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Experimental Characterisation of Heat Transfer in Exhaust Pipe Sections

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ABSTRACT

This paper describes the characterisation of heat transfer in a series of 11 test sections designed to represent a range of configurations seen in production exhaust systems, which is part of a larger activity aimed at the accurate modelling of heat transfer and subsequent catalyst light off in production exhaust systems comprised of similar geometries. These sections include variations in wall thickness, diameter, bend angle and radius. For each section a range of transient and steady state tests were performed on a dynamic test cell using a port injected gasoline engine. In each case a correlation between observed Reynolds number (Re) and Nusselt number (Nu) was developed. A model of the system was implemented in Matlab/Simulink in which each pipe element was split into 25 sub-elements by dividing the pipe into five both axially and radially. The modelling approach was validated using the experimental data.

The steady state relationship between Re and Nu allow heat transfer in the test section to be predicted with acceptable accuracy over transient test cycles and demonstrates good agreement with relationships in the literature.

The model accuracy was enhanced by developing empirical models of heat transfer during the warm up stage of the transient test.