

# 4-Stroke Engine Cycle with Gasoline direct Injection

## Intake Stroke



Intake valve opens and allows air to be pulled into cylinder.  
Fuel is sprayed directly into cylinder

## Compression Stroke



Air/Fuel mixture is compressed as piston moves up

## Power Stroke



Spark plug ignites Air/Fuel mixture  
Combustion pushes piston down

## Exhaust Stroke



Exhaust valve opens allowing piston to push exhaust out as it moves up

# Gasoline Direct Injection Engine Cold Start Improvement By

**Society of Automotive Engineers**



## **Gasoline Direct Injection Engine Cold Start Improvement By:**

*Concepts in Turbocharging for Improved Efficiency and Emissions Reduction* Mehrdad Zangeneh, 2014-09-22 Legislative requirements to reduce CO<sub>2</sub> emissions by 2020 have resulted in significant efforts by car manufacturers to explore various methods of pollution abatement. One of the most effective ways found so far is by shortening the cylinder stroke and downsizing the engine. This new engine then needs to be boosted or turbocharged to create the full and original load torque. Turbocharging has been and will continue to be a key component to the new technologies that will make a positive difference in the next generation engines of years to come. *Concepts in Turbocharging for Improved Efficiency and Emissions Reduction* explores the many ways that turbocharging will deliver concrete results in meeting the new realities of sustainable green transportation. This collection of very focused technical papers selected by Mehrdad Zangeneh, PhD, a professor of thermo fluids at University College in London, provides an assessment of several novel designs intended to improve fuel consumption and cap emissions while maintaining torque at all speeds. The book is divided into four sections, each addressing the most cutting edge technologies on the market today: o Two Stage Turbocharging o Variable Geometry Compressors o Unconventional Compressor Configurations o Electrically Assisted Turbocharging **Emission Control and Fuel**

**Economy** John H Johnson, 2005-06-27 Emission and fuel economy regulations and standards are compelling manufacturers to build ultra low emission vehicles. As a result, engineers must develop spark ignition engines with integrated emission control systems that use reformulated low sulfur fuel. *Emission Control and Fuel Economy for Port and Direct Injected SI Engines* is a collection of SAE technical papers that covers the fundamentals of gasoline direct injection (DI) engine emissions and fuel economy design, variable effects on HC emissions, and advanced emission control technology and modeling approaches. All papers contained in this book were selected by an accomplished expert as the best in the field, reprinted in their entirety. They present a pathway to integrated emission control systems that meet 2004-2009 EPA standards for light duty vehicles.

*Automotive Spark-Ignited Direct-Injection Gasoline Engines* F. Zhao, M.-C. Lai, D.L. Harrington, 2000-02-08 The process of fuel injection spray atomization and vaporization, charge cooling, mixture preparation, and the control of in-cylinder air motion are all being actively researched, and this work is reviewed in detail and analyzed. The new technologies such as high pressure common rail gasoline injection systems and swirl atomizing gasoline fuel injections are discussed in detail, as these technologies along with computer control capabilities have enabled the current new examination of an old objective: the direct injection stratified charge (DISC) gasoline engine. The prior work on DISC engines that is relevant to current GDI engine development is also reviewed and discussed. The fuel economy and emission data for actual engine configurations have been obtained and assembled for all of the available GDI literature and are reviewed and discussed in detail. The types of GDI engines are arranged in four classifications of decreasing complexity, and the advantages and disadvantages of each class are noted and explained. Emphasis is placed upon consensus trends and conclusions that are evident when taken as a whole, thus

the GDI researcher is informed regarding the degree to which engine volumetric efficiency and compression ratio can be increased under optimized conditions and as to the extent to which unburned hydrocarbon UBHC NO<sub>x</sub> and particulate emissions can be minimized for specific combustion strategies The critical area of GDI fuel injector deposits and the associated effect on spray geometry and engine performance degradation are reviewed and important system guidelines for minimizing deposition rates and deposit effects are presented The capabilities and limitations of emission control techniques and after treatment hardware are reviewed in depth and a compilation and discussion of areas of consensus on attaining European Japanese and North American emission standards presented All known research prototype and production GDI engines worldwide are reviewed as to performance emissions and fuel economy advantages and for areas requiring further development The engine schematics control diagrams and specifications are compiled and the emission control strategies are illustrated and discussed The influence of lean NO<sub>x</sub> catalysts on the development of late injection stratified charge GDI engines is reviewed and the relative merits of lean burn homogeneous direct injection engines as an option requiring less control complexity are analyzed

**A Study to Quantitatively Analyze Cold Start Emissions for a Gasoline Direct Injection Engine** Jinghu Hu, 2023 The gasoline direct injection GDI technology is a technology with which the gasoline is directly injected in the cylinder GDI technology has been gaining popularity among vehicle manufacturers due to multiple advantages it presents compared with the port fuel injection technology and has been widely implemented in the light duty passenger vehicles on the US market One weakness of the GDI engine is the excessive hydrocarbon HC emission during the cold start where the engine speed cylinder and piston top temperature and engine fuel rail pressure are all far from optimal Given the more stringent Tier 3 HC emissions regulations enforced by United States Environmental Protection Agency and California Air Resources Board a detailed research on the GDI engine cold start HC emissions was essential to facilitate the compliance with HC emission standards from the modern GDI engines A novel experimental system was designed prototyped and installed The in house instrumentation and control system was designed based on the National Instruments hardware and aimed to control the Ford 2.0 L GDI engine and realize the engine cold start using custom engine powertrain parameters The novel gas collection and analysis system was designed and prototyped to allow a cycle based emission analysis The entire study was carried out using three steps First the validation experiment was conducted to validate whether the designed system hardware and software operated as desired and to provide some basic qualitative understanding of the GDI engine cold start profiles Second the preliminary quantitative analysis was carried out using both gasoline and iso pentane as fuel to further understand the contributing factors of the cold start HC emissions for GDI engines In the final step a parametric study multiple parametric sweeps were carried out for various powertrain parameters to identify the quantitative effect of each parameter on the engine power output and emission performances respectively The initial validation experiment results showed that the designed novel experimental system performed as expected and that HC emissions actually decreased

monotonically among the first five firing cycles of the cold start The preliminary quantitative analysis revealed that for gasoline fueled cold starts not all the injected fuel was collected in the exhaust gas The non collected fuel was potentially due to fuel wall wetting and piston top impingement which could be the main reason for the HC emissions The parametric study found that the main contributing factor of the HC emissions for the very first firing cycle was the injected fuel that did not evaporate in time for combustion but still in time for the emissions The parametric study also found that the HC emissions increased with injected equivalence ratio The change in fuel rail pressure had a complicated effect on the HC emissions at the first firing cycle The increase in injection times from 2 to 4 injections given the same amount of total injected fuel did improve the fuel evaporation and combustion status and led to higher power output and lower HC emissions given the same injected fuel mass The study showed that the key to mitigate the HC emissions during the GDI engine cold start was improving the fuel evaporation and air fuel profile so as to minimize the fuel wall wetting and piston top impingement effect

Annual Index/abstracts of SAE Technical Papers ,2007     *Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance* Richard Folkson,2014-03-19 Most vehicles run on fossil fuels and this presents a major emissions problem as demand for fuel continues to increase Alternative Fuels and Advanced Vehicle Technologies gives an overview of key developments in advanced fuels and vehicle technologies to improve the energy efficiency and environmental impact of the automotive sector Part I considers the role of alternative fuels such as electricity alcohol and hydrogen fuel cells as well as advanced additives and oils in environmentally sustainable transport Part II explores methods of revising engine and vehicle design to improve environmental performance and fuel economy It contains chapters on improvements in design aerodynamics combustion and transmission Finally Part III outlines developments in electric and hybrid vehicle technologies and provides an overview of the benefits and limitations of these vehicles in terms of their environmental impact safety cost and design practicalities Alternative Fuels and Advanced Vehicle Technologies is a standard reference for professionals engineers and researchers in the automotive sector as well as vehicle manufacturers fuel system developers and academics with an interest in this field Provides a broad ranging review of recent research into advanced fuels and vehicle technologies that will be instrumental in improving the energy efficiency and environmental impact of the automotive sector Reviews the development of alternative fuels more efficient engines and powertrain technologies as well as hybrid and electric vehicle technologies

**Gasoline Direct Injection Engine and Spark Ignition Performance** Society of Automotive Engineers,2003     *Combustion Modeling for Gasoline Direct Injection Engines Using KIVA-3V*. Bruno P. Vanzielegem,2004     **Technical Literature Abstracts** Society of Automotive Engineers,2000     SAE Transactions Society of Automotive Engineers,1928 Vols for include index which has title SAE transactions and literature developed

Chemical Abstracts ,2002     **Government Reports Announcements & Index** ,1988     **Mixture Preparation in a 2-valve Gasoline Direct Injection Engine** Edward S.. Suh,1999     Cumulative Index [of The] SAE Papers Society of

Automotive Engineers,1965     *The International Steam Engineer* ,1926     **Proceedings of the ... Spring Technical Conference of the ASME Internal Combustion Engine Division** American Society of Mechanical Engineers. Internal Combustion Engine Division. Spring Technical Conference,2002     **Automotive Engineering** ,1997-07     **Road and Track** ,1976     **Annual Report 1989-90** New Brunswick. Department of Transportation,1991 General activity review of associated branches and agencies to the Department which includes corporate securities registrations a list of tenders received and general financial data Branches and agencies reviewed are responsible for motor vehicle activity highway construction traffic engineering telecommunications and public utilities     *The International Operating Engineer* ,1926

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