CFX helps design more efficient diesel engine water pumps

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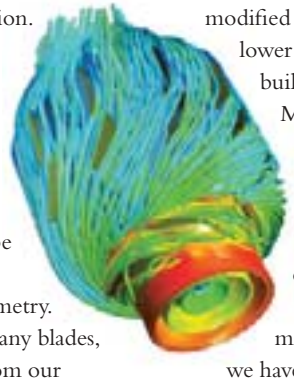
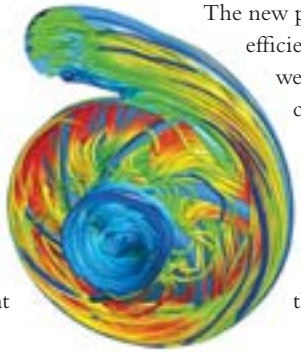
Engineers at EMP, North America's leading producer of cooling pumps for diesel engines, have developed an expert engineering process that quickly leads to optimized designs. The design cycle starts with our own in-house program that calculates initial 3-D designs based on the pump's required performance. Although this step is quick, it is limited because it can't predict potential performance problems such as flow re-circulation or cavitation.

For these reasons, we use CFX to verify and analyze the design. CFX's full suite of software is ideal for modeling pumps. We start with CFX-BladeGen by selecting a general blade shape and entering parameters to adjust it to fit our actual geometry. Now that we have created many blades, we can simply call up one from our library, adjust a few dimensions and we are all set. CFX-TurboGrid lets us select the characteristics of the computational mesh and generates the grid with minimal input. Sometimes, when we want to model an entire volute-based pump, we start with a Pro/ENGINEER solid model that we import into CFX-Build to create the mesh, which is then brought into CFX-TASCflow for analysis. Creating the model takes a bit longer, but it is speeded up by the generalized grid interface that makes it possible to connect completely dissimilar grids, regardless of how they were created.

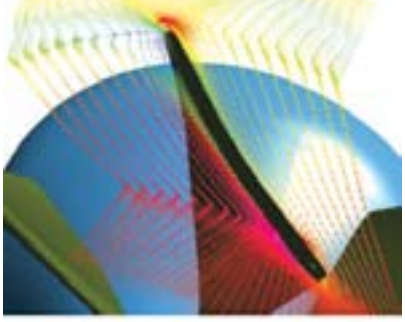


We use CFX-TASCflow for the simulations. The information that the software delivers– such as flow velocity and pressure at every point in the pump – is far greater than that which can be obtained with physical testing. In addition, CFD models can be created and modified in much less time and at lower cost than is required to build a hardware prototype. Moreover, the results of the analyses are used to continually develop our initial in-house design software, reducing future design iterations.

A good example of the many innovative designs that we have created using these methods is a pump designed to meet the requirements of today's engines. It uses a highly efficient flow-through diffuser, resulting in a flexible design that can be easily adapted to existing engines by allowing for various mounting locations.



The new pump can improve efficiency by over 20%, decrease weight by a factor of 2.5 and cut envelope requirements by 50%. CFX makes it possible to design better water pumps such as these in less time and at a lower cost than was possible in the past.



Top left: EMP's procution advanced electric pump for the drag industry.

Left: CFX analysis of centrifugal impeller, colored with pressure, showing localized low pressure at the blade leading edge.

Above: CFD model of blower blade with vector plot showing separation at the trailing edge.

Middle left: Analysis of EMP's advanced electric water pump with streak lines throughout the pump showing very good flow patterns.

Bottom left: CFD model of conventional volute-based water pump with streak lines throughout the pump showing problem areas, separations and recirculation.

Below: CFX assists EMP in preventing cavitation problems. The blue areas in these pictures are isosurfaces that show where the static pressure of the water is below the vapor pressure, leading to cavitation. The pictures are different views of the same impeller.