Analyzing Tire Failure

By Thomas R. Giapponi

“Tire Forensic Investigation: Analyzing Tire Failure” covers the many ways that a tire can fail, and shows how to identify that failure. Based on the author’s 30 years of experience in the tire industry, the book looks at the methodical, physical, visual and tactile examination of the failed tire and identifies the various failure modes for passenger car and light truck tires.

Chapters cover:
- Belt separation
- Belt separation identification
- Other belt separation types
- Identification of causes and contributors to belt separation
- Non-belt separation identification
- Various tire conditions – identification
- Balance weight mark identification and significance
- Tire location on a vehicle
- Addressing several failure theories
- Visual and tactile nondestructive tire investigation techniques

“Tire Forensic Investigation: Analyzing Tire Failure” provides tire forensic experts and researchers with the technical background needed to determine tire failure causation.

About the Author:

Thomas R. Giapponi is President of TRGtech Tire Consulting LLC. His tire industry experience includes over 20 years at Firestone Tire LLC and Armstrong Rubber Company, in positions including Director of R&D and Factory Quality, Director of Tire and Mold Engineering, Manager of Passenger Tire Engineering, and Manager of Heavy Truck Tires. He is a member of SAE and the Tire Society and is Past President of the Tire and Rim Association.

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Chapter 1 Belt Separation

1.1.1 Identification of Belt Separation—Discussion
1.1.2 Identification of Belt Separation—Differentiation
1.2 Belt Separation—Crack Initiation and Propagation
1.3 Root Causes of and Contributors to Belt Separation
1.3.1 Over-Deflection
1.3.2 High Speed
1.3.3 High Ambient and Pavement Temperature
1.3.4 Road Hazards (Impacts)
1.3.5 Ozone Deterioration
1.3.6 Physiological Damage
1.3.7 Unapplied or Improperly Repaired Punctures
1.3.8 Improper Tire Maintenance
1.3.9 Vehicle-Related Conditions
1.3.10 Mounting and/or Demounting Damage
1.3.11 Poor Storage of Tires
1.3.12 Cuts, Snags, Gouges, Tears, and Abrasions
1.3.13 Penetrations
1.3.14 Manufacturing and Design Conditions

Chapter 2 Belt Separation Identification

2.1 Belt Separation Identification
2.1.1 Belt Delamination Characteristics
2.1.2 Belt Stock Degradation
2.1.3 Rubber Loss
2.2 Intact Top Belt and Tread
2.3 Accelerated Wear—Literifying Separation
2.4 Belt Separation—Additional Notes

Chapter 3 Other Types of Belt Separation

3.1 Belt Edge Separation
3.2 Intact Belt Edge Separation
3.3 Atypical Belt Separation

Chapter 4 Identification of Causes and Contributors to Belt Separation

4.1 Punctures
4.1.1 Over-Deflection
4.1.2 In-Canada Punctures
4.1.3 Water and Salt Corrosion
4.1.4 Breakage of Belt Wires
4.2 Over-Deflection
4.2.1 Observation of the Compression Groove
4.2.2 wrinkling of the innerliner
4.2.3 Innerliner Color or Discoloration
4.2.4 Exterior Sidewall Contact with the Road Surface
4.2.5 Observation of the Tread Shoulders
4.2.6 Wheel Weight Clip Mark Depth
4.2.7 Shifting or Chattering of the Balance Weight Mark

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Chapter 5 Identification of Non-Belt Separations

5.1 Tread Separation
5.2 Road Area Separation
5.2.1 Lower Sidewall Compound Separation Off the Tread
5.2.2 Separation Between the Ply Turn-Up(s) or Turn-Down(s)
5.2.3 Separation of the Road Wires or Bundle from the Surrounding Plies
5.2.4 Separation Between the Steel or Fabric Chippers or Chafers
5.2.5 Belt Breaks
5.3 Sidewall Separation
5.3.1 Separation Between the Plios
5.3.2 Separation Between the Sidewall Components
5.3.3 Separation Between the Ply and the Sidewall Components

Chapter 6 Identification of Various Tire Conditions

6.1 Run-Flat Damage
6.2 Chemical Damage to the Tread and Sidewall
6.3 Non-Ozone-Related Cracking, Indentation, and Bites
6.4 Identification of Innerliner Conditions

Appendix A: References
Appendix B: Terms
Appendix C: Compression Groove
Appendix D: Roll-Flat Sequence
Appendix E: Shell Rating Scale for Ozone Deterioration

By using the laws of physics, math, chemistry, and engineering – mixed with real-world tire background and experience – tire forensic experts determine the most likely events that led up to and caused a tire to fail.

Chapter 7 Identification and Significance of Balance Weight Marks

Chapter 8 Location of the Tire on a Vehicle

Chapter 9 Addressing Several Failure Theories

9.1 Brassy Wire Failure
9.1.1 No Bonding Between the Brass Laminate and the Belt Compound
9.1.2 Partial Bonding Between the Brass Laminate and the Belt Compound
9.1.3 Proper Bonding and Brassy Wire Appearance
9.2 Manufacturing Imprints—“Liner Marks”
9.3 Nylon Overlay

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10.2 Marking the Tire for Inspection
10.3 Examination Process—Notes and Belt Photographs
10.4 Tactile and Visual Inspection of the Tire
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10.5.2 Matching the Wheel to the Tire
10.5.3 Identifying Multiple Past Wheel Balances
10.5.4 Photographs

Appendix A: References
Appendix B: Terms
Appendix C: Compression Groove
Appendix D: Roll-Flat Sequence
Appendix E: Shell Rating Scale for Ozone Deterioration

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