

David B. Rich, PhD

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Professional Profile

Dr. Rich is a founding partner and Principal Engineer at Reax Engineering Inc., a thermal sciences consulting firm based in San Francisco's Bay Area. Dr. Rich is a fire expert with comprehensive experience in the fire testing laboratory and with large scale fire testing supported by sophisticated analysis and modeling tools. He is an experienced designer and peer reviewer of building fire safety systems, especially performance based systems supported by computational methods and scale modeling.

Dr. Rich has broad experience as an expert in legal matters, conducting fire scene investigations, review of expert opinions, evidence collection, systems analysis, experimental investigations, computational fire modeling and graphics support for trial and mediation.

Dr. Rich brings a diverse background to engineering, with research and development experience in academia and the private sector, in combustion, bioengineering and mechanical design combined with practical experience as a Rescue Captain and Paramedic in the San Francisco Fire Department. He earned his PhD in the Combustion and Fire Processes Laboratory at the University of California working on NASA funded research to better understand the behavior of polymer fire behavior in zero gravity conditions. He is a lecturer in the Department of Mechanical Engineering at UC Berkeley, in the Fire Protection Engineering graduate program at Cal Poly San Luis Obispo, and in thermo-fluid sciences at Santa Clara University.

Dr. Rich is technical advisor to IEC Technical Committee 108 and a voting member of the US 108 Technical Advisory Group where he provides expertise in flammability behavior of electronics, relevant fire test methods, regulatory requirements, especially as relates to polymer enclosures. Dr. Rich is also a voting member of ASTM Committee E05 on Fire Testing and has addressed this group on issues of fire safety of plastic enclosures.

Education

PhD – Mechanical Engineering (major field: combustion), University of California, Berkeley, 2006

BS/MS – Mechanical Engineering, University of California, Berkeley, 2000/2002

Employment History

8/08 – present **Reax Engineering, Berkeley, CA, *Founding Partner and Principal Engineer***

- Development of experimental programs in support of product development, thermodynamics, fluid mechanics, heat transfer, instrumentation, control and data acquisition
- Fire litigation support – analysis, modeling, and theory, fire inspections/investigations
- Computer fire modeling: forensic fire reconstruction, prediction of heat release rate via fire growth modeling, fire timeline recreation, time to non-tenability/incapacitation by smoke or heat, calculation of smoke detector and sprinkler activation times, onset of flashover
- Ignition and flame spread of materials, evolved species, heat transfer and deformation

2013-Present **University of California, Berkeley, *Lecturer***

- Thermo-fluid sciences, 2 course per annum, summer and fall.

- 2011-Present **California Poly San Luis Obispo, Program in Fire Protection Engineering, Instructor**
- Flammability Assessment Methods, Smoke Management and Special Hazards, 2 courses per annum, spring and fall.
- 2008-Present **Santa Clara University, Department of Mechanical Engineering, Adjunct Professor**
- Graduate and Undergraduate courses in Fluid Mechanics, Thermodynamics, Combustion, Fire Dynamics, and Internal Combustion Engine Technology
- 09/08 – 09/11 **University of California, Berkeley Doctoral, Post-Doctoral Researcher, Staff Researcher**
- Development of carbon neutral fuels from cellulosic feedstock, Scale model and laser imaging of building smoke flows for innovative ventilation (under floor, natural) systems and validation of FDS models, Combustion testing and modeling to characterize fuels and measure energy efficiency of specially developed stoves for use in developing countries.
 - Developed and implemented a forced ignition and flame spread test for polymer materials intended for use in the microgravity conditions of spacecraft.
- 1/07 – 8/08 **Arup Fire, San Francisco, CA Fire Protection Specialist**
- Worked in conjunction with engineering teams, architects, and approving authorities, to develop integrated fire safety strategies for buildings and transportation systems.
- 07/91 – 06/99 **San Francisco Fire Department, San Francisco, CA, Paramedic/Rescue Captain**
- Provided 911 emergency services, conducted community disaster training, and implemented federal multi-agency programs to manage casualties of weapons of mass destruction.

Selected Publications

1. Bar-Ilan, A., Rich, D., Rein, G., & Fernandez-Pello, A.C., “Flow-Assisted Flame Propagation through a Porous Combustible in Microgravity,” *Western States Section/The Combustion Institute*, San Diego, CA, 2002.
2. Cheng, E.S., Rich, D., Dibble R.W., & Buckholz, B.A., “Quantifying the Contribution of Lubrication Oil to Particulate Emissions from a Diesel Engine,” *Journal of the Society of Automotive Engineers*, 2003.
3. Lautenberger, C., Stevanovic, A., Rich, D., & Torero, J., “Effect of Material Composition on Ignition Delay of Composites,” *Composites 2003*, Anaheim CA, October 2003.
4. Lautenberger, C., Stevanovic, A., Rich, D., Torero, J. & Fernandez-Pello, A.C., “An Experimental and Theoretical Study on the Ignition Delay Time of Composite Materials,” *Western States Section/The Combustion Institute*, Los Angeles CA, October 2003.
5. Rich, D., Lautenberger, C., Stevanovic, A., Metha, S., Torero, J., Yuan, Z., Ross, H., Fernandez-Pello, C., “Piloted Ignition of Polypropylene/Glass Composites in a Forced Air Flow,” *7th International Workshop on Microgravity Combustion and Chemically Reacting Systems*, Cleveland, OH, 2003.
6. Lautenberger, C., Rich, D., Yuan, Z., & Fernandez-Pello, C., “Modeling Ignition of Solid Combustibles in Normal and Micro Gravity,” Work in progress poster presented at the *30th International Symposium on Combustion*. Chicago, IL, 2004.
7. Rich, D., Lautenberger, C., Hernandez, J., & Fernandez-Pello, A.C. “Effect of Environmental Variables on Critical Pyrolysate Mass Flux for Piloted Ignition of PMMA and PP/GL Composite,” *Proceedings of the 4th Mediterranean Combustion Symposium*, Lisbon, Portugal, 2005.
8. Rich, D., Lautenberger, C., McAllister, S. & Fernandez-Pello, A.C., “Microgravity Flame Spread Rates Over Samples of Polymer and Polymer/Glass Composites,” *Western States Section/The Combustion Institute*, Boise ID, March 2006.
9. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., “Modeling the Effect of Environmental Variables on Opposed-Flow Flame Spread Rates with FDS,” *International Congress on Fire Safety in Tall Buildings*, Santander, Spain, October 2006.
10. Rich, D., Lautenberger, C., Torero, J.L., Quintiere, J.G. & Fernandez-Pello, C., “Mass Flux of Combustible Solids at Piloted Ignition,” *Proceedings of the Combustion Institute* **31** 2653-2660 (2007).
11. McAllister, S., Rich, D., Lautenberger, C., & Fernandez-Pello, C., “Modeling Microgravity and Normal Gravity Opposed Flame Spread over Polymer/Glass Composites,” *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-740.
12. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., “Effect of Environmental Variables on Flame Spread Rates in Microgravity,” *45th AIAA Aerospace Sciences Meeting*, Reno, NV, Jan. 2007, AIAA 2007-383.

13. McAllister, S., Rich, D., Lautenberger, C., Fernandez-Pello, C. & Yuan, Z.G., "Modeling Microgravity and Normal Gravity Flame Spread Rates over Samples of Polymer and Polymer/Glass Composites," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.
14. Shaw, Susan D., Blum, A., Weber, R., Kurunthachalam, K., Rich, D., et.al., "Halogenated Flame Retardants: Do the Fire Safety Benefits Justify the Risks?," *Reviews on Environmental Health*, Volume 25, No. 4 2010.
15. Babrauskas, V., Rich, D., Singla, V., and Blum, A., "Toxic Chemicals and Toxic Money: The Science and Politics of Flammability Standards," IAFSS Newsletter, August 2012
16. Rich, D., "Effectiveness vs. toxicity of flame retardants, Featured Article for the incoming issue (No. 36)", *International Association of Fire Safety Science Newsletter*, No. 36, In Review, January 2014.

Selected Project Experience

Dr. Rich has served as a Fire/Life Safety Engineer/Expert for numerous projects with and prior to his time at Reax. A summary of selected projects are provided below.

Policy

- **International Electro-Technical Commission, Technical Committee 108 on Consumer Electronics**, Technical Expert.
- **US Technical Advisory Group, TC 108 on Consumer Electronics**, Voting Member
- **Global Alliance for Incinerator Alternatives** – Technical Reviewer

Peer Review

- **Coalition of California Utilities and Communication Providers and CPUC**, (San Francisco, CA) – Wildland fire risk modeling, weather effects on ignition and flame spread.
- **Foster and Partners Architects** (Cupertino, CA) – Performance based sprinkler design development and test witnessing.
- **City and County of San Francisco Fire Department (San Francisco, CA)** – Multiple (6) fire stopping equivalency judgments.
- **City and County of San Francisco Fire Department (San Francisco, CA)** – Smoke control system and weather interactions, municipal rail infrastructure.
- **State of California Fire Marshal's Office**, (Sacramento, CA) – Prison smoke control system and egress modeling.
- **Global Alliance for Incineration Alternatives**, (Berkeley, CA) – Multiple (5) reviews of incinerator plant designs for feasibility.
- **City and County of San Francisco Department of Building Inspections** (San Francisco, CA) – Residential high rise smoke control modeling and regulatory requirements for proposed code change.
- **City and County of San Francisco Department of Building Inspections** (San Francisco, CA) – School ventilation system.

Fire Testing

- **Confidential Client, Product development**, (Los Gatos, CA) – Thermal and flammability design of wallboard, cone calorimeter, thermal conductivity.
- **California Energy Commission, Fire Life Safety** (CA) – Scale modeling of fire induced flows in buildings.
- **City and County of San Francisco Fire Department (San Francisco, CA)**, Municipal railway fire testing and material property estimation.
- **Confidential Client, Biofuels**, (CA) – Testing and modeling of fuel flash points, modeling of fuel dispersion code and regulatory requirements for industrial chemical process.
- **Darfur Stoves Project**, (Berkeley, CA) – Testing and modeling of cook stove for rural communities.
- **Confidential Client**, (Denver, CO) – Development of large scale tunnel fire sprinkler test apparatus.
- **Guinness Book of World Records/History Channel**, (Salinas, CA) – Human fire walk record instrumentation and documentary commentary.

Design

- **Hanford Nuclear Facility, Fire Safety** (Hanford, WA) – Fire safety design for radioactive heating of filter elements.
- **JDSU, Hazardous Liquids Storage**, (Santa Rosa, CA) – Fire safety design for storage in industrial occupancy.
- **Confidential Client, Pyrolysis plant modeling**, (CO) – Modeling support for tire pyrolysis process.
- **Confidential Client, Biofuels**, (CA) – Modeling of industrial process plume dynamics.
- **Confidential Client, Ethanol Fuel Handling** (Los Angeles, CA) – Development of an ethanol flame arrestor for use in consumer fuel bottles. Production of comprehensive fire safety literature.
- **Ability Production Architects**, (Menlo Park, CA) – CFD modeling of a public pool ventilation system.
- **Signum Architecture**, (Napa, CA) – Alternative methods of compliance, winery re-design project.
- **Foundation Capital**, (Menlo Park, CA) – Developed prototype vapor absorption refrigeration for vaccine delivery.
- **Jeffries and CO., Computer data center fire systems**, (San Francisco, CA) – Oversee updates to fire suppression system.
- **Confidential Client, combustion emissions control** (CA) – Development and implementation of a comprehensive material fire properties test and modeling program.
- **Confidential Client, electronic cigarette** (CA) – Prototype development of a smokeless cigarette.
- **San Francisco Municipal Rail**, (San Francisco, CA) – Fire safety assessment of art exhibit.
- **California Utilities and Communication Providers - multiple projects**, (San Francisco, CA) – Wildland fire risk modeling, weather effects on ignition and flame spread.
- **San Francisco Public Utilities Commission** (San Francisco, CA) – Lead developer of organization disaster plan.
- **SEQ Energy** (San Francisco, CA) – Thermodynamic analysis of graphene pyrolysis process.
- **Stanford University**, (Menlo Park, CA) – Design and cold smoke testing of naturally ventilated atrium.
- **Wooley Classic Suites, Paller and Associates Architects** (Aurora, CO) – Design of hotel atrium smoke management system.

Investigations

- **Residential explosion and fire**, (Pueblo, CO) – Utility liability, Gas infiltration testing, site inspection and documentation, CFD modeling of explosion potential.
- **Residential Fire**, (Sacramento, CA) – Landlord liability, site inspection, cause and origin support, fire modeling, CFD modeling of fire spread.
- **Helicopter fatality accident**, (Catalina, CA) – Helicopter fire cause investigation, fire behavior and modeling.
- **Municipal Incinerator Fire**, (Panama City, FL) – Cause investigation, fire modeling, fire behavior, regulatory compliance.
- **Wildland fire**, (Electra, TX) – Wildland fire cause investigation, particle ignition, arcing, electrical heating of wood and ignition.
- **Industrial appliance fire**, (South San Francisco, CA) – Cause determination investigation, polymer ignition in wash rack.
- **Restaurant Duct Fire**, (San Francisco, CA) – Smoke migration modeling, fire cause investigation, regulatory compliance.
- **Explosion, personal injury**, (CA) – Testing of explosives with simulated human skin to determine potential for damage. Shock wave model of same.
- **Aircraft fatality fire**, (Wabash, IN) – Cause investigation, graphics development, fire behavior modeling.
- **Restaurant Fire**, (San Diego, CA) – Cause determination investigation.
- **Laptop fatality fire**, (CA) – Cause determination investigation.
- **Aircraft Fatality Fire**, (KY) – Cause determination investigation.
- **Hotel Fire**, (Lake Tahoe, CA) – Cause determination investigation, Fire modeling.
- **Residential fire, multiple fire fighter fatality**, (San Francisco, CA) – Fatality investigation, SFFD.
- **Vehicle Fire**, (Orinda, CA) – Cause and origin investigation.
- **Restaurant Fire**, (San Francisco, CA) – Cause and origin investigation

- **Construction defects, Fire Training Facility, (Elk Grove, CA)** – Construction defects, fire and materials testing, inspection, fire modeling reconstruction, code compliance.
- **Helicopter fatality fire, (Europe)** – Helicopter fatality crash and fire cause determination investigation.
- **Federal facility roofing fire (Atlantic City, NJ)** – Cause and origin investigation, computational fire modeling with weather effects, code and regulatory requirements, material fire property testing.
- **Wood mill fire (Crescent City, CA) – Cause and origin investigation**
- **Residential Fire, television (Sacramento, CA) – Cause and origin investigation**
- **Commercial electrical fire, strip lights, (Berkeley, CA)** – Cause and origin investigation
- **Hotel Fire, can lights (Springfield, MA)** – Cause and origin investigation, heat transfer modeling.
- **Campfire injury, (Oakland, CA)** – Cause and origin investigation, fire testing.
- **Dust Explosion, (Riverside, CA)** – Cause and origin investigation
- **Daycare center fire, (Victor, NY)** – Cause and origin investigation, fire modeling, ignition & spread tests.
- **Wildland Fire, (Santa Barbara, CA)** – Cause and origin investigation, particle ignition testing.
- **Sprinkler malfunction, (Santa Cruz, CA)** – Cause investigation.
- **Restaurant severe injury fire, (Houston, TX)** – Cause determination investigation, fire modeling.
- **Electrical vault fire firefighter fatality explosion and fire, (Los Angeles, CA)** – Cause determination investigation, fire testing.
- **Residential injury fire, (San Francisco, CA)** – Cause determination investigation, fire modeling.
- **Residential fire, (Oakland, CA)** – Origin and cause determination investigation.
- **Wildland fire, (Northern CA)** – Wildland fire cause investigation, particle ignition, arcing, electrical heating of wood and ignition.
- **Motorcycle severe injury fire, (Parumph, NV)** – Origin and cause determination investigation, testing of clothing protection from fire effects.
- **Laptop computer fatality fire, (Modesto, CA)** – Origin and cause determination investigation.
- **Aircraft fire (Dolan Springs, AZ)** – Origin and cause determination investigation.
- **Hotel fatality fire (Carborro, MA)** – Origin and cause determination investigation, fire modeling.
- **Bridge fire (Cle Elum, WA)** – Origin and cause determination investigation, particle ignition testing.
- **Industrial multiple injury explosion (Fremont, CA)** – Cause determination investigation
- **Bridge fire, (Throgs Neck, NY)** – Origin and cause determination investigation, computer fire modeling.
- **Commercial HCAC fire, (San Francisco, CA)** – Origin and cause determination investigation.
- **Spontaneous coal ignition, (San Pedro, CA)** – Cause determination investigation.
- **Residential multiple fatality fire, (Dallas, TX)** – Origin and cause determination investigation, computational fire modeling.

Deposition and Mediation

- **Bradley, Curley, Asiano, Barrabe & Gale, P.C. (Larkspur, CA)** – Construction defects (expert witness deposition and mediation)
- **PSA, Phillips, Spallas, Angstadt, LLP, (San Francisco, CA)** – Smoke detector malfunction (expert witness deposition)

Professional Societies

- Society of Fire Protection Engineers (SFPE)
- National Fire Protection Association (NFPA)
- American Society for Testing and Materials (ASTM)
- International Association of Fire Safety Scientists (IAFSS)

Journal Reviewer

- *Fire Safety Journal*
- *Fire Science and Technology*
- *Fire Technology*
- *Journal of Building and Environment*
- *Proceedings of the Combustion Institute*
- *Mediterranean Combustion Symposium*