Splash and Spray from Road Vehicles
(and Associated Topics) — A Bibliography

by

N.A. Cowperthwaite

Department of Aerodynamics
College of Aeronautics
Cranfield Institute of Technology
Bedford, England
Splash and Spray from Road Vehicles
(and Associated Topics) – A Bibliography

by

N.A. Cowperthwaite

Department of Aerodynamics
College of Aeronautics
Cranfield Institute of Technology
Bedford, England

Research Sponsored by:
Department of Environment: Department of Transport
Transport and Road Research Laboratory
Crowthorne
Berkshire
Contract Agreement No. TRR/842/424

ISBN 0 947767 10 X
£7.50

"The views expressed herein are those of the authors alone and do not necessarily represent those of the Institute."
1. Ahman, K.I.  
"Omkörning av Lastbilar -Trafikstudier." (Overtaking and Passing of Lorries).  

2. Albert, B.J. and Walker J.C.  
"Tyre to Wet Road Friction at High Speeds."  

3. Alberta Department of Highways and Transport.  
"Report on the Testing of Triple Trailer Combinations."  
Alberta Dept. of Highways and Transport, April 1960.

4. Allan, J.W.  
"A Note on the Reduction of Water Spray from Heavy Lorries and on Measurement of Spray During Trials."  
AASU Memo 79/1, Dept. of Aeronautics and Astronautics, University of Southampton, October 1979.

5. Allan, J.W., Burgin, K. and Lilley, G.M.  
"On Water Spray Generation by Road Vehicles and Methods for its Control."  

6. Allan, J.W. and Lilley, G.M.  
"Reduction of Water Spray from Road Vehicles in Wet Conditions: A Further Investigation with Improved Trials Measurement Equipment and Technique."  

7. Allan, J.W. and Lilley, G.M.  
"The Reduction of Water Spray from Heavy Road Vehicles."  

"Drivers Visibility Requirements for Roadway Delineation, Volume 1. Effects of Contrast and Configuration on Driver Performance and Behaviour.  
9. Anderson, D.R.
"Some Thoughts on Splash and Spray."

10. Anderson, J.W. and Carlson, G.C.
"Vehicle Spray Pattern Study."

11. Anon.
"Splash and Spray. A Review of the Test Programs Aimed at Reducing the Problem of Vehicle Splash and Spray."

"Stopping Splash and Spray."
Heavy Duty Trucking, Vol. 51, No. 11, H.I.C. Corporation.
Newport Beach, California, November 1972.

"Spray Suppression Proposals too Specific."
Transport Engineer, October 1983, pp 6-7.


15. Anon.
"Lorry Spray Experiment: April/May 1984"
Transport and Road Research Laboratory Note. (Unpublished).

16. Armitage, A.
"Report of the Enquiry into Lorries, People and the Environment."

17. Barrett, R.V.
"Measurement of the Drag and Spray Produced by Model Pneumatic Wheels Moving Through Water Layers."

18. Barrett, R.V.
"Spray from Aircraft Undercarriage at High Speeds - A Model Investigation."
"Spray from Road Vehicles."

"Predicting Driver Seeing Distance in Natural Rainfall."
Human Factors, 23(6), 667-682, 1981.

"Effect of Ambient Air Velocity on Atomisation of Two Impinging Water Sheets."

22. Braun, H.
"Neure Erkentisse über Radabdeckungen " (Recent Findings on Wheel Coverings).
Brunswick Technological Institute, Germany, 1972.

23. British Standards Institution
"Draft Specification for Spray Reducing Devices for Heavy Goods Vehicles."

24. Brown, J.R.
"Pervious Bitumen-Macadam Surfacing Laid to Reduce Splash and Spray at Stonebridge, Warwickshire."

25. Brown, J.R.
"Interim Report on the Performance on Surfacings for Maintaining Bituminous Roads: Al Buckden (1975-77)."

26. Carr, G.W.
"Some Aerodynamic Aspects of Safety in Road Vehicles."

27. Cassella, C.W. and Vivari, J.A.
"Splash and Spray Accident Reports."
28. Chatfield, A.C., Reynolds, A.K. and Foot, D.J.  
"Water Spray from Heavy Goods Vehicles: An Assessment of Some Vehicle Modifications."  

29. Chapoux, E.  
"De l'Effet des Dispositifs de Protection dits "Bouettes" sur des Protection d'Eau des Vehicles Automobiles."  
(Investigation of the Effects of Mudflaps on Passenger Cars).  
Union Technique de l'Automobile, du Motorcycle et du Cycle, CIDITVA 32-12, 1967.

30. Cranfield Institute of Technology  
"Cranfield Institute of Technology Water Depth Gauge."  

"Relationship of Rural Highway Geometry to Accident Rates in Louisiana."  
Louisiana State University (published in Highway Research Report No. 312).

32. Davies, C.N.  
"Evaporation of Airborne Droplets."  

33. Davis, Q.C.  
"Water Surface Depth Instrument."  

34. Department of the Environment.  
"Design of Heavy Goods Vehicles for Safety - Spray from Road Vehicles."  

35. Deutsch, C.  
36. Dickson-Simpson, J.
"Stopping Spray from Lorries."
Transport and Road Research Laboratory Symposium on Heavy Goods Vehicle Safety, Crowthorne, Berks. 1976.

37. Dugoff, H.
"The Davidson Laboratory Rolling-Road Facility."
Stevens Institute of Technology, Davidson Laboratory, Note 693. November 1963.

38. Dugoff, H. and Erlich, I.R.
"A Laboratory Scale Model Technique for Investigating Pneumatic Tyre Hydroplaning."

"Reduction of Adverse Aerodynamic Effects of Large Trucks."

40. Federal Register
"Spray Proectors - Passenger Cars, Multipurpose Passenger Vehicles, Trucks, Buses and Trailers."

41. Forbes, T.W.
"A Study of Accident Hazards in Relation to Fenders and Mudguards for Motor Vehicles."

42. Fraser, Dombrowski and Routley.
"The Atomisation of a Liquid Sheet by an Impinging Air Stream."

43. Frost, A.R.
"Rotary Atomisation."
Proc. of the Symposium on Controlled Drop Application, University of Reading. April 1978 (British Crop Protection Council) pp 7-21.
44. Furness, J.W.  
"The Commercial Vehicle: Some Problem Areas in Future Legislation."  
Transport Engineer pp. 11, 13, 15, July 1976.

45. Gallaway, B.M., Rose, J.G. and Schiller, R.E. Jr.  
"The Relative Effects of Several Factors Affecting Rainwater Depths on Pavement Surfaces."  
Texas Transportation Institute, Texas A&M University.  
(published in Highway Research Record No. 396).

46. Gallaway, B.M., Schiller, R.E. Jr. and Rose, J.G.  
"The Effects of Rainfall Intensity, Pavement Cross Slope, Surface Texture and Drainage Length on Pavement Water Depths."  
Research Report No. 138-5, Texas Transportation Institute, Texas A&M University, May 1971.

47. Gaussoin, J., Nottingham, R.B. and Reichard, R.E.  
"Spray Suppression Device for a Highway Vehicle."  

48. Glennon, J.C.  
"The Frictional Requirements of Passing Vehicles."  
Texas Transportation Institute, Texas A&M University  

49. Harrin, E.N.  
"Investigation of Tandem - Wheel and Air-Jet Arrangements for Improving Braking Friction on Wet Surfaces."  

50. Hills, B.L.  
"Vision, Visibility and Perception in Driving."  

51 Horne, W.B.  
"Air Jets - A Possible Solution to Hydroplaning and Other Associated Runway Wetness Problems."  

52. Horne, W.B. and Dreher, R.C.  
"Phenomena of Pneumatic Tyre Hydroplaning."  
53. Kamm, I.O. and Wray, G.
"Suppression of Water Spray on Wet Roads."

54. Kamm, I.O., Wray, G. and Kolb, R.C.
Stevens Institute of Technology, Davidson Laboratory,

55. Kamm, I.O., Wray, G. and Kolt, R.C.
"Truck Spray on Wet Roads Reduced by New Fender Design."
Automotive Engineering, Vol. 78, No. 9, September 1970,

56. Kemp, D.H.
"Tyres - Grip and Slip: Noise and Spray."
Society of Automotive Engineers, Australasia National Convention,

57. Kihlgren, B.
"Provning av Stänkskärmar." (Testing of Fenders).
National Swedish Road Research Institute, Stockholm
(predecessor of National Swedish Road and Traffic Research

58. Koessler, P.
"Kotflugeluntersuchungen." (Investigation of Mudguards.)
Deutsche Kraftfahrforschung Heft 175, 1965. (Translated from
German by H.R. Fassbender, M.I.R.A. Translation No. 32/65).

59. Lane, W.R.
"Shatter of Drops in Streams of Air."

60. Le Guen, M.H.
"Projections d'Eau Occasionnées par les Vehicles sur Route
Mouillée." (Spray from Vehicles on Wet Roads.)

61. Lissaman, P.B.S. et al
"Methods of Reducing the Splash and Spray Hazards of Large
Trucks."
Aero Vironement Inc., Pasadena, California, Report AVFR 7149,
Final Reports and Appendices. (2 Volumes).
"A Study of Variables Associated with Wheel Spin-Down and Hydroplaning."
Texas Transportation Institute, Texas A & M University (published in Highway Research Record 396).

63. Mason, B.J.
"The Physics of Clouds."

64. Maycock, G.
"The Problem of Water Drawn up by Vehicles on Wet Roads."

65. Michigan State University
"A Study of Accident Hazards in Relation to Fenders and Mudguards for Motor Vehicles."

"Vision through the Atmosphere."
University of Toronto Press, 1952.

67. Ministry of Transport.
"Instructions for Using the Portable Skid Resistance Tester."
Ministry of Transport, R.R.L. Road Note 27, Crowthorne, U.K.

68. Monsanto.
"Truck Splash and Spray: A Discussion of its Cause, Effect and Control. (Preliminary Findings)."
Monsanto, St. Louis, USA. 1978.

69. National Swedish Road Safety Office.
"Beestämmelser om Stänkskydd" (Regulations Concerning Spray Protectors).

70. O.E.C.D.
"Adverse Weather, Reduced Visibility and Road Safety."
The Road Research Group on Driving in Reduced Visibility Conditions due to Adverse Weather, OECD, Paris, 1976.
71. Onderko, W.
"Study of Truck Splash Guards."

72. Palmer, G.M. and Amy, J.B.
"Model Tests of Drag and Spray Effects of Aerodynamic Modifications to Present Vehicles."

73. Ritter, T.E.
"The Development of Techniques to Measure Vehicle Spray on Wet Roads."
Society of Automotive Engineers Paper No. 740526.

74. Ritter, T.E.
"Spray Protector Testing of Trucks."
Southwest Research Institute, San Antonio, Texas.

75. Ritter, T.E.
"Truck Splash and Spray Tests at Madras, Oregon."
Southwest Research Institute, San Antonio, Texas.

76. Roberts, A.
"Investigation of the use of Airjets and Chines on Aircraft Undercarriage using Model Wheels and a Moving Ground Belt and Water Layer."

77. Rose, M.J. and Stewart, M.J.
"A Preliminary Study of the Control of Spray from Light Vehicles by Aerodynamic Design."

78. Sabey, B.E.
"The Known Risks We Run: The Highway."
79. Sabey, B.E.
"Accidents: Their Cost and Relation to Surface Characteristics."
Paper presented at a symposium: 'Safety and the Concrete Road Surface - Design, Specification and Construction.'

80. Sandburg, U.
"Measurement of Splash and Spray Generated by Vehicles on Wet Roads - a Pilot Study."

81. Sandburg, U.
"Splash and Spray from Vehicles on Wet Roads - a Bibliography."
The National Swedish Road and Traffic Research Institute, Linköping. 1977-78.

82. Sandburg, U.
"Splash and Spray Protection."

83. Sandburg, U.
"Spray Protectors Testing of Efficiency."

84. Sandburg, U.
"Spray Protectors Testing of Efficiency."

85. Sandburg, U. and Bennerhult, O.
"The Attenuation of Tyre Noise Emmission by Tyre Enclosing."

86. Sherard, T.D.
"Can We do Away With Splash and Spray."

87. Sherard, T.D.
"Splash and Spray Tests."
88. Sherard, T.D.
"Suppression of Vehicle Splash and Spray."

89. Sherman, R.E.
"Test-Triple Trailer Combination - Winter Conditions."
A memorandum report to Major P.A. Johnson, Washington
State Patrol, January 30th, 1969.

90. Shomura, M.
"On the Visibility of Trucks."

91. Simpkins, P.G. and Newton, J.R.
"Water Spray Generated by Road Vehicles."
Annual Report of the University of Southampton contract

92. Society of Automotive Engineers.
"Rear Wheel Splash and Stone Protection."
Vol. 4, Section 36, pp 60.

93. Steckel, S.S. and Westburg, J.V.
"Full Scale Evaluation of an Air Jet System as a means to
Eliminate the Harmful Effects of Wet Runways."

94. Stimpson, W.A. and Shapiro, S.R.
"A Cost-Effectiveness Evaluation of Devices for Reducing the
Adverse Aerodynamic Effects of Large Trucks."
Alan M. Voorhees and Associates, Final Report on Subcontract

95. Stow, C.D. and Stainer, R.D.
"The Physical Products of a Splashing Water Drop."

96. Transport and Road Research Laboratory.
"Spray Reducing Surfaces."
LF 195, Dept. of Environment, Transport and Road Research
Laboratory, Crowthorne, April 1975.
97. Transport and Road Research Laboratory.
"Water Spray from Heavy Vehicles."
LF 602, Dept. of Environment, Transport and Road Research Laboratory, Crowthorne, December 1975.

98. Voigt, P.
"Dackskarming" (Tyre Noise Enclosing).

99. Various

100. Walton, W.H. and Prewett, W.C.
"The Production of Sprays and Mists of Uniform Drop Size by Means of Spinning Disc Type Sprayers."

101. Waterson, M.
"A Laser Transmission Technique for Measuring the Attenuation of Light by a Dense Spray."
Dept. of Transport, London.

102. Weinstein, A.I.
"Fog Dispersal: A Technology Assessment."

103. Weir, D.H.
"Truck Splash and Spray - Some Recent Results."

104 Weir, D.H.

105. Weir, D.H., Strange, J.F. and Heffley, B.K.
106. Western Highway Institute.  
"Splash and Spray Characteristics of Trucks and Truck Combinations." 

107. Wilcox, D.  
"U.S. Operator's Idea Cleans up Nicely." 

108. Wolfson Unit.  
"Optical Laser Equipment for Spray Detection." 

109. Wray, G.  
"The Formation of Truck Spray on Wet Roads. Phase III, Laboratory Experiments."  
Stevens Institute of Technology, Davidson Laboratory, Report 1384, March 1969.

110. Yamanka, A.  
"Visibility Test on Mitsubishi Fuso Heavy. Duty Trucks."  

111. Yamanka, A.  
"Dynamic Visibility of Motor Vehicles."  

112. Yamanka, A. and Nagaika, N.  
"Measurement and Control of Truck Spray on Wet Roads."  

113. York, J.L. and Stubbs, H.E.  
"Photographic Analysis of Sprays."  
Acknowledgement

The author would like to thank Mr. A. Naysmith of the Transport and Road Research Laboratory and Professor A.T. McDonald of Purdue University for kindly supplying copies of their own bibliographies which proved useful in the compilation of this report.