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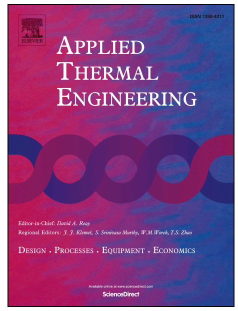

Reduced scale thermal characterization of automotive disc brake

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Reduced scale thermal characterization of automotive disc brake

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Abstract

The thermal behaviour of a disc brake is a critical factor that needs to be considered at the design phase. Most researchers utilise a full size brake dynamometer or a simple pin-on-disc rig to experimentally evaluate the performance of a friction pair (disc and pad). In the current paper, a scaling methodology is proposed to evaluate the thermal performance of a disc brake at a reduced scale. The resulting small scale disc brake has the advantage of low cost and reduced development time. The proposed scaling methodology was validated by comparing the results for the full and small scale discs using a conventional brake dynamometer. In addition, a two dimensional axisymmetric transient thermal finite element model was developed using Abaqus software to assist in the validation of the scaling methodology. The numerical simulations confirmed the equivalence between the full and small scale disc thermal performance using the proposed scaling methodology and also gave good agreement with the experimental results. It is concluded that the scaling methodology is an important tool with which to evaluate the thermal performance of disc brakes in the early design phase.

Keywords: Disc brake, thermal performance, dynamometer, small scale.

Notation

α	Thermal diffusivity	$[m^2/s]$
γ	The ratio of heat flux into the pad to the total heat flux	[---]
μ_a	The viscosity of the air	$[kg/ms]$
ρ	Material density	$[kg/m^3]$
ρ_a	The density of the air	$[kg/m^3]$
ω	Rig rotational speed	$[rad/s]$
τ	Torque	$[Nm]$