AUTOMOTIVE HEATER CORE FOR OFF–DESIGN CONDITIONS

Taahir Ibrahim Bhaiyat

A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Engineering.

Johannesburg, 2023

ABSTRACT

This dissertation presents the overall heat transfer performance of a louvered fin-and-tube heater core and a newly developed "lattice porous" heater core, each operating under uniform and non-uniform incident flow-fields. Specific emphasis is placed on the physical mechanisms pertaining to their differences in heat transfer rates, based on thermal and hydraulic dispersion characteristics of the cores. The variation of heat transfer rate with airstream flowrate is experimentally detailed in a typical range applicable to Automotive Climate Control System (ACCS) units (i.e., $58.8 \leq Re_{lp} \leq 361$). It has been demonstrated that a non-uniform airstream incident on a louvered fin-and-tube core reduces heat transfer to the airstream, while a non-uniform airstream incident on a lattice porous core enhances heat transfer to the airstream. This is because concentrated regions of momentum in a non-uniform incident airstream are fully dispersed, laterally, throughout a lattice porous core, thereby increasing surface interaction between the core and the airstream, as well as increasing flow mixing.