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Dedication

To Dr. Hans Strien,
at Alfred Teves, Co. in Frankfurt, Germany,
who took into his brake department a young engineering trainee.
# Table of Contents

**Chapter 1  Fundamentals of Braking Performance, Design, and Safety**

1.1 The Functions of a Brake System ..........................................................1  
1.2 Vehicle Deceleration and Stopping Distance ........................................2  
1.3 Elements of Automotive Brake System Design .....................................10  
1.4 Pedal Force and Pedal Travel ...............................................................17  
1.5 Design Solution Selection Process .....................................................18  
1.6 Braking System Involvement in Accidents .......................................20

**Chapter 2  Design and Analysis of Friction Brakes**

2.1 Brake Torque .....................................................................................27  
2.2 Brake Factor .....................................................................................27  
2.3 Brake Factor of Drum Brakes ...........................................................29  
2.4 Disc Brakes ......................................................................................48

**Chapter 3  Thermal Analysis of Automotive Brakes**

3.1 Temperature Analysis .......................................................................65  
3.2 Thermal Stress Analysis ..................................................................107  
3.3 Thermal Design Measures ...............................................................112

**Chapter 4  Analysis of Mechanical Brake Systems**

4.1 General Observations .......................................................................119  
4.2 Wheel Brakes ..................................................................................120  
4.3 Driveshaft-Mounted Brakes ..............................................................122

**Chapter 5  Analysis of Hydraulic Brake Systems**

5.1 Manual Hydraulic Brakes .................................................................125  
5.2 Boost System Analysis .....................................................................127  
5.3 Brake Line Pressure Control Devices ................................................141  
5.4 Brake Fluid Volume Analysis ............................................................150  
5.5 Dynamic Response of Hydraulic Brake Systems .............................175
## Chapter 6 Analysis of Air Brake Systems

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Basic Concepts</td>
<td>183</td>
</tr>
<tr>
<td>6.2</td>
<td>Foundation Brakes</td>
<td>184</td>
</tr>
<tr>
<td>6.3</td>
<td>Brake Torque</td>
<td>190</td>
</tr>
<tr>
<td>6.4</td>
<td>Vehicle Deceleration</td>
<td>194</td>
</tr>
<tr>
<td>6.5</td>
<td>ABS Modulating Valves</td>
<td>196</td>
</tr>
<tr>
<td>6.6</td>
<td>PC-BRAKE AIR Multi-Axle Software Application</td>
<td>199</td>
</tr>
<tr>
<td>6.7</td>
<td>Response Time of Air Brake Systems</td>
<td>200</td>
</tr>
<tr>
<td>6.8</td>
<td>Electronic Brake Control (Braking by Wire)</td>
<td>209</td>
</tr>
</tbody>
</table>

## Chapter 7 Single Vehicle Braking Dynamics

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Static Axle Loads</td>
<td>213</td>
</tr>
<tr>
<td>7.2</td>
<td>Dynamic Axle Loads</td>
<td>214</td>
</tr>
<tr>
<td>7.3</td>
<td>Optimum Braking Forces</td>
<td>216</td>
</tr>
<tr>
<td>7.4</td>
<td>Actual Braking Forces Developed by Brakes</td>
<td>224</td>
</tr>
<tr>
<td>7.5</td>
<td>Comparison of Optimum and Actual Braking Forces</td>
<td>225</td>
</tr>
<tr>
<td>7.6</td>
<td>Tire-Road Friction Utilization</td>
<td>228</td>
</tr>
<tr>
<td>7.7</td>
<td>Braking Efficiency</td>
<td>230</td>
</tr>
<tr>
<td>7.8</td>
<td>Fixed Brake Force Distribution Analysis</td>
<td>232</td>
</tr>
<tr>
<td>7.9</td>
<td>Variable Brake Force Distribution Analysis</td>
<td>238</td>
</tr>
<tr>
<td>7.10</td>
<td>Braking Dynamics of Two-Axle Truck Equipped with Air Brakes</td>
<td>249</td>
</tr>
<tr>
<td>7.11</td>
<td>Three-Axle Straight Truck – Air Brakes</td>
<td>253</td>
</tr>
<tr>
<td>7.12</td>
<td>Vehicle Stability Analysis</td>
<td>258</td>
</tr>
<tr>
<td>7.13</td>
<td>Braking Dynamics While Turning</td>
<td>267</td>
</tr>
</tbody>
</table>

## Chapter 8 Braking Dynamics of Combination Vehicles

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>Tow Vehicle-Trailer Combination</td>
<td>275</td>
</tr>
<tr>
<td>8.2</td>
<td>Electronic Stability Control and Trailer Swing</td>
<td>278</td>
</tr>
<tr>
<td>8.3</td>
<td>Braking of Tractor-Trailer Combinations</td>
<td>279</td>
</tr>
<tr>
<td>8.4</td>
<td>Braking of 2-S1 Combination</td>
<td>281</td>
</tr>
<tr>
<td>8.5</td>
<td>2-S1 Tractor-Trailer Combination – PC-BRAKE AIR Software</td>
<td>281</td>
</tr>
<tr>
<td>8.6</td>
<td>Braking of 3-S2 Tractor-Semitrailer Combination</td>
<td>312</td>
</tr>
<tr>
<td>8.7</td>
<td>2-S1–2 Combination: Two-Axle Tractor, Single-Axle Semitrailer, and Double-Axle Trailer</td>
<td>318</td>
</tr>
<tr>
<td>8.8</td>
<td>2-S2 Tractor-Semitrailer</td>
<td>320</td>
</tr>
<tr>
<td>8.9</td>
<td>2-S3 Tractor-Semitrailer – Triple-Axle Trailer with Leaf Springs</td>
<td>321</td>
</tr>
<tr>
<td>8.10</td>
<td>Test Results</td>
<td>325</td>
</tr>
</tbody>
</table>
### Chapter 9 Automatic Brake Control .......................... 327
   9.1 Basic Considerations .................................................. 327
   9.2 Wheel-Lockup Analysis .............................................. 328
   9.3 Basic Performance Requirements of ABS Systems ........ 343
   9.4 Hydraulic ABS Systems .............................................. 353
   9.5 ABS System Components ........................................... 360
   9.6 Drivetrain Influence on ABS ........................................ 364
   9.7 ABS Systems for Air Brakes ........................................ 364

### Chapter 10 Analysis of Brake Failure .......................... 373
   10.1 Basic Considerations .................................................. 373
   10.2 Development of Brake Failure .................................... 374
   10.3 Analysis of Partial Brake Failure ................................. 376
   10.4 Comparison of Dual Brake Systems ............................ 389
   10.5 Vacuum Assist Failure ............................................... 391
   10.6 Full Power Brake Failure .......................................... 392
   10.7 Degraded Braking Due to Air Inclusion ....................... 393
   10.8 Brake Fluid Considerations in Design and Failure Analysis 394
   10.9 Seal and Rubber Materials ......................................... 396
   10.10 Data Collection in Brake System Failures .................... 396
   10.11 Failure of Air Brake Systems ...................................... 403

### Index ................................................................. 405

### About the Author ................................................... 415
While writing the third edition, I have carefully considered the comments received from readers all over the world. One engineer remarked that whenever he has new trainees in his brake department, they must read Limpert's brake book. Following that mandate I have added explanations and examples to the theoretical analysis of braking and brake temperature while retaining the practical aspects of brake system design.

Electronic system controls have significantly increased the potential of braking systems. Notwithstanding the advances made in applying brakes by mechanical, hydraulic, or electrical means, vehicles are slowed and stopped by friction between pad and rotor. Only when the underlying brake system is properly engineered will automatic controls perform effectively and vehicles brake safely under all foreseeable operating conditions.

The third edition provides the fundamental tools necessary to design efficient braking systems that will comply with safety standards, minimize consumer complaints, and perform safely and efficiently long before and while electronic brake controls become active. New to the readers is the brake design software, developed by the author as an effective companion tool to this edition. The efficient design of automotive brake systems, including trucks and trailers, with PC-BRAKE software is demonstrated with detailed examples. Automotive engineering students, brake engineers, and forensic experts will benefit greatly from the third edition in conjunction with the computer programs and brake design workshop available from the author’s website www.pcbreakeinc.com.

Rudy Limpert
Preface to the Second Edition

The Second Edition continues to provide a systems approach to designing safer brakes. Consulting experts will find it a single reference in determining the involvement of brakes in accident causation.

Brake system technology has attained a high standard of quality over the last two decades. Nearly all automobiles are now equipped with antilock brakes. Federal braking standards require commercial vehicles to use antilock brakes. Revolutionary innovative brake designs are not expected. Improvements in brake systems will only be achieved through basic research, the application of sound engineering concepts, and testing, resulting in small, yet important, design changes.

The objective of the Second Edition is to assist the brake engineer in accomplishing his task to design safer brakes that can be operated and maintained safely. The brake expert will find all the analytical tools to study and determine the potential causes of brake failures. The Second Edition is expanded to cover all essential subjects, including the mechanical and thermal analysis of disk brakes. Mistakes found in the First Edition were corrected.

I thank all those who have made valuable suggestions and comments and helped me to understand brakes better, in particular the many individuals who attended my Brake Design and Safety seminars.
Preface to the First Edition

The purpose of this book is to provide a systems approach to designing safer brakes. Much of the material presented was developed during my work as a brake design engineer, conducting automotive research, consulting as a brake expert, and teaching brake design.

The book is written for automotive engineers, technical consultants, accident reconstruction experts, and lawyers involved with the design of brake systems, the analysis of braking performance, and product liability issues. Junior engineers will benefit from the book by finding in one single source all essential concepts, guidelines, and design checks required for designing safer brakes.

Chapter 1 reviews basic stopping distance performance, design rules, and product liability factors.

In Chapter 2, drum and disc brakes are discussed. Brake torque computations are shown for different drum and disc brake designs.

Temperature and thermal stresses are analyzed in Chapter 3. Practical temperature equations are shown whenever possible.

Chapter 4 briefly reviews basic concepts involved in analyzing mechanical brake systems.

The operation and design of hydraulic brakes are discussed in Chapter 5.

Air brake systems and their components are discussed and analyzed in Chapter 6.

Brake force distribution, braking efficiency, optimum brake force distribution, and vehicle stability during braking for the single vehicle are analyzed in Chapter 7.

Car-trailer and commercial truck-trailer braking is discussed in Chapter 8.

Important elements of antilock braking performance and design are introduced in Chapter 9.

Brake failures are discussed in Chapter 10.