Simulation of R-1234yf Performance in a Typical Automotive System

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Simulations are conducted using R-1234yf (2,3,3,3-tetrafluoropropene; CF3CF=CH2) in a typical baseline R-134a small-size European automotive air-conditioning system, where the baseline R-134a system has a nominal cooling capacity of 5.8 kW at a compressor volumetric flow rate of 7.8 m^3h^{-1}. If R-1234yf is used as a drop-in replacement in this baseline system, its cooling capacity is 2.0 % lower than the R-134a value, and its COP is 1.0 % lower than the R-134a value. If on the other hand, the two systems are compared at equal cooling capacities, the COP values of the R-1234yf system are 0 % to 4 % lower than the R-134a values over operating conditions from idle to highway speeds. While both systems would benefit from the use of a liquid-line/suction-line heat exchanger, R-1234yf would benefit somewhat more from its use than would R-134a. Also, R-1234yf could benefit from the optimization of the heat exchanger circuitries. The thermodynamic and transport properties of R-1234yf are estimated from Brown et al. (2009a). The simulation results and analyses presented in this paper demonstrate the attractiveness of R-1234yf as a potential replacement for R-134a in automotive applications.