MRM MS 2hp imp | 10.01 | | 242 | 1.16 | 244 | 0.0983 | 0.34 A | 1525 | 2.5 | 40.7 | 4.15 | 6.2 | 2.8 | 40.8 | 4.16 | 0.167 | 13.47 | 0.861 |
| Century MRM MS 1hp imp | 9.54 | | 242 | 1.21 | 256 | 0.1024 | 0.33 A | 1700 | 2.5 | 40.7 | 4.15 | 5.7 | 3 | 40.4 | 4.12 | 0.159 | 13.37 | 0.873 |
| Nidec MRM MS 2hp imp | 9.59 | | 243 | 1.19 | 261 | 0.1039 | 0.42 A | * | 2.6 | 41.7 | 4.25 | 6 | 2.9 | 41.7 | 4.25 | 0.160 | 13.48 | 0.899 |
| Nidec MRM MS 1hp imp | 9.18 | | 242 | 1.24 | 272 | 0.1042 | 0.41 A | * | 2.4 | 41.6 | 4.24 | 5.8 | 2.6 | 40.4 | 4.12 | 0.153 | 12.56 | 0.905 |
| Legend | | | | | | | | | | | | | | | | | | |
| MRM= Manufactured Replacement motor | | | | | | | | | | | | | | | | | | |
| IMP= impeller | | | | | | | | | | | | | | | | | | |
| OEM= Original Manufacture Equipment | | | | | | | | | | | | | | | | | | |
| MS= Multi-speed | | | | | | | | | | | | | | | | | | |
| Label= nameplate | | | | | | | | | | | | | | | | | | |
| SS= Single speed | | | | | | | | | | | | | | | | | | |
| Single speed standby T104 mechanism | | | | | | | | | | | | | | | | | | |
| **kWh= kWh to move 1000 gallons | | | | | | | | | | | | | | | | | | |
| *Nidec controller does not display RPM | | | | | | | | | | | | | | | | | | |
| *** Single Speed mtr- assumed 3450 rpm | | | | | | | | | | | | | | | | | | |
| EF=Flow(gpm)*60/Power (watts) | | | | | | | | | | | | | | | | | | |
| gallon per watt=gpm/watt | | | | | | | | | | | | | | | | | | |



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10842 Noel St. #107

Los Alamitos, CA 90720

PDF Document

IPSSA Pump Test Results 2009 - Corrected 9/01/09

| Nameplate/Horsepower* | Volts | Current | Watts** | Outlet | Flow- | Velocity | TDH | Vacuum | Pressure | Gallons | kWhr |
|------------------------------|-------|---------|---------|--------|-------|----------|-------|--------|----------|----------|------|
| 1 hp single speed ref. pump | | AMPS | | press. | GPM | fps | | Hg/in | psi | per watt | |
| 2" pipe | 240.9 | 7.48 | 1785 | 9.73 | 95.3 | 9.79 | 50.13 | 4.5 | 19.5 | 0.0534 | 1.79 |
| 1.5" pipe | 239.9 | 7.69 | 1827 | 16.75 | 86.8 | 15.76 | 50.05 | 7.5 | 18 | 0.0475 | 1.83 |
| 1/2 hp wfe single speed | | | | | | | | | | | |
| 2" pipe | 120.5 | 8.74 | 1008 | 1 | 76.55 | 7.82 | 13.2 | 3.5 | 4 | 0.0771 | 1.01 |
| 1.5" pipe | 120.3 | 9.09 | 1041 | 7 | 60.7 | 11.02 | 24.16 | 4 | 8.5 | 0.0583 | 1.04 |
| 3/4 hp wfe single speed | | | | | | | | | | | |
| 2" pipe | 120.5 | 11.95 | 1306 | 1 | 77.25 | 7.88 | 15.47 | 5 | 4.25 | 0.0592 | 1.31 |
| 1.5" pipe | 120.5 | 11.81 | 1295 | 6 | 57 | 10.3 | 20.69 | 4 | 7 | 0.044 | 1.3 |
| 3/4 hp dual speed high speed | | | | | | | | | | | |
| 2" pipe | 120.5 | 15.18 | 1656 | 2.6 | 100.8 | 10.29 | 24.09 | 6.5 | 7.25 | 0.0601 | 1.66 |
| 1.5" pipe | 119.6 | 15.44 | 1701 | 13.5 | 80.4 | 14.6 | 43.72 | 7 | 15.5 | 0.0473 | 1.7 |
| 3/4 dual speed low speed | | | | | | | | | | | |
| 2" pipe | 119.8 | 4.87 | 370 | 2.6 | 52.1 | 5.3 | 6.86 | 3 | 1.5 | 0.1408 | 0.37 |
| 1.5" pipe | 120.9 | 4.86 | 360 | 3.2 | 40.2 | 7.3 | 11.48 | 3 | 3.5 | 0.1166 | 0.36 |
| 1.0 hp dual speed high speed | | | | | | | | | | | |
| 2" pipe | 240.5 | 8.13 | 1889 | 3 | 107.4 | 10.97 | 26.98 | 6.5 | 8.5 | 0.0569 | 1.89 |
| 1.5" pipe | 240.7 | 8.3 | 1938 | 15.8 | 86.8 | 15.76 | 49.47 | 8 | 17.5 | 0.0448 | 1.94 |
| 1.0 hp dual speed low speed | | | | | | | | | | | |
| 2" pipe | 241.6 | 3.3 | 436 | 3.2 | 55.1 | 5.62 | 7.45 | 2.5 | 2 | 0.1264 | 0.44 |
| 1.5" pipe | 240.9 | 3.3 | 435 | 3.6 | 41.24 | 7.49 | 11.5 | 2 | 4 | 0.0948 | 0.44 |

*Testing of all pumps mentioned above were completed at IAPMO in Ontario, CA

**Watts are equal to energy supplied less harmonic distortion of approximately 3.5% - power factor .965 avg.

Pumps tested were full rated pump/motor combinations.

Information from the IPSSA pump test results was determined under specific conditions that may not exist at the location you are attempting to evaluate

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Ipssa Pump Test Results 2009 Comparison Chart VS3050 4X160

| Comparison @ horsepower flow rate | Voltage | Current | Watts** | Outlet Pres | Flow | Velocity | TDH | Vacuum | Pressure | gallons | kWhr |
|-----------------------------------|---------|---------|---------|-------------|-------|----------|------|--------|----------|----------|------|
| 1 hp single speed reference pump | | AMPS | | psi | GPM | fps | | Hg/in | psi | per watt | |
| 2" pipe | 240.3 | 3.53 | 830 | 3.9 | 95.7 | 9.77 | 20.7 | 5 | 6.5 | 0.1153 | 0.83 |
| 1.5" pipe | 240 | 6.49 | 1541 | 15.4 | 86.8 | 15.76 | 47.2 | 7 | 17 | 0.0563 | 1.54 |
| compare to 1/2 hp single speed | | | | | | | | | | | |
| 2" pipe | 240.7 | 2.17 | 502 | 3.8 | 76.1 | 7.77 | 13.2 | 3.5 | 4 | 0.1516 | 0.50 |
| 1.5" pipe | 242 | 2.89 | 681 | 8.2 | 60.7 | 11.02 | 27 | 4.5 | 9.5 | 0.0891 | 0.68 |
| compare to 3/4 hp single speed | | | | | | | | | | | |
| 2" pipe | 239.7 | 2.16 | 495 | 2 | 76.8 | 7.84 | 13.2 | 3.5 | 4 | 0.1552 | 0.50 |
| 1.5" pipe | 239.6 | 3.05 | 713 | 8.5 | 57 | 10.35 | 27.6 | 10 | 8.5 | 0.078 | 0.71 |
| compare to 3/4 hp dual speed | | | | | | | | | | | |
| High Speed 2" pipe | 240.7 | 4.05 | 959 | 3 | 100.9 | 10.3 | 23.5 | 5.5 | 7.5 | 0.1502 | 0.96 |
| High speed 1.5" pipe | 238.4 | 5.43 | 1283 | 15 | 80.4 | 14.6 | 44.3 | 6.5 | 16 | 0.0627 | 1.29 |
| Low speed 2" pipe | 239.1 | 1.08 | 239 | 1 | 52.4 | 5.35 | 6.29 | 2.5 | 1.5 | 0.2192 | 0.24 |
| Low speed 1.5" pipe | 240.7 | 1.6 | 360 | 4.4 | 40.2 | 7.3 | 14.9 | 3 | 5 | 0.1117 | 0.36 |
| compare to 1 hp dual speed | | | | | | | | | | | |
| High Speed 2" pipe | 240.6 | 4.47 | 1060 | 5 | 107.7 | 11 | 25.3 | 6 | 8 | 0.1016 | 1.06 |
| High speed 1.5" pipe | 240 | 6.49 | 1541 | 15.4 | 86.8 | 15.76 | 47.2 | 7 | 17 | 0.0563 | 1.54 |
| Low speed 2" pipe | 239.8 | 1.21 | 269 | 2 | 55.2 | 5.63 | 7.45 | 2.5 | 2 | 0.2051 | 0.27 |
| Low speed 1.5" pipe | 240.7 | 1.59 | 363 | 4 | 41.24 | 7.48 | 13.8 | 3 | 4.5 | 0.1136 | 0.36 |

*Testing of all pumps mentioned above were completed at IAPMO in Ontario, CA

**Watts are equal to energy supplied less harmonic distortion of approximately 3.5% - power factor .965 avg.

Pumps tested were full rated pump/motor combinations.

Information from the IPSSA pump test results was determined under specific conditions that may not exist at the location you are attempting to evaluate

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