



Problem

Our Sponsor, Pentair, Inc. is hoping to replace the AC induction motors currently in use in their water pumps with motors that are greener - more energy efficient and longer lasting.

Objectives

- Research and test potential motor technologies
- Report our findings to Pentair, along with our recommendation for which motor they should select to use in their water pumps.

Methodology

Research - We sought to learn as much as possible about AC and DC motors and controller technology for DC motors.

Motor Search - We searched for motors using the internet and calling area dealers. We found several that interested us from a few countries.

Design Phase - Designed adapters for both mounting the motor to the pump and driving the pump.

Our Visits to Pentair, Inc.



The group receiving a tour of the pump testing section of the Pentair factory in Delevan, Wisconsin.



Our group learning about the testing procedure for water pumps.



The pump testing station, with hoses leading to the differential pressure transmitters.

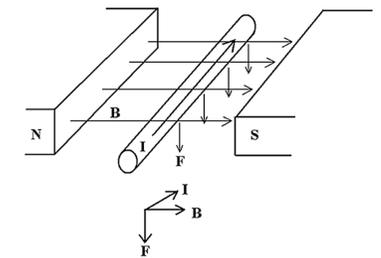


Flowmeter (blue meter) with valve (black) for regulating flow and pressure.

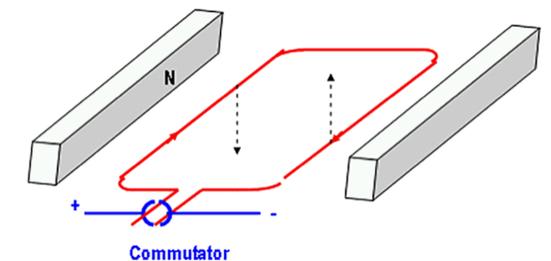


We received the STA-RITE JHE-63HL centrifugal pump to use for testing. The pump uses a component structure for easy serviceability. The pump design was to remain unchanged for this project.

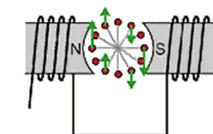
How a Motor Works



An electric current in a magnetic field experiences a force.



When a current carrying wire is bent into a loop, the two sides, with currents going in opposite directions create a rotating force (torque) about the center of the loop.



Practical motors have several loops on an armature to create a more uniform torque. The magnetic field is usually created by field coils, a type of electromagnet arrangement.

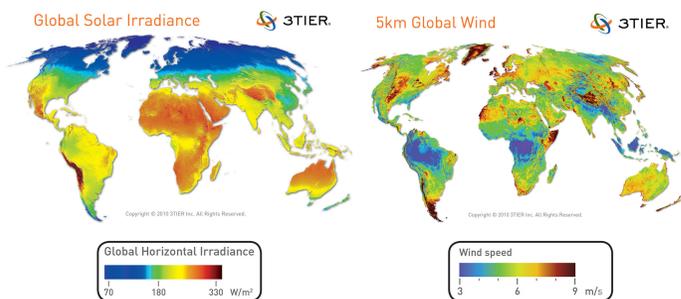
Why Use Brushless DC Motors?

DC motors provide the best balance of high output, low energy consumption, and are widely available.

Motor Type Comparison

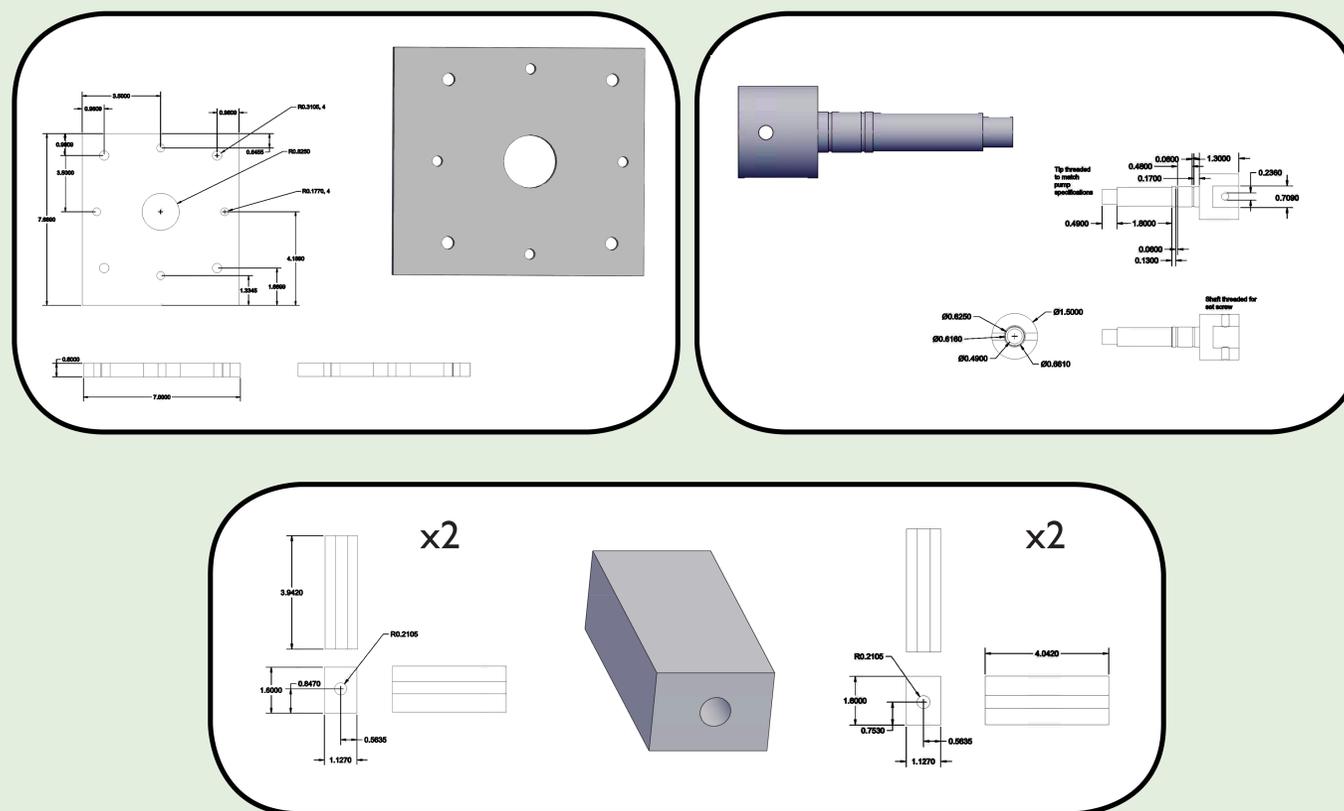
	AC polyphase induction	Brushless DC
+	Low cost, long life, high efficiency, many standardized types	Long lifespan, low maintenance, high efficiency
-	High starting current draw, speed control requires variable frequency source	High initial cost, requires a controller

How Can Alternative Energy be Utilized?



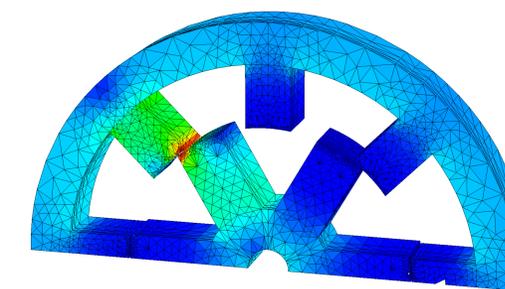
Between Solar and Wind energy, much of the land on Earth has a renewable energy source. These are very reliable sources of energy that can be utilized to power water pumps from wells in remote areas where no electrical infrastructure exists.

Designing an Adapter



Future Work

Switched Reluctance Motors (SRMs)



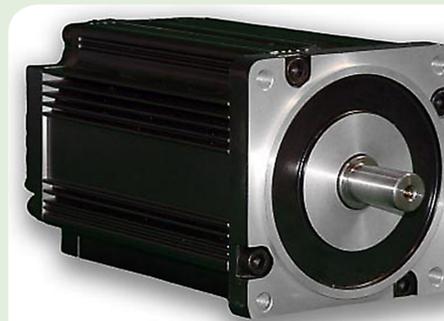
A magnetic flux diagram showing the repulsive (reluctant) force between the a stator and the rotor.

The switched reluctance motor (SRM) is a synchronous motor which runs by reluctance torque. It has wound field coils similar to DC motors for the stator windings. However, the rotor has no magnets or coils attached. The rotor becomes energized once the opposite poles of the stator become magnetized. To achieve full rotation in an SRM, the windings must be energized in the correct sequence and with precise phasing.

SRMs are believed to be the ultimate motor, theoretically, they would have the least amount of energy loss in a motor. At this time, they are not widely available on the market. Further testing should be performed once these motors are more widely available.

Conclusions

The Anaheim Automation BLZ48 Series Brushless DC Motors are compact and have a high power density. Many windings are available and can be customized to fit any application. The winding of this motor can be customized to match any voltage, current, and maximum operating speed. Shaft modifications are also available.



We expect that this motor will consume less power while providing the same output from the pump.