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Computational and Experimental Investigations of Performance Curve of an Axial Flow Fan Using Downstream Flow Resistance Method

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A newly developed computational approach different from the conventional methods which are popularly adapted by the fan designers is employed to study the flow field and performance characteristics of an axial flow fan by using the commercial code (STAR-CD) of computational fluid dynamics. The new approach, which is termed the "downstream flow resistance" (DFR) method, engages the flow resistance of the fan test bench in the downstream area of the computational domain. Both the static and moving grids are employed in the computation. The results show at least three emphases. Firstly, the deviation of the calculated fan performance curves from the experimental results can attain levels less than 3% and 1.5% by using the DFR method with static-grid and moving-grid schemes, respectively. These results present dramatic improvement over the maximum deviation of about 26% obtained by using the conventional method with the static-grid scheme. Secondly, usage of the static or moving grids for the purpose of fan performance prediction is no longer an important issue when the DFR method is employed because both the static and moving grids show almost identical results. Thirdly, the *stall* occurs when the aerodynamic contour of the fan blade is inappropriately designed for the mid and high back-pressure operations. Under this situation, recirculation bubble would appear around the trailing edge of the suction surface of the fan blade, and therefore obstructs the development of the flow. At *deep-stall*, large recirculation flow structures may even appear around the pressure surface and block the passage between the neighboring fane blades to cause the reduction of flow rate.

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