

2010-01-2263

A Review of Pre-Chamber Initiated Jet Ignition Combustion Systems

William P. Attard
MAHLE Powertrain LLC

Elisa Toulson, Harold J. Schock
Michigan State Univ.

ABSTRACT

This paper reviews progress on turbulent jet ignition systems for otherwise standard spark ignition engines, with focus on small pre-chamber systems (<3% of clearance volume) with auxiliary pre-chamber fueling. The review covers a range of systems including early designs such as those by Gussak and Oppenheim and more recent designs proposed by GM, FEV, Bosch and MAHLE Powertrain. A major advantage of jet ignition systems is that they enable very fast burn rates due to the ignition system producing multiple, distributed ignition sites, which consume the main charge rapidly and with minimal combustion variability. The locally distributed ignition sites allow for increased levels of dilution (lean burn/EGR) when compared to conventional spark ignition combustion. Dilution levels are comparable to those reported in recent homogeneous charge compression ignition (HCCI) systems. In addition, jet ignition systems have the potential for combustion phasing control and hence speed/load range benefits when compared to HCCI, without the need for SI-HCCI combustion mode switching. The faster burn rates also allow for a base compression ratio increase (1-2 points) when compared to spark ignition and when combined with diluted mixture combustion, provide increased engine efficiency.