

A Gasoline Fueled Pre-Chamber Jet Ignition Combustion System at Unthrottled Conditions

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ABSTRACT

Turbulent Jet Ignition is an advanced spark initiated pre-chamber combustion system for otherwise standard spark ignition engines. Combustion in the main chamber is initiated by jets of partially combusted (reacting) pre-chamber products which provide a high energy ignition source. The resultant widely distributed ignition sites allow relatively small flame travel distances enabling short combustion durations and high burn rates. Demonstrated benefits include ultra lean operation ($\lambda > 2$) at part load and high load knock improvement near stoichiometric conditions.

Although previous results of this combustion system have been very promising, the main hurdle of this system has been the need for a dual fuel system, with liquid gasoline used in the main combustion chamber and small fractions of gaseous propane in the pre-chamber. The purpose of this paper is to demonstrate that this combustion system can operate robustly using a sole gasoline system, with vaporized gasoline found to be a successful substitute for the pre-chamber propane over all comparable conditions. With this concept, the test engine recorded a peak net thermal efficiency of 42.8% (190 g/kWh ISFCn) and single digit engine out NO_x emissions. The pre-chamber jet ignition system was also examined at unthrottled stoichiometric conditions up to 5500 rev/min, with successful operation demonstrated up to 13.2 bar IMEPn. Additionally, jet ignition combustion was also examined in order to evaluate pressure rise rate limitations for potential future high load powertrain applications.