- Thermal Expansion in Automotive-Engine Design
  SAE Technical Paper 300010 Frank Jardine

- A Refiner's Viewpoint on MOTOR FUEL QUALITY
  SAE Technical Paper 430113 W. M. Holaday, John Happel

Of the many gasoline characteristics in which the consumer is interested, a limited number are subject to close control by the refiner. The most important of these-antiknock sequality, vapor pressure, and distillation-are controlled largely by the requirements of modern automotive engines as determined by road tests and by customer acceptance. The various processes which the refiner uses to control the properties of his gasoline involve to a considerable extent the complete rebuilding of crude oil molecules which form the starting point of the refining process. The refiner's problem includes not only the manufacture of gasoline to meet a variety of automotive requirements, but the production of sufficient quantities of fuel with the greatest economic efficiency.

- The NSU-Wankel Rotating Combustion Engine
  SAE Technical paper 610017 Walter G Froede

- Small Wankel Engines
  SAE Technical Paper 680572 Helmut Keller

After stating all advantages of the new Wankel engine design, the development status of small, air cooled, rotary combustion engines from 6-20 hp is reported. These engines are now completely competitive with conventional reciprocating piston engines. The housing is cooled by air and the piston by the fuel mixture. Specific fuel consumption is comparable to that of a 4-stroke reciprocating engine of equal size. Lubrication is done by mixing oil and fuel in a ratio of 1: 50. A metering oil pump can be provided for separate tanking of fuel and oil. Some typical applications are specified.

- The Wankel RC Engine Design and Performance. RF Ansdale, 1968. ISBN 0 592 00625 5

- Rotary Engine
  Books by Kenichi Yamamoto, Toyo Kogyo, Mazda. 1969, 1971 and 1981 Editions

- The Wankel Engine, Jan P. Norbye, 2nd printing, Aug 1972. ISBN 0-8019-559-2

- Rotationskolben-Verbrennungsmotoren, W.-D. Bensinger, 1973. ISBN 978-3-642-52173-7

- Combustion Characteristics of Rotary Engines
  SAE Technical Paper 720357 K. Yamamoto, T. Muroki, T. Kobayakawa

An inherent characteristic of the rotary engine geometry is its high surface-to-volume ratio. This results in a high quenching effect at the trailing portion of the charge.

- Improvements of the Rotary Engine with a Charge Cooled Rotor
  SAE Technical Paper 720466 Kojiro Yamaoka, Hiroshi Tado

This paper covers the features of rotary engines with charge-cooled rotors developed by Yanmar Diesel Engine Co., Ltd. It includes test results obtained with charge-cooled rotors during the course of development of the engine with this feature. With continuing new applications of the NSU/Wankel rotary engine, charge-cooling appears to be a promising feature, especially in small-sized engines, from the point of view of simple structure and improved economy.

- Combustion Promoting Improvement in Rotary Engine Pat US3848574 (A) Fujikawa T; Kawano M; Yamamoto M. Kawasaki Heavy Ind Ltd.

The sparking electrodes of a spark plug of a rotary engine are disposed within a recess formed in the wall of the engine casing with an opening into the casing interior at a position downstream from the minor axis of the trochoidal inner surface of the casing inner surface, this recess being defined by a substantially semi-cylindrical downstream wall surface, side wall surfaces convergently extending in the upstream direction from the downstream wall, and an inclined bottom surface adjoining the side wall and downstream wall surfaces and extending smoothly with progressively decreasing depth toward the upstream direction. "Upstream" and "downstream" directional designations are with respect to the rotational direction of the engine rotor.

- Lubricant and Fuel Requirements and General Performance Data of Wankel Rotary Piston Engines
  SAE Technical Paper 730048 R. D. Behling, E. Weise

This paper presents a discussion of the requirements and performance data of the relatively recently manufactured rotary piston (RP) engine. In comparison with the older reciprocating piston engine, the lower octane requirements, lower NOx emission, and lower space and weight requirements are assets of the RP engine. Oil requirements and the wear problem are investigated; the RP engine has performed satisfactorily with conventional engine oils developed for reciprocating engines, and the wear problem is largely solved. In order to prevent premature engine damage or failure, the pre-ignition susceptibility of the RP engine must be reduced; possible solutions presented are: low content of ash precursors in the lubricant, selection of optimum base oil components, and design modifications.

- Kreiskolbenmotoren des Systems NSU-Wankel ihre Berechnung und Auslegung. J.P. Corbat, U. L. Pawlowski; Springer Basel AG, 1973. ISBN 978-3-7643-0693-9

- Rotary Engines - A Fuel and Lubricant Composition Study SAE Technical Paper 740160 Jh du Jeu, B. Brandone

In former papers, results of the study of test methods for wear and preignition in the NSU RO 80 engine were given. Conclusions were reached on the effects of the quantity and the viscosity of engine oils, the influence of the apex seal materials, the speed, the load, and the temperatures (coolant and oil). This paper is devoted first to a study of sulfur compounds and lead antiknock additives in the fuel (wear versus sulfur, lead, and scavengers contents), and second to a study of lubricating oils.

- The Effect of Selected Coolants on Metal Temperatures in a Rotary Engine SAE Technical Paper 741091 G. A. Paul

Rotary engines, by design, are somewhat more difficult to cool than conventional reciprocating powerplants. ...The basic aim of this research was to study the metal temperatures of many points in the rotary engine with standard and experimental coolants in an attempt to develop a product with superior heat rejection properties in a conventional cooling system. ...The engine used for the experiment was a two-rotor liquid-cooled Wankel engine obtained from a 1972 Mazda R-100. Both road and chassis dynamometer evaluations were run over a wide range of operating conditions to obtain a comprehensive look at coolant performance.

- ‘Heat Transfer in Rotary Combustion Engines’, Trans. from the ASME, Journal of Heat Transfer, May 1975, K. M. Atesmen

- Rotary Combustion Engine Hydrocarbon Source Studies SAE Technical Paper 780965 Robert J. Bayer, Stephen F. DeNagel, John C. Steiner

In an effort to improve the trade-off between fuel economy and emissions in the rotary combustion engine, research was undertaken to provide a better understanding of the sources of unburned hydrocarbons in the exhaust. ...Examinations were made of the effects of air-fuel ratio, engine load, residual gas, and engine speed on combustion and hydrocarbon emissions using the two experimental techniques. These studies identified two major sources of hydrocarbon emissions: flame extinction and, not surprisingly, apex seal leakage.

- Analysis of Light-Load Performance in Rotary Engines SAE Tech Paper 790435 Toshiyuki Kohno, Ryozo Ito, Minoru Morita, Nobutaka Mizuno

In rotary engines, misfires or partial burns often tend to occur under light load. By investigating gas composition in the combustion chamber, it was confirmed that these problems were mainly caused by the excess of internal EGR (Exhaust Gas Recirculation) in this range. A study of the processes by which internal EGR develops showed that a rather large proportion of the internal EGR was due to the unique intake-exhaust mechanism of the rotary engine. Favorable combustion was achieved by the use of air injection at the exhaust port, thereby reducing the EGR only in the light load range, and also through the use of glow plugs for improved ignition capacity.

- Predicting the Performance Characteristics of Two-Cycle Engines Fitted with Reed Induction Valves
  SAE Technical Paper 790842 G. P. Blair, E. T. Hinds, R. Fleck

Earlier papers by the principal author in conjunction with others have described the prediction of noise and performance characteristics of two-cycle spark-ignition crankcase compression engines. These calculations are performed on a digital computer and are shown to simulate accurately the unsteady gas flow and thermodynamic processes in such power units. The engines described previously had induction control by the piston or with a disc valve. In this paper the work is extended to engines fitted with reed valves controlling intake air flow and examples illustrating the effectiveness of such calculations are presented. In particular, a single-cylinder industrial engine is employed to show clearly the effects of changing such parameters as reed petal thickness, stop-plate radii and numbers of reed petals on the performance characteristics.

- Syvaro’s SP-440, Air Cooled, Rotary-Trochoidal Engine
  SAE Technical Paper 800974 Andrei Adam

A new, air cooled, rotary-trochoidal engine for industrial and recreational applications was designed and developed during the last eight years at SYVARO, Ltd. Engine features, structure, and development are discussed leading to the point where die-cast production could be offered for market penetration trials. In-depth description of the engine’s specific components - peripheral cooled rotor housing, high pressure die-cast end housings, rotor, crankshaft, and bearings - is followed by the discussion of its auxiliary systems and accessories - cooling, lubricating, ignition and starting. The engine’s relevant performances are reported including power output specific fuel consumption, evolution during endurance tests, and vibration.

- Development of the Norton Rotary Motorcycle Engine
  SAE Technical Paper 821068 D. W. Garside

Norton Motors have developed the mechanically-simple air-cooled-rotor-type of Wankel engine to have a higher specific output than the oil cooled rotor type. The paper traces the development over a thirteen year period and describes the present design. A characteristic of the engine is the very low mechanical friction. Mainly resulting from this factor, the specific fuel

consumption is similar to the best four-stroke reciprocating engines. The potential exists for further improvements.

- Heat Pipes Dunn, P. D. Published by Pergamon (1982-11-01) ISBN 10: 0080293557 / ISBN 13: 9780080293554

- Rotary Engine of the type cooled by an Air-Fuel Mixture Intake Pat US3991722 (A) Fujikawa Tetsuzo; Tamba Shinichi. Kawasaki Heavy Ind Ltd

- The Effect of Alcohol Blends on the Performance of an Air Cooled Rotary Trochoidal Engine
  SAE Technical Paper 840237 Marcel Gutman, Izu Iuster

Results obtained from tests on an air cooled Rotary Trochoidal Engine fuelled with a gasoline-alcohol mixture, without modification of the carburetor, are presented in this paper. The tests were performed with one and two spark plugs. Amongst the obtained results, lower thermal load, better economy and improvement in cycling uniformity when running with two spark plugs were observed. The observed reduction in the rotor housing wall temperature and in the oil sump temperature presents particular advantages for an air cooled engine.

- A Comprehensive Study of Wankel Engine Performance
  SAE Technical Paper 830332 R. Sierens, R. Baert, D. E. Winterbone, P. C. Baruah

An extensive experimental and analytical study of the performance of a Wankel engine is reported, with special emphasis on the combustion process. A one dimensional technique for calculating gas velocities in the combustion chamber under motoring conditions is described and this is then used to evaluate flame travel when combustion occurs. ...A one dimensional technique for calculating gas velocities in the combustion chamber under motoring conditions is described and this is then used to evaluate flame travel when combustion occurs. A novel three-zone combustion model is introduced. The effect of the position of the rotor recess is examined and shown to change the engine power output and hydrocarbon emissions. ...A one dimensional technique for calculating gas velocities in the combustion chamber under motoring conditions is described and this is then used to evaluate flame travel when combustion occurs.

- A Dynamic Analysis of Rotary Combustion Engine Seals
  SAE Technical Paper 840035 J. Knoll, C. R. Vilmann, H. J. Schock, R. P. Stumpf

Real time work cell pressures are incorporated into a dynamic analysis of the gas sealing grid in Rotary Combustion Engines. The analysis which utilizes only first principal concepts accounts for apex seal separation from

the trochoidal bore, apex seal shifting between the sides of its restraining channel, and apex seal rotation within the restraining channel.

- Recent Technology Development of High-Powered Rotary Engine at Mazda SAE Technical Paper 841017 Takumi Muroki

In response to today's market demands, technological development for high-powered rotary engines has been under way for application to passenger models and racing engines. This paper, describes first the development work devoted to achieve higher output, including a turbocharger system, tuned induction and exhaust systems, combustion chamber shape, ignition system. New technologies used for components so as to cope with higher power output, thus securing engine reliability and durability are discussed. Those technologies include a new surface treatment for improved lubrication of the trochoid surface, reduction in rotor gear stress, and optimization of the spark plug and igniter system. Those development efforts resulted in production of: TURBO CHARGED 573 cc × 2 rotors, 165 ps/6500 rpm engine for passenger car and 573 cc × 2 rotors, more than 260 ps/9000 rpm engine and 654 cc × 2 rotors, more than 300 ps/9000 rpm engine for racing.

- Detonation Characteristics of Industrial Natural Gas Rotary Engines SAE Technical Paper 860563 T. N. Chen, R. N. Alford, S. S. Kim

The 41 litre (2500 cu. in.) per cavity natural gas fueled industrial rotary engine manufactured by Ingersoll-Rand Co. has completed many hours of successful field operation. Occasional engine detonation has been observed when the fuel quality deteriorated due to the presence of liquid hydrocarbons in the natural gas fuel. Such a condition could cause structural damage particularly to the apex seals. Detonation characteristics of this engine are discussed and the experimental and analytical results presented. The detonation limit of the engine for a given fuel can be expressed as a function of the firing pressure and the adiabatic compression temperature of the end gas. A method for estimating the stagnation detonation pressure is presented based on engine data obtained on an Ingersoll-Rand IR-2500 engine operating under incipient detonation conditions. For natural gas fueled engines the stagnation detonation pressure can exceed 32.4 MPa (4700 psia).

- Research and Development Work on Rotary Combustion Engines in China SAE Technical Paper 880628 Teluan Chen

The gasoline rotary combustion engine has been developed in China for more than 26 years. In this paper, the six technical key problems and the way to solve them are briefly reviewed. ...It is felt that the performance of rotary combustion engines developed in China has reached the level suitable for production.

- Rotary Engine Design: Analysis and Developments SAE SP-768

Papers from an international congress and exposition held in Detroit in February/March 1989, cover engine developments and supportive fundamental data base. Mazda and John Deere as the foremost applicants, and NASA as a prime sponsor of rotary engine technology, present most of the papers.

- Relative Performance of Rotary and Piston Engines on Synthetic Coal-Derived Gasoline SAE Technical Paper 890212 C. Kappos, S. Rajan

The paper compares the overall power and emissions features and in-cylinder combustion characteristics of a two-rotor Wankel engine and those of a four-cylinder piston engine, with particular reference to thermal efficiency, oxides of nitrogen, unburnt hydrocarbons, exhaust temperature, ignition delay and combustion interval. The study provides insight into the similarities and differences in the mechanisms of pollutant formation and combustion characteristics of rotary and piston engines, while operating on a synthetic coal-derived gasoline. In particular, the shorter ignition delay and longer combustion interval of the rotary engine indicates its suitability for use with lower quality fuels.

- The Introduction of a New Ultra-Lite Multipurpose Wankel Engine SAE Technical Paper 900035 Dankwart Eiermann, Roland Nuber, Michael Soimar

A new family of compact, light weight Wankel engines for multi-purpose applications was designed and is currently under an optimization test. The engine short block with fewer parts reaches the pinnacle in the simplicity of the rotary combustion engine design concept. New technological solutions have been employed in the design of the cooling, ignition and lubrication systems in order to lower the engine maintenance and operating costs. The paper describes the primary components and systems of the engine and much of the design and development work that led to the validation of the new design. The single rotor and two rotor engines cover a power range of 5-50Kw when naturally aspirated, with a weight to power ratio close to 1 lbs/lhp. The design concept demonstrated a high potential for turbocharged applications. Unparalleled weight to power ratio are estimated for the fully developed turbocharged version of both engines.

- Rotary Engine Performance Limits predicted by a Zero-Dimensional Model NASA CR 189129, March 1992
  Timothy A Bartrand, Edward A Willis

- The Development of Lubricating Oils for Rotary Racing Engines
  SAE Technical Paper 922375
  Takao Yabe, Toshihiko Arai, Shoji Aoyama, Masayuki Oshima

In order to achieve the highest power output and lowest fuel consumption for the rotary engine in endurance race such as Le Mans, two types of lubricating oils were developed by conducting a single - rotor engine test at the rotational speed of 7500 rpm under full load. ...One was the engine oil for the lubrication of the combustion chamber. The other was a so - called system oil for lubrication of the engine system outside the combustion chamber. ...The other was a so - called system oil for lubrication of the engine system outside the combustion chamber. The conclusions obtained from the development are as follows: 1) Engine oil for the combustion chamber The engine oil greatly influences spitback phenomenon1) which can cause rotary engine trouble in an endurance race.

- Catalytic Glow Plugs in the JDTI Stratified Charge Rotary Engine
  SAE Technical Paper 930680 Dylan Hixon, Kevin Burns, William Pfefferle

A catalytic glow plug was developed for low surface temperature operation which shows the capability of achieving equivalent effectiveness as a similar-geometry non-catalytic plug operating at a higher temperature. The plug was tested in a diesel-fueled version of the John Deere Technologies International Stratified Charge Rotary Engine (SCRE), wherein a glow plug can be used as the continuous ignition source for the pilot injector. The catalytic plug operated the engine using an indicated surface temperature as much as 275°C colder than the non-catalytic baseline plug. The catalytic glow plug, by operating effectively at a lower temperature than a conventional glow plug, offers the potential for greatly improved durability. Interesting applications include the SCRE engine, other low compression diesel engines, alternative fuel diesel engines, gas turbine engines, and diesel engine cold starting.

- Development of a Lightweight Heavy Fuel Rotary Engine
  SAE Technical Paper 930682 Len Louthan

A single rotor Wankel engine displacing 294 cc was converted from a carbureted gasoline configuration to a turbocharged, direct injected heavy fuel engine.

- Evaluation of Thermal Barrier and PS-200 Self-Lubricating Coatings in an Air Cooled Rotary Engine. Paul S Moeller (Möller); NASA Contract Report CR 195445, March 1995

- The Characteristics of Fuel Consumption and Exhaust Emissions of the Side Exhaust Port Rotary Engine SAE Technical Paper 950454 Ritsuharu Shimizu, Haruo Okimoto, Seijo Tashima, Suguru Fuse

Mazda has been pursuing the research of side exhaust porting for its rotary engine in an effort to improve the engine's fuel efficiency and exhaust emissions characteristics. The side exhaust porting configuration provides greater flexibility in setting port timing and shape, as compared to the peripheral exhaust porting configuration, which is in use in the current-generation Rotary engines; the side exhaust porting configuration enables the selection of a port timing more favorable to reduced fuel consumption and exhaust emissions. The side exhaust port rotary engine used in this research has its exhaust port closure timing around the top dead center (TDC) and has no intake-exhaust timing overlap. As a result, burnt gasses entering the next cycle of combustion are reduced, thus enhancing combustion stability; also, the air-fuel ratio can be set leaner for improved fuel consumption.

- Controlling two-stroke engine emissions
  Automotive Engineering International 2000-02-01 (a SAE Magazine) With the constant rich operation of two-stroke engines, common design criteria for three-way catalysts fail.

- Altitude Performance Comparison of A Wankel Engine With Carburetor and Fuel Injection
  SAE Technical Paper 2003-28-0017 V Sarveswaran, Y V S Murthy (IN), V Ganesan

The modern automobile engine has enjoyed more than a century of continuous development dating back to 1878, when the German engineer, Dr. Nicholas August Otto exhibited his first four-cycle engine. The quests for positive displacement rotary piston machines have attracted the attention of several centuries and actually pre-date the invention of the reciprocat ing piston principles. A bewildering variety of possible rotary engine configurations seem to have been tried and at the same time, confused inventive minds, thereby preventing the early success of purely rotating engines. Over the period of time, engine technology, which was in paper those days staged a comeback, and started entering the market. One such, new technology is the Wankel engine development. This engine has already made their impact in the aeronautical field, and its use in automobile field is being explored. These engines are available in both carburetor and Electronic Fuel Injection (EFI) version.

- The Numerical Investigation on the Performance of Rotary Engine with Leakage, Different Fuels and Recess sizes
  SAE Technical Paper 2013-32-9160
  Dun-Zen Jeng, Ming-June Hsieh, Chih-Chuan Lee, Yu Han

This study investigates the influence of leakage through the apex seal, fuel type and recess size on the performance of a Rotary Engine. A commercial CFD software, Fluent, was applied and a two-dimensional model was constructed to predict the engine performance. Air and fuel flow into the chamber by two separate ducts in this model were used to simulate fuel-air mixing. Three different apex seal clearances (0mm, 0.4mm, 0.5mm) were simulated. The computations with two types of fuel, CH4 and C8H18, were performed and put in result comparison in this study. The recess sizes were based on three compression ratios, 8.33, 9.55 and 10.18. To simplify rotor mesh construction in the model with leakage, a porous region was generated to model this quite small gap. The generation of a porous region can greatly reduce mesh sizes and stabilize the numerical iterations.

- The Intake and Exhaust Pipe Effect on Rotary Engine Performance
  SAE Technical Paper 2013-32-9161
  Dun-Zen Jeng, Ming-June Hsieh, Chih-Chuan Lee, Yu Han

This article is to investigate the inlet and exit pipe effect on a rotary engine performance. A 1-dimensional, three-cylinder reciprocating engine model was adopted to simulate the operation of a rotary engine with three separate chambers. The chamber volume variation in this model was identical to a real rotary engine. The test data of the real rotary engine were used as a benchmark test for this model. Various parameters are then studied, including pipe length, pipe diameters, and pipe shape with convergent/divergent angles. In the performance analysis, the results showed that the averaged performance data (BSFC, brake work, brake torque, pressure distribution) was within 5 % in tolerance. The results of pipe length variation showed that in a range of short inlet pipe brought higher power (8.4 %). On the contrary, the exhaust pipe had a better work output over a certain length (10%). With a shorter inlet pipe and a longer exhaust pipe, the work output makes about 14.3% higher.

- A Heat Pipe Assisted Air-Cooled Rotary Wankel Engine for Improved Durability, Power and Efficiency
  SAE Technical Paper 2014-01-2160 Wei Wu, Yeong-Ren Lin, Louis Chow

Abstract In this paper, we address the thermal management issues which limit the lifespan, specific power and overall efficiency of an air-cooled rotary Wankel engine used in Unmanned Air Vehicles (UAVs). Our goal is to eliminate the hot spots and reduce the temperature gradients in the engine housing and side plates by aggressive heat spreading using heat pipes. We

demonstrate by simulation that, for a specific power requirement, with heat spreading and more effective heat dissipation, thermal stress and distortion can be significantly reduced, even with air cooling. The maximum temperature drop was substantial, from 231°C to 129°C. The temperature difference (measure of temperature uniformity) decreased by 8.8 times (from 159°C to 18°C) for a typical UAV engine. Our heat spreaders would not change the frontal area of the engine and should have a negligible impact on the installed weight of the propulsion assembly.

- Advanced Low Friction Engine Coating Applied to a 70cc High Performance Chainsaw SAE Technical Paper 2014-32-0115
  Mikael Bergman, Magnus Bergwall, Thomas Elm, Sascha Louring, Lars Nielsen

Abstract Present two stroke engines used for hand held power tools must confirm to prevailing emission legislation. A fact is that today the engines have to be run at leaner air fuel setting resulting in less amount of lubrication oil passing through the engine. This lean mixture combined with high mixture trapping efficiency also affects the combustion, raising the overall working temperature of the engine. So to gain more robustness out of these air-cooled power heads one viable route is to use different coatings to take control of tribology and heat management within the two stroke power head. In this paper a first discussion and description of the different coatings and their merits to the air cooled two stroke engine is conducted. Furthermore engine data for the test engine, in this case a 70cc professional chainsaw are presented. The outcome of engine dyno testing of the different coatings are presented and analyzed for further discussion.

- Modeling of the Rotary Engine Apex Seal Lubrication
  SAE Technical Paper 2015-01-2035 Mathieu Picard, Tian Tian, Takayuki Nishino

The Wankel rotary engine is more compact than conventional piston engines, but its oil and fuel consumption must be reduced to satisfy emission standards and customer expectations.

- CAD/CFD/CAE Modelling of Wankel Engines for UAV
  SAE Technical Paper 2015-01-2466 Alberto Boretti

The Wankel engine for Unmanned Aerial Vehicle (UAV) applications delivers advantages vs. Piston engines of simplicity, smoothness, compactness and high power-to-weight ratio. The use of computational fluid dynamic (CFD) and computer aided engineering (CAE) tools may permit to address the major downfalls of these engines, namely the slow and incomplete combustion due to the low temperatures and the rotating combustion chambers. The paper proposes the results of CAD/CFD/CAE modelling of a Wankel engine featuring tangential jet ignition to produce faster and more complete combustion.

- Implementation of a Rotary Engine (Wankel Engine) in a CFD Simulation Tool with Special Emphasis on Combustion and Flow Phenomena Technical Paper 2015-01-0382
  Johann Spreitzer, Felix Zahradnik, Bernhard Geringer

This paper describes the development of a comprehensive simulation environment for investigations of gas-dynamic processes and combustion phenomena in rotary engines, conducted by the Austrian Institute for Powertrains and Automotive Technology of the Vienna University of Technology. In this connection, proven, commercially available engine cycle calculation Software-Tools have been used. For this, a rotary engine test bench has been established. As analysis tools, in addition to the traditional acquisition of the emitted engine torque, various pressures and temperatures, the recording of the pressure profile (combustion analysis measurement system) in the combustion chamber, as well as in the intake and exhaust ports, were used. The data of the test bench were used to develop and validate the methodology for the simulation tools. The focus in this paper is the development of a CFD (computational fluid dynamics) model with the software Converge from Convergent Science, Inc.