

# Rail Diesel Exhaust Analysis for Legal Cases

## Case Study

By

Dr. Kevin Linfield, P.Eng., P.E. and Kelly Hile  
Airflow Sciences Corporation

*Copyright © 2021*

*Airflow Sciences Corporation*

*All rights reserved. No part of this publication  
may be reproduced, stored in a retrieval system,  
or transmitted, in any form or by any means,  
electronic, mechanical, photocopying, recording,  
or otherwise, without the prior permission of the  
copyright owners.*

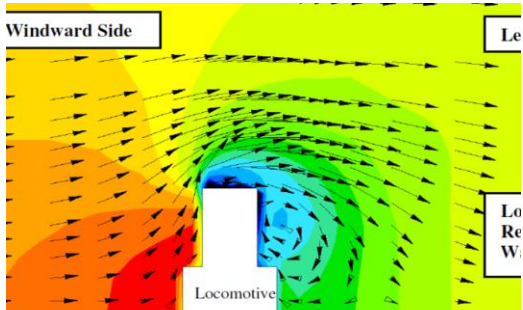
*(734) 525-0300*

*[www.airflowsciences.com](http://www.airflowsciences.com)*

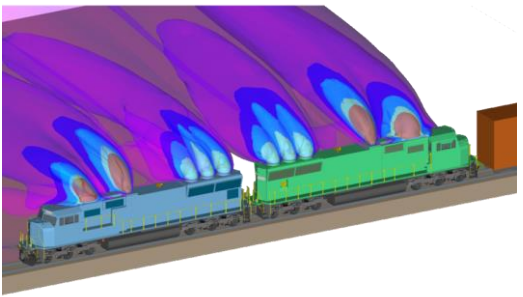
*Document A-74*



*Figure 1: Diesel Exhaust Plume*



*Figure 2: Recirculation Patterns Can Occur Because of Wind and Train Motion*



*Figure 3: CFD Simulation of Locomotive Exhaust Plume*



*Figure 4: Wind Tunnel Test of Locomotive at 1:15 Scale*

In legal cases that rely on technical details, engineers are often called upon to perform engineering analysis or testify as expert witnesses. This can strengthen a client's case significantly and ensure that legal arguments are scientifically sound. As of 2021, Airflow Sciences Corporation (ASC) has consulted on eleven legal cases where the train operators' exposure to diesel exhaust was evaluated (see Figure 1). These cases involve many parameters, including switch yard and trunk routes, different locomotive models, variable speeds and directions for both the wind and the train, as well as the orientation of the locomotive.

Effects of the wind and the moving train can often create a flow pattern near a locomotive's cab where the exhaust plume recirculates instead of dispersing, as shown in Figure 2. Since locomotives may operate with open windows, the operator could therefore be subject to these exhaust fumes. This can happen during line-haul operations but also in the switch yard.

Computational Fluid Dynamics (CFD) was used to calculate the exhaust level at the open window on the leeward side of the subject locomotive. Figure 3 shows the diesel exhaust from two locomotives, one with the long hood forward and the other with the short hood forward.

Wind tunnel testing of scale locomotives at a variety of wind speeds and directions feature a complex system to simulate the exhausts (see Figure 4). ASC has built a database of various locomotives under multiple test conditions and has used this data and our CFD results for expert testimony reports.

Clients choose Airflow Science as exhaust legal experts because of our wealth of experience. We have conducted over 50 studies on rail aerodynamics that include computer simulation, wind tunnel testing of scale models, and even full-scale, over-the-track tests. ASC has performed numerous studies to calculate diesel exhaust concentrations in the vicinity of locomotive cabs since 1984, and have been awarded six patents in the rail industry.