Design and Simulation of Four-Stroke Engines

List of Chapters:



The Last Mu	ulled Toast
Foreword	
Acknowled	gements
Nomenclatu	ıre
Chapter 1	Introduction to the
1.0	Four-Stroke Engine About This Book
1.0	The Fundamental Method of
	Operation of a Simple Four-
	Stroke Engine
1.2	The Cylinder Head Geometry
1.2	of Typical Spark-Ignition
	Engines
1.3	The Cylinder Head Geometry
	of Typical Compression-Ignition
	Engines
1.4	Connecting Rod and
	Crankshaft Geometry
1.5	The Fundamental Geometry of
	the Cylinder Head
1.6	Definitions of Thermodynamic
	Terms Used in Engine Design,
	Simulation, and Testing
1.7	Laboratory Testing of Engines
1.8	Potential Power Output of
	Four-Stroke Engines
1.9	The Beginnings of Simulation
	of the Four-Stroke Engine
1.10	The End of the Beginning of
	Simulation of the Four-Stroke
	Engine
Refe	erences for Chapter 1
	endix A1.1 Fundamental
	modynamic Theory for
the (Closed Cycle

Chapter 2

Gas Flow through Four-Stroke Engines

- 2.0 Introduction
- Motion of Pressure Waves in a 2.1 Pipe
- 2.2 Motion of Oppositely Moving Pressure Waves in a Pipe
- 2.3 Friction Loss and Friction Heating during Pressure Wave Propagation
- 2.4 Heat Transfer during Pressure Wave Propagation
- 2.5 Wave Reflections at **Discontinuities in Gas** Properties
- **Reflection of Pressure Waves** 2.6
- Reflection of a Pressure Wave 2.7 at a Closed End in a Pipe
- 2.8 Reflection of a Pressure Wave at an Open End in a Pipe
- 2.9 An Introduction to Reflection of Pressure Waves at a Sudden Area Change
- 2.10 **Reflection of Pressure Waves** at an Expansion in Pipe Area
- 2.11 **Reflection of Pressure Waves** at a Contraction in Pipe Area
- 2.12 Reflection of Waves at a **Restriction between Differing Pipe Areas**
- 2.13 An Introduction to Reflections of Pressure Waves at Branches in Pipes
- 2.14 The Complete Solution of **Reflections of Pressure Waves** at Pipe Branches
- 2.15 **Reflection of Pressure Waves** in Tapered Pipes
- 2.16 **Reflection of Pressure Waves** in Pipes for Outflow from a Cvlinder
- 2.17 **Reflection of Pressure Waves** in Pipes for Inflow to a Cylinder



Design and Simulation of Four-Stroke Engines



- 2.18 The Simulation of Engines by the Computation of Unsteady Gas Flow
- 2.19 The Correlation of the GPB Finite System Simulation with Experiments
- 2.20 Computation Time
- 2.21 Concluding Remarks

References for Chapter 2

Appendix A2.1 The Derivation of the Particle Velocity for Unsteady Gas Flow

Appendix A2.2 Moving Shock Waves in Unsteady Gas Flow

Chapter 3 Discharge Coefficients of Flow within Four-Stroke Engines

- 3.0 Introduction to Discharge Coefficients
- 3.1 The Traditional Method for the Measurement of Discharge Coefficients
- 3.2 The Reduction of Measured Data to Determine a Discharge Coefficient
- 3.3 The Discharge Coefficients of Bellmouths at an Open End to a Pipe
- 3.4 The Discharge Coefficients of a Throttled End to a Pipe
- 3.5 The Discharge Coefficients of a Port in the Cylinder Wall of a Two-Stroke Engine
- 3.6 The Discharge Coefficients of Poppet Valves in a Four-Stroke Engine
- 3.7 The Discharge Coefficients of Restrictions within Engine Ducts
- 3.8 Using the Maps of Discharge Coefficients within an Engine Simulation

3.9 Conclusions Regarding Discharge Coefficients References for Chapter 3

Chapter 4 Combustion in Four-Stroke Engines

- 4.0 Introduction
- 4.1 The Spark-Ignition Process
- 4.2 Heat Released by Combustion
- 4.3 Heat Availability and Heat Transfer During the Closed Cycle
- 4.4 Theoretical Modeling of the Closed Cycle
- 4.5 Squish Behavior in Engines

References for Chapter 4

Appendix A4.1 Exhaust Emissions

Appendix A4.2 A Simple Two-Zone Combustion Model

Chapter 5 Computer Modeling of Four-Stroke Engines

- 5.0 Introduction
- 5.1 Structure of a Computer Model
- 5.2 Physical Geometry Required for an Engine Model
- 5.3 Mechanical Friction Losses of Four-Stroke Engines
- 5.4 The Thermodynamic and Gas Dynamic Engine Simulation
- 5.5 The Ryobi 26 cm³ Hand-Held Power Tool Engine
- 5.6 The Matchless (Seeley) 496 cm³ Racing Motorcycle Engine
- 5.7 The Ducati 955 cm³ Racing Motorcycle Engine
- 5.8 The Nissan Infiniti 4000 cm³ Car Engine for the Indy Racing League





Design and Simulation of Four-Stroke Engines



- 5.9 Automobiles: A 2000 cm³ Four-Cylinder Sports-Car Engine
- 5.10 Automobiles: A 2000 cm³ Four-Cylinder Turbocharged Diesel Engine
- 5.11 Concluding Remarks

References for Chapter 5

Chapter 6 Empirical Assistance for the Designer of Four-Stroke Engines

- 6.0 Introduction
- 6.1 Empiricism for the Design of the Cylinder Head
- 6.2 The Relevance of Empiricism for the Design of the Cylinder Head
- 6.3 Empiricism for the Optimization of Intake System Tuning
- 6.4 Empiricism for the Optimization of Exhaust System Tuning
- 6.5 Concluding Remarks on Empiricism for Engine Optimization

References for Chapter 6

Chapter 7 Reduction of Noise Emission from Four-Stroke Engines

- 7.0 Introduction
- 7.1 Noise
- 7.2 Noise Sources in a Simple Four-Stroke Engine
- 7.3 The Different Silencing Problems of Two-Stroke and Four-Stroke Engines
- 7.4 Some Fundamentals of Silencer Design
- 7.5 Acoustic Theory for Silencer Attenuation Characteristics
- 7.6 Engine Simulation to Include the Noise Characteristics
- 7.7 Concluding Remarks on Noise Reduction

References for Chapter 7

Postscript — The Second Mulled Toast

Appendix — Computer Software and Engine Simulation Model

Index

About the Author