

***AEC announces a highly integrated motor/pump unit offering improved fluid handling performance with controllable flow***

There is tremendous interest today in **reducing the parasitic losses** in engineered systems in order to **improve fuel economy** and reduce emissions. This is particularly true in mobile systems where efficiency improvements are directly translated into **reduced size, reduced weight, increased range, and simplified logistics**. Advanced Energy Conversion is developing a **highly integrated fluid pump** that we believe can be an important element in advancing the state of the art in fluid handling for high performance applications. Initially the technology development has been focussed on the transportation sector; the **automotive, truck, rail** and **marine** markets, as well as **fuel cells**. Other commercial/industrial markets, which also rely on fluid handling for improved performance, are also candidates for the use of this AEC integrated pump technology.

In conventional electrically driven pumps, the pump and motor are each contained within their own housing and connected through a shaft. The AEC integrated pump provides for the dual use of parts by integrating the rotor of the electric motor with the impeller of the pump in a common housing. Our analysis has also shown it is possible to enable substantially improved fluid handling performance by developing a pump that is able to operate at controllable flow.

Accordingly, AEC is developing an innovative mixed flow pump design that uses **fewer parts**, is **more compact**, is **more efficient**, and **less expensive**. The AEC integrated motor/pump design can be expected to provide at least the following benefits:

- A **power dense electric machine** that is efficient and capable of controlled operation over a wide speed range.
- Substantially **improved thermal performance of the electric motor** due to direct liquid cooling of the windings.
- **Reduced physical size** by combining the motor and the pump in a single housing.
- **Reduced part count** by virtue of component integration.
- **Improved reliability** as a direct result of the reduced parts count.
- **Low manufacturing cost** through improved material utilization and reduced part count.
- Additional **system benefits** such as:
  - **Reduced radiator size** through better thermal performance from the controlled flow pump.
  - **Smaller bearings with reduced wear** through elimination of side loads for the electrically driven pump relative to belt-driven pumps.

AEC has patented an integrated pump that will create the tight coupling between the motor and the pump in order to facilitate substantial change in how fluid handling systems are implemented. In doing so, we expect to realize the following benefits:

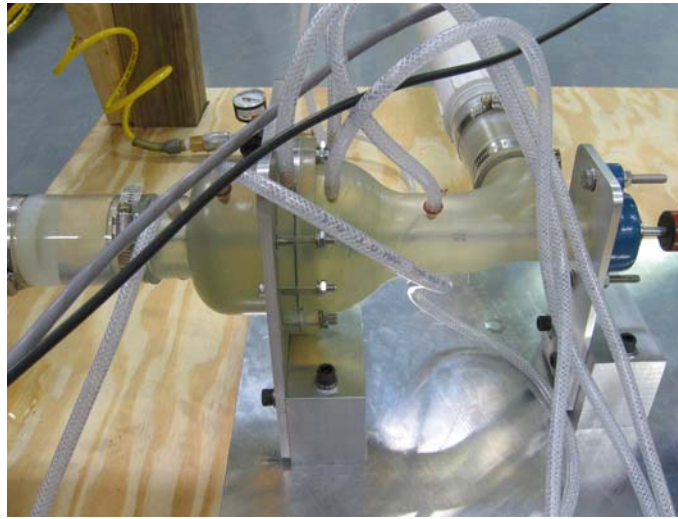
- The cost will be reduced through part reduction and reduced motor size.
- This reliability will be improved, again through part reduction.
- The physical size of the motor will be reduced. By putting the windings in close contact with the fluid, the heat in the windings can be easily removed. This will reduce the physical size of the motor, bringing it into line with the size of the pump.

Development of the pump is underway. A rapid prototype has been built to experimentally validate our models for the hydraulic design. Figure 1 shows the prototype pump that was used for experimental characterization of the flow characteristics. For this preliminary experimental work the pump impeller was driven by an external electric motor. Figure 2 shows the pressure-flow characteristics of the pump. Continued refinement of the hydraulic design is expected to increase the head for a given flow.

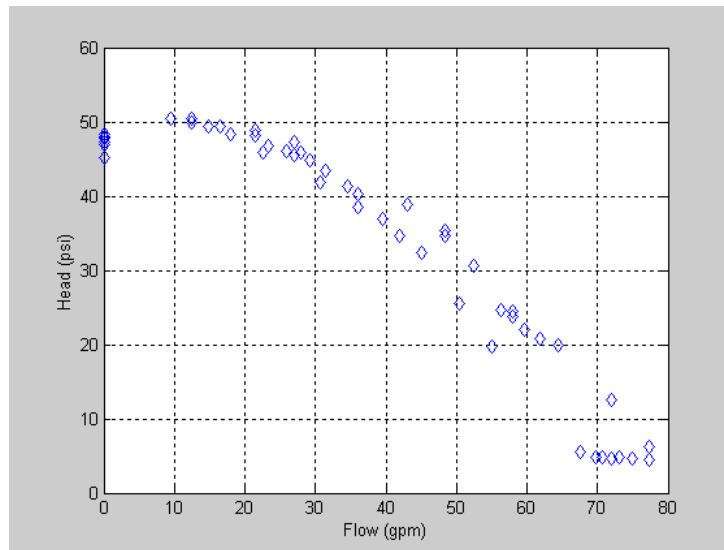


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**Figure 1:** The rapid prototype pump in the flow loop for hydraulic characterization. The tubing goes to gauges that track pressure through the pump.



**Figure 2:** Measured data from the rapid prototype pump.

A prototype integrated motor/pump has been built and tested. The motor is based on proven AEC technology for switched reluctance electric motor designs. Table 1 provides specifications for the prototype pump, which were selected to be compatible with needs in the heavy truck industry.

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**Table 1:** The target specifications for the prototype pump.

Parameter	Value	Units
Maximum Flow Rate	75.7	l/min
Maximum Pressure Rise	103	kPa
Maximum Fluid Temperature	125	°C
Input Voltage	9-16	V (dc)
Overall Efficiency	45	%

Advanced Energy Conversion is an engineering company with expertise in developing systems solutions using power electronics, embedded controls and mechatronics. AEC grew out of the electric power engineering program at Rensselaer Polytechnic Institute, Troy, NY. AEC has substantial experience in the transportation, distributed generation, and military markets in addition to our work in other industries. The focus at AEC is to find solutions to market-based problems that enable improving energy efficiency, reducing emissions, and increasing functionality in rapidly expanding markets.

Contact David Torrey at AEC for additional information about the fluid pump, at 518-289-8020, x11 or [DavidTorrey@AdvancedEnergyConversion.com](mailto:DavidTorrey@AdvancedEnergyConversion.com).