Cooling Performance Investigation of a Rear Mounted Cooling Package for Heavy Vehicles

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The aim of the study was to investigate the cooling performance of two cooling package positions for distribution vehicles by using Computational Fluid Dynamics. The first cooling package was positioned in the front of the vehicle, behind the grill and the second position was at the rear of the vehicle. Each case was evaluated by its cooling performance for a critical driving situation and its aerodynamic drag at 90 km/h, where the largest challenge of an alternative position is the cooling air availability. The geometry used was a semi-generic commercial vehicle, based on a medium size distribution truck with a heat rejection value set to a fixed typical level at maximum power for a 13 litre Euro 6 diesel engine. The heat exchangers included in the study were the air conditioning condenser, the charge air cooler and the radiator. It was found that the main problem with the rear mounted cooling installation was the combination of the fan and the geometry after the fan. The combination of these parameters for the rear mounted cooling module resulted in a high system restriction and low cooling performance values. To obtain the same cooling performance as the front mounted installation the fan had to rotate 23 % faster, corresponding to 86 % more power for the fan, for a maximum power driving situation. For the rearward installation it was seen that the drag was reduced and no recirculation was present at low velocities as it was for the frontal positioned cooling module. Thereafter the duct after the fan for the rear mounted position was removed and the cooling performance became better than the front positioned cooling module. The conclusions made from the study were that the rearward positioned cooling module was an advantage at lower vehicle velocities, at higher speeds the air inlet has to be redesigned to obtain a more uniform airflow over the heat exchangers as well as obtaining higher cooling performance, and that the combination of the fan and its environment must be carefully matched. Though, this study was based on distribution vehicles mainly operating at lower velocities.

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