HOMOGENEOUS CHARGE COMPRESSION IGNITION DEVELOPMENT

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As a method of reducing exhaust emissions from a compression ignition engine, Caterpillar Technical Services Division is developing the technology required to achieve homogenous charge compression ignition (HCCI) via very early direct injection. Progress on the program to date has been in several key areas including analysis, injector testing and development, design and procurement of combustion system hardware, control system development, and preliminary engine evaluation of injector orifice geometry. As part of this program, this technology will be demonstrated on a high-speed, direct-injected engine as well as a heavy-duty, direct-injected engine. CAT3D combustion modeling has been used to select potential improved piston bowl designs for HCCI combustion. Variable valve timing and variable compression ratio studies were completed using simulation tools to help determine which technologies provide the most flexibility for combustion control. The initial HCCI injector has been developed, and bench validation is complete. A new spray chamber for HCCI injectors was commissioned. This, along with an optical test engine, has been used to select the optimum injector tip geometry for the HCCI. Initial HCCI engine testing on a Caterpillar 3171 has focused on optimum injector tip geometry. A HSDI single cylinder has been commissioned and is ready for combustion system development.