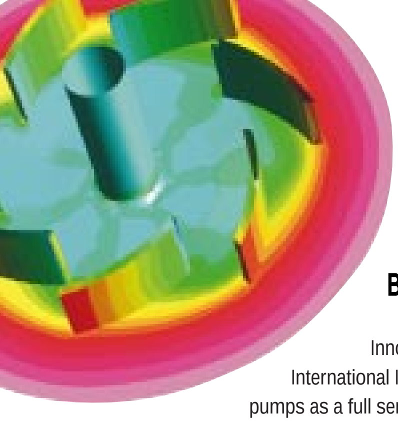


RIGHT FIRST TIME DESIGN FOR AUTOMOTIVE WATER PUMPS

Top left: Static pressure distribution on the impeller surface.

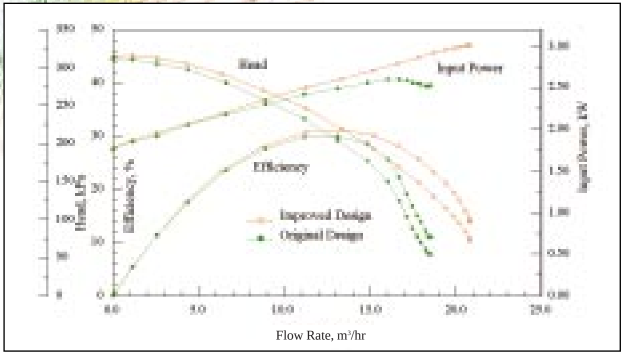
Behind: Relative velocity vectors on the mid-span plane.

By Fangbiao Lin, Innovative Cooling Dynamics, Ontario, Canada

Innovative Cooling Dynamics, a division of Tesma International Inc., designs and produces automotive water pumps as a full service Tier 1 supplier. To improve the efficiency of the design process, ICD has developed a state-of-the-art computer-aided development system with CFX products as core components.

One-dimensional empirically-based studies provide the general layout of the pump and key impeller parameters such as diameter, leading and trailing edge angles, number of blades, blade sweep angle, inlet and exit dimensions, and hub and shroud profiles. CFX-BladeGen is then used to refine the design, create a three-dimensional description of the impeller and prepare input data files for generating computational grids using CFX-TurboGrid. Following these preliminaries, the full 3-D performance of the impeller is evaluated using CFX-TASCflow, allowing the designers to deduce the expected pump efficiency, head rise and power consumption. In addition, the predictions reveal the details of blade behavior, such as flow separation, pressure distribution and sources of loss, information which underpins understanding of the large-scale performance. At this stage, the whole design process can be iterated easily until satisfactory pump performance is achieved. Finally, laboratory tests are performed to prove the design.

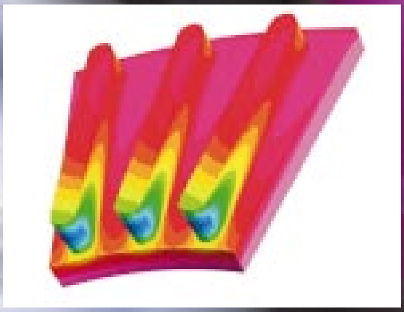
ICD's integrated approach to design is delivering benefits in several areas. Development time has been significantly reduced, and designs are achieved 'right first time'. We can now ensure that our pumps meet or exceed our customers' performance requirements, which in turn gives us a competitive edge in the market.



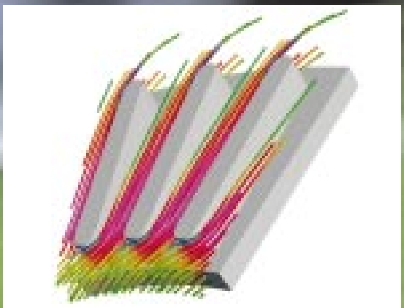
Pump characteristics for original and improved designs.

Cooler disc brakes

by Bob Sporzynski, LucasVarity Automotive, Michigan, USA and Mihajlo Ivanovic, AEA Technology



Temperature distribution on the brake rotor surface.



Streamlines colored with speed through the brake rotor.

Automotive disc brakes work by transforming the kinetic energy of the vehicle into heat as the brake pads are forced against the disc by the action of the calipers. The disc is then cooled by the ambient air. It is important that this cooling is sufficient, otherwise accumulation of heat can cause boiling of the brake fluid or brake "fade". Non-uniformity of heat transfer can also result in thermal stressing and possible cracking or distortion of the disc.

As a major manufacturer of brake discs, LucasVarity Automotive is naturally interested in optimizing its components. For this reason, their engineers turned to AEA Technology to investigate heat transfer through their disc brakes. In this particular device, a cast iron disc is composed of a pair of parallel plates which are supported by fins. As the disc rotates with the wheel, it acts like a centrifugal pump, drawing air through its core and thereby providing greater convective cooling than with simple solid discs.

In the CFX-TASCflow model set up by AEA Technology, parameters such as fin height, number and thickness can all be modified easily. The model also capitalizes on the periodicity of the device, thus allowing the engineers to investigate a single fin passage of the disc. The calculations assume that the flow is incompressible, enabling the decoupling of momentum and heat transfer. The fluid flow is computed first, and that solution serves as an input for subsequent calculation of the temperature field in which conduction is calculated through the cast iron.

Parametric analysis of different brake disc configurations, including fin height, thickness and number, is allowing LucasVarity to select the best design for any particular application.