Klaus Mollenhauer
Helmut Tschöke
Eds.

Handbook of Diesel Engines

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With 584 Figures and 86 Tables

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Preface

This machine is destined to completely revolutionize engine engineering and replace everything that exists. (From Rudolf Diesel's letter of October 2, 1892 to the publisher Julius Springer.)

Although Diesel's stated goal has never been fully achievable of course, the diesel engine indeed revolutionized drive systems. This handbook documents the current state of diesel engine engineering and technology. The impetus to publish a Handbook of Diesel Engines grew out of ruminations on Rudolf Diesel's transformation of his idea for a rational heat engine into reality more than 100 years ago. Once the patent was filed in 1892 and work on his engine commenced the following year, Rudolf Diesel waited another 4 years until the Association of German Engineers provided him a platform to present his engine to the public at its convention in Kassel on June 16, 1897. The engine came to bear the name of its ingenious inventor soon thereafter.

The editors and publisher intend this English edition of the handbook to furnish readers outside German-speaking regions a scholarly and practical presentation of the current state of the diesel engine and its large range of applications. The handbook has not only been conceived for diesel experts but also "diesel laypersons" with prior knowledge of engineering or at least an interest in technology. Furthermore, it is intended to benefit students desiring a firsthand comprehensive and sound overview of diesel engine engineering and technology and its state of development.

These aims are reflected in the book's five-part structure. Part I provides a brief history of the diesel engine followed by sections on the fundamentals, including supercharging systems, diesel engine combustion, fuels and modern injection systems. Parts II–IV treat the loading and design of selected components, diesel engine operation, the pollution this causes and the increasingly important measures to reduce it. Part V presents the entire range of engines from small single cylinder diesel engine up through large low speed two-stroke diesel engines. An appendix lists the most important standards and regulations for diesel engines.

Further development of diesel engines as economizing, clean, powerful and convenient drives for road and nonroad use has proceeded quite dynamically in the last twenty years in particular. In light of limited oil reserves and the discussion of predicted climate change, development work continues to concentrate on reducing fuel consumption and utilizing alternative fuels while keeping exhaust as clean as possible as well as further increasing diesel engine power density and enhancing operating performance. Development is oriented toward the basic legal conditions, customer demands and, not least, competition with gasoline engines, which are still considered the benchmark car engine in many sectors.

The topics to be treated were weighed with all this in mind: In addition to engine internal measures that reduce exhaust emissions with the aid of new combustion systems and new fuels, the section on *Exhaust Gas Aftertreatment* deserves particular mention. The oxidation catalytic converters introduced in the car sector as standard in the 1990s will soon no longer meet the mounting requirements for air hygiene; particulate filters and nitrogen oxide reduction systems, e.g. SCR and storage catalysts, have become standard.

New combustion systems with a larger share of premixed, homogeneous combustion than normal diffusion combustion are just as much the subject of this handbook as the refinement of supercharging to enhance the power output, increase the peak cylinder pressure and thus limit load as the brake mean effective pressure increases. Quickly emerging as the optimal injection system when the car sector switched from indirect to direct injection at the end of the 1990s, the common rail system also came to be used – initially only experimentally – for larger diesel engines at the start of the new millennium. The common rail system is now standard in diesel engines

of virtually every size. Hence, reflecting current but by far not yet finalized development, this handbook treats the different designs, e.g. with solenoid valve-controlled or piezo-actuated injectors, in detail. Ample space has accordingly also been given to electronics with its diverse options to control processes in the engine.

To be able meet the expectations and demands connected with a Handbook of Diesel Engines, we relied as much on the collaboration of outstanding engineers from the engine industry as on the research findings of professors at universities of applied sciences and universities. After all, a particularly close connection has existed between theory and practice, between academia and industry, in engine research since Diesel's day, his invention itself being based on the engineering of his day.

Thanks to the work of many generations of engineers, scientists, researchers and professors, the diesel engine continues to be the most cost effective internal combustion engine and has evolved into an advanced high-tech product.

We would like to thank all the authors – whether experts working in industry where the utmost dedication is demanded or our colleagues in academia where the days of creative leisure have long since become a thing of the past – for their collaboration, their ready acceptance of our ideas and the many fruitful discussions. We would also like to extend our gratitude to the companies that allowed their employees to work on the side, supported the compilation of texts and master illustrations and provided material. Acknowledgement is also due the many helpers at companies and institutes for their contributions without which such an extensive book manuscript could never have been produced.

Particularly special thanks go to the Diesel Systems Division at Robert Bosch GmbH for the technical and financial support, which made it possible to complete this extensive work in the first place.

Despite the sometimes hectic pace and considerable additional work, the editors tremendously enjoyed their collaboration with the authors, the publisher and all the other collaborators.

Berlin, Germany,
Magdeburg, Germany
September 2009

Klaus Mollenhauer
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My engine continues to make great advances. . . . (From Rudolf Diesel's letter of July 3, 1895 to his wife.)

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