The Thermodynamics

of Internal Combustion Engines

Basics and Examples for

Engine Layout, Analysis and Development

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C O N T E N T S

1. Introduction

This script deals with a summary of the most important thermodynamic processes for internal combustion engines (ICE) and is partly covered by published literature and complimented with own results and graphs based on HERON in-house projects.

The goal of the training course is to refresh specific knowledge, as published in relevant textbooks or learned during higher education, and to be able to apply this successfully within daily work.

Due to increasing complexity of the development process of modern ICE, success can only be achieved by well organised team work, which may well lead to a further increase of number of specialists, only dealing with specific parts of the problem. As a result, fundamental contexts and simple control mechanism may get lost when, for example, measurement errors occur.

An attempt is therefore made to reduce the theoretical foundations down to their essentials such as examining the gas exchange and combustion processes influencing variables respectively, by using concrete examples.

Implementation and examples of applicability are demonstrated using EXCEL spreadsheets; where necessary, tips as well as the utilizations of some existing options have been provided. (Keyword: parameterization and Macros). In terms of the applied IC processes, this script focuses on four stroke DIESEL and OTTO engines only. Today, the two stroke engine and the rotary piston engine are designs mainly applied in niche markets and will not be discussed in detail.

Although we shall predominately consider turbo-charged engines today, for the study of gas-dynamic setups, naturally aspirated OTTO engines will also be reviewed. The thermodynamics and chemistry of exhaust after-treatment will not be included.

The engine parameters used in the documentation and the resulting computation's results are based on data similar to the engines of various projects undertaken by HERON Technik GmbH. Hence similarities to existing work is inevitable. Customers' details are not kept and/or have been modified accordingly. In the event of accidental illustration of confidential data, or any errors of such a nature, please contact us for swift rectification thereof.

Thank you very much in advance,
Dr. Hans Alten