Feature: CAD

Simulation saves Xerox years of printer system development time

By Francesco Zirilli

Computer simulation has saved Xerox Corp. three years in optimizing the design of a contamination control system in a new printer.

The greatest challenge was to provide the required flow rate to each component by accurately balancing the flow through 29 branches of the distribution system.

Figure 1: Contours of static pressure on the surfaces of the ozone collection subsystem, one of three that were simulated.

In a recent project, a new Xerox high-end printer contains a sophisticated contamination control system that includes an ozone collection subsystem, an emissions controls subsystem, and an environmental control subsystem.

Xerox engineers turned to computational fluid dynamics (CFD) software from Fluent, Inc. (fluent.com), and began by separately modeling each of the three subsystems. CAD files were imported in IGES format into Gambit, Fluent's preprocessor, to generate the geometric model. The geometry (Figure 1) was cleaned up using the tools available in Gambit, after which a hybrid mesh (involving multiple element shapes) was generated. Fluent 6.0 was used to compute the pressure and velocity fields. Initial results obtained provided an accurate solution for the flow inside the cyclone separators. To accurately predict the total flow through the system, the main blower unit was modeled in detail using the multiple reference frames (MRF) model available in Fluent. With this model, a rotating frame is used for the impeller while a stationary frame is used for the blower housing. The solution proceeds with a steady transfer of information across a pre-defined interface between the two frames. The other seven blowers were modeled by measuring their flow characteristics in the laboratory and entering the "fan curves" into the CFD model.

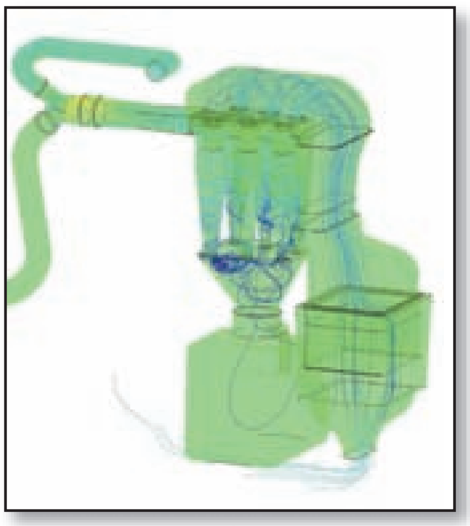

Figure 2: The emissions control subsystem, showing particle trajectories within the cyclone separators, the collection bottle, and the final filter.

Various filters in the contamination control system were modeled as porous media, with loss coefficients that were determined from experimental measurements.

Each model was validated by comparing its predictions to an early prototype. Once the models were validated, Xerox engineers modified pipe and restrictor diameters and manifold shapes in order to obtain the correct flow distribution.

Figure 2 shows the particle trajectories within the cyclone separators, the collection bottle, and the final filter. Since the filter was modeled as a porous media, the model allows the particles to flow through the filter media.

Figure 3 shows the geometric model of the environmental control unit. Air is cooled to remove moisture, and heated to the desired operating temperature.

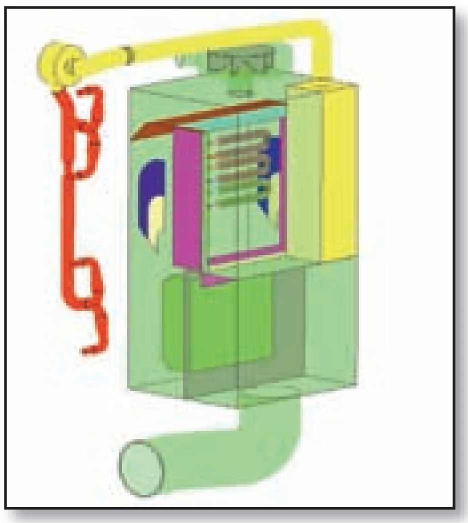

Figure 3: The geometric model of the environmental control unit.

Additional design iterations were required in order to bring the entire system back into compliance. Once this was accomplished, engineers changed the model assumptions to simulate operation at different altitudes in order to ensure that the system would continue to operate effectively.

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