# Table of Contents

<table>
<thead>
<tr>
<th>Section I</th>
<th>Rail Life:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Changing Face of Rail Replacement</td>
</tr>
<tr>
<td></td>
<td>Replacing Branchline Rail</td>
</tr>
<tr>
<td></td>
<td>Using Rail Information</td>
</tr>
<tr>
<td></td>
<td>More Rail Reliability Issues</td>
</tr>
<tr>
<td></td>
<td>Extending Rail Life; Recent Experiences</td>
</tr>
<tr>
<td></td>
<td>Extending Wheel/Rail Life: The Australian Experiences</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section II</th>
<th>Rail Fatigue:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rail Fatigue - When to Relay</td>
</tr>
<tr>
<td></td>
<td>Predicting Rail Defects</td>
</tr>
<tr>
<td></td>
<td>Separating Shelling and Spalling</td>
</tr>
<tr>
<td></td>
<td>Rail Steel Composition and Fatigue Life</td>
</tr>
<tr>
<td></td>
<td>Detection of Rail Steel with Increased Fatigue Potential</td>
</tr>
<tr>
<td></td>
<td>Crack Growth in Rails</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section III</th>
<th>Rail Wear &amp; Lubrication:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Greasing” the Way to Savings</td>
</tr>
<tr>
<td></td>
<td>Linking Lubrication and Rail Wear, Fatigue</td>
</tr>
<tr>
<td></td>
<td>Rail Lubrication Caveats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section IV</th>
<th>Rail Grinding:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rail Surface Maintenance: Combining Old and New</td>
</tr>
<tr>
<td></td>
<td>Profile Rail Grinding</td>
</tr>
<tr>
<td></td>
<td>Preventive Rail Grinding</td>
</tr>
<tr>
<td></td>
<td>More Rail Grinding Economics</td>
</tr>
<tr>
<td></td>
<td>Corrective vs. Preventive Grinding: Recent Results</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section V</th>
<th>Track Structure:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Testing Track Strength</td>
</tr>
<tr>
<td></td>
<td>Gage Widening Strength</td>
</tr>
<tr>
<td></td>
<td>Modeling Track Component Life</td>
</tr>
<tr>
<td></td>
<td>Effect of Track Stiffness on Vehicle Rolling Resistance</td>
</tr>
<tr>
<td></td>
<td>Track Modulus vs. Track Structure</td>
</tr>
<tr>
<td></td>
<td>Track Modulus Characteristics</td>
</tr>
<tr>
<td></td>
<td>Continuous Measurement of Track Gauge Strength</td>
</tr>
<tr>
<td></td>
<td>Lateral Ballast Resistance</td>
</tr>
<tr>
<td></td>
<td>Track Structure Sensitivities</td>
</tr>
<tr>
<td></td>
<td>Vertical Wheel Loads: The Distribution on Cross-Ties</td>
</tr>
<tr>
<td></td>
<td>Distribution of Vertical Wheel Loads: Ballast and Subgrade</td>
</tr>
</tbody>
</table>
SECTION VI

TRACK GEOMETRY: .........................................................................................73
What is Track Quality ..................................................................................75
Planning Through Track Geometry - Part I .................................................77
Planning Through Track Geometry - Part II ...............................................79
TQI's - Part I, Statistical ............................................................................81
TQI's - Part II, Alternatives .....................................................................83
Effect of Axle Load on Geometry Measurements .................................85

SECTION VII

MAINTENANCE PLANNING: .................................................................87
Changes in Track Maintenance Planning .................................................89
Forecasting Maintenance Needs ...............................................................91
Track Replacement Needs as a Function of Traffic Densities ............93

SECTION VIII

WHEEL/RAIL DYNAMICS: .................................................................95
Wheel/Rail Impact Loading .....................................................................97
Track Stiffness and Impact ....................................................................99
The Effect of L/V ....................................................................................101
Dynamic Loading of The Track Structure Part I
  - Vertical Loads ..................................................................................103
Dynamic Loading of The Track Structure Part II
  - Lateral Loads ..................................................................................105
Dynamic Loading of Track Structure Part III
  - The Effect of Premium Suspensions .................................................107

SECTION IX

TRACK BUCKLING: ...........................................................................109
Vehicle Dynamics and Track Buckling ...................................................111
Temperature and Rail Laying .................................................................113
Train Energy's Effect on Track Buckling ...............................................115

SECTION X

RAIL INSPECTION: ...........................................................................117
Economics of Rail Inspection .................................................................119
Misreading Rail Flaw Size .....................................................................121
Monitoring the Railhead .......................................................................123
Effective Rail Inspection .......................................................................125
EMATs For Rail Inspection? .................................................................127
Scheduling Rail Testing .......................................................................129

SECTION XI

RAIL MISCELLANEOUS: .................................................................131
Field Welding Rail ..................................................................................133
Rail Corrugations on Freight Railroads ...............................................135
Types of Rail Corrugations .................................................................137
Economics of Alternate Repair Welding Techniques ..........................139
SECTION XII  TIES AND FASTENERS: ................................................................. 141
   Rail Fastener Performance: What About Strength? ......................... 143
   Rail Fastener Performance: The Intangibles .................................. 145
   Missing Fasteners Vs. Gage Strength ............................................. 147
   Examining Wood Tie Failure ......................................................... 149
   Extending the Life of Wood Crossties .......................................... 151
   Wood Tie Life: Part I Average Tie Life ........................................ 153
   Wood Tie Life: Part II Distribution of Failed Ties .......................... 155
   Strength Properties of Wood Crossties ....................................... 157

SECTION XIII  BALLAST AND SUBGRADE: ................................................... 159
   The Many Faces of Ballast Testing ............................................... 161
   Geotextile Performance .............................................................. 163
   The Many Faces of Ballast Fouling ............................................. 165
   Using Radar to Investigate Roadbed .......................................... 167
   Cone Penetrometer Testing of Roadbed ....................................... 169
   Effect of Material Quality on Ballast Life ................................ 171
   The Cost of Ballast Maintenance ............................................... 173
   Effects of Tamping on Ballast Degradation .................................. 175
   Stone Blowing: An Alternative Approach to Track Surfacing .......... 177
   Identifying the Sources of Ballast Fouling .................................. 179

SECTION XIV  DERAILMENTS: ............................................................... 181
   Rail Defect Type vs. Derailment Risk ......................................... 183
   Track-Caused Derailments ......................................................... 185

SECTION XV  LIFE CYCLE COSTS: ............................................................ 187
   M/W First Costs vs Life Cycle Costs .......................................... 189

SECTION XVI  BRIDGES: ........................................................................... 191
   Fatigue Life of Steel Bridges ..................................................... 193
   Fatigue Life of Bridges ............................................................. 195

SECTION XVII TURNOUTS: ................................................................. 197
   Reducing Wheel/Rail Forces in Turnouts ..................................... 199
   Improved Performance from “Premium” Turnouts ....................... 201