Keeping Printer Touch Temperatures Low

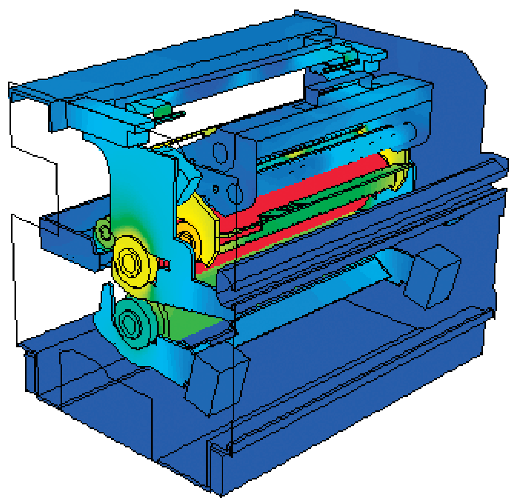
By Francisco Zirilli, PhD, Xerox Corporation, Rochester, NY

Engineers at Xerox Corporation have used FLUENT to reduce the temperatures in a new color printer in places that could be touched by users when clearing a paper jam. The new printer, the DocuColor iGen3, provides unparalleled speed, productivity, image quality, and paper-handling capabilities. Many of its replaceable units are designed for reuse or recycling. One of its internal components, the fuser roll, is used to fix the toner image to the paper, and the roll must be quite hot to do so. This creates an engineering challenge, since free convection can cause the temperature of customer accessible surfaces in the printer to rise to a level that could cause discomfort.

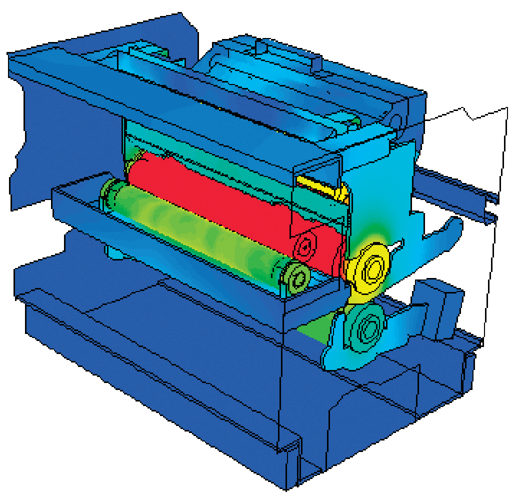
Fusing, the process in which the transferred toner image is fixed to the paper, is the last step in the xerographic process. Fusing the toner to the paper is usually done by passing the paper through a set of rolls that are forced to make contact with each other. The fuser roll is in direct contact with the toner. It consists of a hollow aluminum core coated with a rubber compound. This roll is heated internally using a radiant lamp. The opposing roll is called the pressure roll, and is made from solid steel. Successful fixing of the toner depends on maintaining the right fuser roll surface temperature and toner thermal properties. In the event of a paper jam, the customer may need to access certain areas in the fuser region of the printer. By design, any surface that the customer needs to come in contact with during jam clearance may not exceed specified touch temperatures.

Xerox engineers began the analysis process by importing IGES files of the printer into GAMBIT, where the geometry was simplified and an unstructured mesh of approximately 1.74 million cells was built. Their model considered both conduction and free convection heat transfer. Temperatures were specified for the surface of the roll in order to avoid the additional computational time needed to model the conduction inside the roll. The model was solved in two different ways. A laminar flow solution was performed that was based on the Boussinesq buoyancy approximation. A turbulent solution was also performed that included the effects of buoyancy. When the simulations were compared with physical experiments, both methods provided accurate results to within 10% of experimental measurements, so the more cost-effective laminar approach was used for subsequent analyses.

The results gave engineers all the information they needed to either redesign the customer accessible components or shield them from the high temperature sources. Natural convection was found to be the primary driver for carrying the heat from the fuser roll to the ends of the printer compartment. Portions of the pins and brackets that are touched by customers when clearing a paper jam reached unacceptably high temperatures in an early design, so the engineers repositioned these parts to move them out of the air stream. After simulating several design iterations, they found a configuration that maintained the temperatures at acceptable levels. Because the thermal conductivity of a material has a significant impact on the perceived touch temperature, they also used the results of the analysis to specify materials for user accessible components. ■



Temperature distribution of the fuser system, viewed from the paper exit, with some components removed for clarity



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