

DEVELOPMENT OF CONTINUOUSLY VARIABLE INTAKE MANIFOLD FOR FORMULA STUDENT RACING ENGINE

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ABSTRACT: After several years of research and development of Formula Student's air mass flow restricted racing engine at the Internal Combustion Engines Department of the Faculty of Mechanical Engineering, University of Belgrade, the design process of a new intake manifold for the 2014 competition season was set off. Through several seasons, the intake manifolds of the YAMAHA YZF-R6 high performance engine evolved from a dual volume, into a single volume concept and finally to the continuously variable intake manifold (CVIM) design. Comparative analysis of data obtained during in-laboratory engine testing and data logged from ECU during the races gave some guidelines in the design of CVIM. The main goal of this research is increasing the number of engine operating points with resonant supercharging. The Ricardo WAVE engine mathematical model is improved and particular attention is dedicated to the approximation of the adopted CVIM concept using Helmholtz Resonance Theory. This paper describes the correlation between optimal intake runner length and manifold volume over engine speed at wide open throttle as well as their influence on volumetric efficiency and engine effective parameters.

KEY WORDS: engine testing, variable intake manifold, optimization, resonant supercharging, Formula Student

RAZVOJ KONTINUALNO PROMENLJIVE USISNE GRANE ZA MOTOR FORMULE STUDENT

REZIME: Nakon nekoliko godina istraživanja i razvijanja protoka vazdušne mase Formule student ograničenog trkačkog motora na katedri Motora sa unutrašnjim sagorevanjem Mašinskog fakulteta, Univerziteta u Beogradu, proces projektovanja nove usisne grane za sezonu 2014 je počeo. Kroz nekoliko sezona, usisna grana YAMAHA-e YZF-R6 motora visokih performansi je evoluirala od koncepta dvostruke zapremine u koncept jedne zapremine i konačno do koncepta (CVIM) kontinualno promenljive usisne grane. Usporedna analiza podataka dobijenih tokom laboratorijskih ispitivanja motora i podataka očitanih od ECU tokom trke daje neke smernice u dizajnu CVIM. Glavni cilj ovog istraživanja je povećanje broja radnih tačaka motora sa rezonantnim predpunjenjem. Rikardov WAVW matematički model je unapređen i posebna pažnja je posvećena aproksimaciji usvojenog CVIM koncepta primenom Helmholtzove rezonantne teorije. Ovaj rad opisuje vezu između optimalne dužine usisa i zapremine usisne grane zavisno od broja obrtaja motora sa potpuno otvorenim leptirom, kao i njihov uticaj na zapreminsku efikasnost i efektivne parametare motora.

KLJUČNE REČI: ispitivanje motora, promenljiva usisna grana, optimizacija, zvučno predpunjenje, Formula student