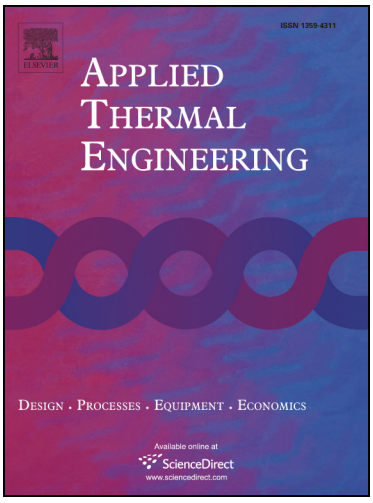

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Experimental investigation of two-dimensional wall thermal loads in the near-injector region of a film-cooled combustion chamber

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Abstract

Heat transfer management of the combustion chamber walls of rocket engines is key to predicting their life-cycle. This study used a test apparatus to measure heat transfer on the inner wall of a film-cooled combustion chamber. Experiments on a heat-sink GH_2/GO_2 combustion chamber with film cooling at the injector head were carried out to measure the distribution of wall heat flux and temperature under different chamber pressures and propellant mixture ratios. Averaged heat fluxes and transient values were obtained in the tests, which found a high correlation between transient heat flux and chamber pressure. A heat flux peak appeared in the near-injector region, and its distance from the injector head increased with chamber pressure. The thermal loads decreased obviously when the mixture ratio was increased from 5.0 to 7.0. The measurement data were used to interpolate two-dimensional contours of the wall's thermal loads. The results will be useful for the thermal-structural analysis needed to provide detailed boundary conditions in the hot-gas-side walls of rocket combustion chambers.

Key words: Rocket engine; Film cooling; Thermal loads; Heat flux; Combustion chamber.

Nomenclature		*Subscript*	
C^*	characteristic velocity, m/s	end	end of the firing time
h	convective heat transfer coefficient, W/(m^2*K)	k	node number of the time intervals
$\dot{m}$	mass flow rate, kg/m^3	w	hot gas side wall
N	number of the trial functions	g	average values of hot gas
p	pressure, MPa	h	hot gas near the wall
$\dot{q}$	heat flux, W/m^2	m	measured values
t	time, s	cc	combustion chamber
T	temperature, K	exp	experimental values
u	velocity, m/s	th	theoretical values
x	axial coordinate, mm		

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