

Carlos Fernandez-Pello, PhD

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Current Position

Technical Director, Reax Engineering, Inc. – Berkeley, CA

Education

PhD – Engineering Science, University of California, San Diego, 1975

MS – Engineering Science, University of California, San Diego, 1973

Dr. Eng – Aeronautical Engineering, Polytechnic University of Madrid, Spain, 1979

Eng – Aeronautical Engineering, Polytechnic University of Madrid, Spain, 1968

Overview

Dr. Carlos Fernandez-Pello is an internationally-recognized mechanical/aeronautical engineer specializing in thermo-fluids with emphasis on fire physics, fluid mechanics, heat transfer, and thermodynamics. His primary areas of specialty include: ignition and fire spread in solid and liquid fuels; self heating and spontaneous ignition of combustible materials; smoldering; spacecraft/aircraft fire safety; wildland fire spotting propagation; wind effects on power lines; metal particle and embers trajectories in high winds; micro-scale power generation. In addition to teaching, he has conducted research in the above areas funded by NASA, DOD, DOE, NIST, NSF and several industries. He has also consulted for research organizations, government agencies and industrial companies in a variety of subjects ranging from LNG spills to spacecraft fire safety. Dr. Fernandez-Pello is currently a Professor of Mechanical Engineering at the University of California at Berkeley where he has been a faculty member since 1980.

A significant component of his consulting activities for the last 30 years has included forensic work on mechanical and aeronautical engineering. This work includes cause, origin and development of thermo-mechanical failures, and fires and explosions, with emphasis on the analysis, testing and modeling of the incident. His litigation activities have involved many areas such as ignition of different fuels; fire spread; liquid pool fire burning; self heating and spontaneous combustion; smoldering and flaming; thermal failure of metal structures; pressure failure of containers and pipelines; explosive boiling; wind effects on power lines; embers and hot particle trajectories in high winds; spot ignition of wildland fires; aircraft and vehicle fires; pyrotechnic explosions; residential, warehouse and industrial fires and explosions; television and laptop fires; smoke detector thermal failure; fire reconstruction and modeling; and several other areas. He has testified as an expert witness in State and Federal courts.

Work History

2008 – present **Reax Engineering, Partner**

1986 – present **University of California, Berkeley** Dept. of Mechanical Engineering, *Professor*

2010 – present **University of California, Berkeley** Dept. of Mechanical Engineering, *Almy C. Maynard and Agnes Offield Maynard Endowed Chair of Mechanical Engineering*

2003 – present **University of California, Berkeley** Graduate Division, *Associate Dean*

1982 – 1986 **University of California, Berkeley** Dept. of Mechanical Engineering, *Associate Professor*

1980 – 1982 **University of California, Berkeley** Dept. of Mechanical Engineering, *Assistant Professor*

1980 – present **Freelance technical consultant for liability-related litigation and industry**

1980 – 1980 **Northwestern University** Dept. of Mechanical Engineering, *Associate Professor*

1977 – 1980 **Princeton University** Dept. of Mechanical and Aerospace Engineering, *Research Staff Member*

1975 – 1976 **Harvard University** Division of Engineering and Applied Physics, *Post-doctoral research fellow*

Expert Witness and Engineering Practice

Between 1980 and 2011, Dr. Fernandez-Pello has served as a consultant to law firms, industry and government organizations for work related to thermo-mechanical failures, combustion, fire, and explosions.

Representative litigation/expert witness clients include:

- **Beardsley, Jensen & Von Wald** (Rapid City, SD) – Wildland fire involving power lines (deposition)
- **Begs & Lane** (Pensacola, FL) – Fire and crash of a general aviation aircraft
- **Bishop, Barry, Howe, Haney & Ryder** (San Francisco, CA) – Explosion of liquid fuel (depo & testimony)
- **Burke & Bauermeister** (Anchorage, AK) – Structure fire involving large television (deposition)
- **Cozen & O'Connor** (Atlanta, GA) – Fire in a enamel drying industrial facility (deposition)
- **Cozen & O'Connor** (Philadelphia, PA) – Fire in an industrial oven facility (deposition)
- **Cozen & O'Connor** (Philadelphia, PA) – Industrial fire involving naphthalene (deposition)
- **Cozen & O'Connor** (Philadelphia, PA) – Electrical heater fire in warehouse (deposition & testimony)
- **Dale Sprik & Associates** (Grand Rapids, MI) – Residential fire originating in a kitchen (deposition)
- **Ernest M. Thayer** (Oakland, CA) – Automobile/structure fire (deposition & testimony)
- **Fetterly & Gordon** (Minneapolis, MN) – Rack storage fire in a paper recycling warehouse (deposition)
- **Fetterly & Gordon** (Minneapolis, MN) – Smoke detector product liability in structure fire (deposition)
- **Fowler et al.** (Miami, FL) – Crash and subsequent fire of a general aviation airplane (deposition)
- **Gordon & Rees** (San Francisco, CA) – Electrical transformer fire
- **Griffin & Laser** (Houston, TX) – Ignition of spilled solvent by water heater pilot
- **Haight Brown & Bonesteel** (Santa Ana, CA) – Residential fire involving ignition of a solvent (deposition)
- **Hallmark et al.** (Portland, OR) – General aviation airplane crash and fire
- **HellerEhrman** (San Francisco, CA) – Modeling of wildland fire involving power lines
- **Herrick, Hart, Duchemin, Spaeth, Sullivan & Schumacher** (Eau Claire, WI) – Tanker fire (deposition)
- **Hillsinger & Costenco** (San Diego, CA) – General aviation airplane fire (deposition)
- **Kirtland & Packard** (Los Angeles, CA) – Smolder initiated structure fire (deposition)
- **Knox et al.** (Oakland, CA) – Smolder initiated fire in a commercial building (deposition & testimony)
- **LA DWP** (Los Angeles, CA) – Office building fire involving transformer (deposition & testimony)
- **Laser, Proctor & Cole** (Houston, TX) – Oil well gas ignition and explosion (deposition)
- **Mackenroth, Ryan, Jacobson, Fong** (Sacramento, CA) – Fire in general aviation aircraft
- **Maloney & Smith** (Dallas, TX) – General aviation aircraft fire (deposition)
- **Martin** (Reno, NV) – Propane gas explosion and smolder initiated fire (deposition)
- **Martin, Ryan, & Andrada** (Oakland, CA) – Propane container explosion
- **Morgenstein & Jubelirer** (San Francisco, CA) – Residential fire involving a laptop
- **Morgenstein & Jubelirer** (San Francisco, CA) – Structure fire involving electrical heater (deposition)
- **Morris, Haynes & Hornsby** (Birmingham, AL) – Residential fire involving a gas heater (deposition)
- **Murchison & Cumming** (Los Angeles, CA) – Spontaneous ignition in coal loader (deposition & testimony)
- **Murchison & Cumming** (Los Angeles, CA) – Wildland fire involving power lines (deposition & testimony)
- **O'Melveny & Myers** (Los Angeles, CA) – Gasoline pipeline failure and fire
- **O'Melveny & Myers** (Los Angeles, CA) – Spontaneous ignition of chemical product
- **Paine, Hamblen, Coffin, Brooke & Miller** (Spokane, WA) – Wildland fire
- **Pretzel & Stouffer** (Chicago, IL) – Fuel tanker truck fire (deposition)
- **Pretzel & Stouffer** (Chicago, IL) – Rack storage fire in a cold storage facility
- **Ronquillo & Orderica** (San Diego, CA) – Gasoline initiated structure fire (deposition & testimony)
- **San Diego Gas & Electric** (San Diego, CA) – Wildland fire (deposition & testimony)
- **Schwartz & Cera** (San Francisco, CA) – Hydrogen explosion in gas mixing and storage facility (deposition)
- **Shield & Smith** (Los Angeles, CA) – General aviation airplane fire
- **St. Clair, McFertridge, & Griffin** (San Francisco, CA) – Pier fire (deposition)
- **Subrogors Committee** (Las Vegas, NV) – Explosion in a rocket propellant plant
- **Youngerman & McNutt** (Los Angeles, CA) – pyrotechnic explosion (deposition & testimony)

Consulting for other institutions:

- **National Institute of Standards and Technology, NIST** (Gaithersburg, MD)
- **National Aeronautics and Space Administration, NASA** (Cleveland, OH)

- **National Research Council, NRC** (Washington, DC)
- **Lawrence Livermore National Laboratories, LLNL** (Livermore, CA)
- **Sandia National Laboratories** (Albuquerque, NM)
- **Bechtel Corporation** (San Francisco, CA)
- **Failure Analysis/Exponent** (Menlo Park, CA)
- **Exxon** (Florham Park, NJ)
- **Fire Science Applications** (San Carlos, CA)
- **IHI** (Tokyo, Japan)
- **SENER** (Madrid, Spain)

Research

Ignition of Fuel Beds by Embers and Heated/Burning Metal Particles (NSF)

- The objective of this work is to develop quantitative predictive capabilities for determining whether or not an ember or hot/burning particle will ignite a fuel bed based on particle properties, fuel bed characteristics, and ambient conditions.
- Experiments and numerical modeling are conducted investigate the ignition of vegetation fuel beds by woody embers, hot molten and burning metal particles.

Tackling CFD Modeling of Flame Spread on Practical Solid Combustibles (NSF)

- Project involves the development of a generalized pyrolysis model that can simulate the pyrolysis and burning of real-world materials encountered in fires
- The computer model is coupled to an existing CFD code and used to calculate flame spread on real-world solid combustibles over a range of length scales.

Smoldering Combustion and its Transition to Flaming in Spacecraft (NASA Space Flight Program)

- Research concerns smoldering and the transition to flaming of foams, composite, and cellulosic materials
- Experimental studies performed at normal gravity and in reduced gravity in the Space Shuttle

Test Method for Materials Flammability in Spacecraft (NASA Space Flight Program)

- Work leading to the development of a new test method for the fire properties of materials used in aircraft and spacecraft
- The test is based on the piloted ignition (hot spot or spark) of materials exposed to external heating

Carbon Monoxide and Soot Formation in Inverse Diffusion Flames (NASA Ground Based Program)

- Experimental study of CO and soot production in inverse diffusion flames (special case of underventilated combustion)
- Results will improve understanding of the formation of these products during underventilated fires in earth and spacecraft

Ignition, Flame Spread and Extinction in Solid and Liquid Fuels (NIST/NSF)

- Research on the initiation and spread of flames over solid and liquid fuels
- Includes studies of fuel ignition, the subsequent spread of flames and steady burning, and flame extinction

Transport and Combustion of Embers and Metal Particles in Wild-land Fires (Various)

- Objective is to model the trajectory of embers and burning metal particles generated in wildland fires to predict fire spotting
- Results of the project could help predict wildland fire development to help fire fighters to direct fire efforts in wild-land fires
- Results could also protect the life of firefighters that are often caught in the middle of two propagating fires due to fire spotting by flying embers

Rotary Internal Combustion Micro-Engine (DARPA/MEMS)

- Develop a portable small-scale rotary internal combustion micro-engine would be capable of delivering power using liquid fuels.

- Because liquid fuels have a much higher power density than batteries, the project aims at the replacements of batteries in cases where weight is critical.
- Potential applications include propulsion of small devices and portable power generation.

Liquid Fuel Spray Ignition (ARO/TACOM)

- Studies of the mechanisms of ignition and burning of liquid fuel droplets and sprays under supercritical conditions for diesel engines applications.

Liquid Fuel Pool Fires and Boilover Burning of Fuels Spilled on Water (CNR/France)

- Collaboration with ENSMA, Poitiers, France to study the boilover burning of heavy hydrocarbon fuels (diesel oil, heating oil, etc.) spilled on water

PhD Dissertation and MS Thesis Advising

- Chaired 24 PhD dissertations and 57 MS Theses in UC Berkeley Department of Mechanical Engineering

Publications

Co-author of the book *Fundamentals of Combustion Processes*, Springer Publishing. Over 190 refereed archival publications in technical journals in the fields of combustion, fire, and heat transfer. Four book chapters. Over 200 other publications. Selected publications:

1. Fernandez-Pello, A.C. "The Challenge of Fire Prediction," *Combustion Science and Technology*, Special Silver Anniversary Issue, The Next 25 Years **98**: 281-290 (1994).
2. Garo, J.P., Vantelon, J.P., & Fernandez-Pello, A.C. "Boilover Burning of Oil Spilled on Water," *Proceedings of the Combustion Institute* **25**: 1481-1487 (1994).
3. Cordova, J., August, M., & Fernandez-Pello, A.C., "Auto-ignition of a Flat Solid Fuel in a High Temperature, Oxidizing, Boundary Layer Flow," *Combustion Science and Technology* **113-114**: 573-595 (1996).
4. Tse S.D. & Fernandez-Pello, A.C. "On the Flight Paths of Metal Particles and Embers Generated by Power Lines in High Winds and Their Potential To Initiate Wildland Fires," *Fire Safety Journal* **30**: 333-356 (1998).
5. Anthenien, R.A., Walther, D.C., & Fernandez-Pello, A.C. "Smolder Ignition of Polyurethane Foam: Effect of Oxygen Concentration," *Fire Safety Journal* **34**: 343-359 (2000).
6. Alvares, N. & Fernandez-Pello, A.C. "Fire Initiation and Spread in Overloaded Communication System Cable Trays," *Experimental Thermal and Fluid Science* **21**: 51-57 (2000).
7. Cordova, J.L., Torero, J.L., Walther, D.C., & Fernandez-Pello, A.C., "Oxidizer Flow Effects on the Flammability of Solid Combustible Materials," *Combustion Science and Technology* **164**: 253-278 (2001).
8. Stevanovic, A., Mehta, S., Zhou, Y.Y., Walther, D., & Fernandez-Pello, A.C., "Effect of Fiberglass Concentration on the Piloted Ignition Delay of Polypropylene Fiberglass Composites," *Combustion Science and Technology* **174**: 169-185 (2002).
9. Alvares, N. & Fernandez-Pello, A.C. "A Methodology to determine Pre-crash Fuel quantity from Post-crash Fire Thermal Damage to Aircraft Structure" *Fire and Explosion Hazards: Proceedings of the 4th International Seminar* (2004).
10. Fernandez-Pello, A.C, Rein, G., Bar-Ilan, A., and Alvares, N. "Estimating the Performance of Enclosure Fire Models by Correlating Forensic Evidence of Accidental Fires" *Interflam 2004* (2004).
11. Anthenien, R., Tse, S. & Fernandez-Pello, A.C. "On the Trajectories of Embers Initially Elevated or Lofted by Ground Fire Plumes in High Winds," *Fire Safety Journal* **41**: 349-363 (2006).
12. Rein, G., Bar-Ilan, A., Fernandez-Pello, A.C. & Alvares, N., "A Comparison of Three Fire Models in the Simulation of Accidental Fires," *Journal of Fire Protection Engineering* **16**: 183-209 (2006).
13. Lautenberger, C., Torero, J.L., & Fernandez-Pello, A.C, "Understanding Material Flammability," Chapter 1 in *Flammability Testing of Materials in Building, Construction, Transport and Mining Sectors*, V. Apte, Editor, Woodhead Publishing, pp. 1-21 (2006).
14. Sardoy, J., Consalvi, J., Porterie, B., Loraud, J., & Fernandez-Pello, A.C., "Modeling Transport and Combustion of Firebrands from Burning Trees," *Combustion and Flame* **150**: 151-169 (2007).
15. Lautenberger, C. & Fernandez-Pello, A.C., "Modeling Ignition of Combustible Fuel Beds by Embers and Heated Particles," *Forest Fires 2008*, 2008.
16. Lautenberger C. and Fernandez-Pello, C. "A Model for the Oxidative Pyrolysis of Wood," *Combustion and Flame* **156**: 1503-1513 (2009).

17. Chetehouna, K., Barboni, T., Zarguili, I., Leoni, E., Simeoni A., & Fernandez-Pello, A.C., "Investigation on the Emission of Volatile Organic Compounds from Heated Vegetation and their Potential to Cause an Eruptive Forest Fire," *Combustion Science and Technology* **181**: 1273-1288 (2009).
18. Nmira, F., Consalvi, J-L., Kaiss, A., Porterie, B., & Fernandez-Pello, A.C., "A Numerical Study of Water Mist Mitigation of Tunnel Fires," *Fire Safety Journal* **44**: 198-211 (2009).
19. McAllister, S., Fernandez-Pello, C., Ruff, G., & Urban D., "Effect of Pressure and Oxygen Concentration on Piloted Ignition Delay of Combustible Solids," *Combustion and Flame* **157**: 1753-1759 (2010).
20. Hadden, R., Scott, S., Lautenberger, C. & Fernandez-Pello, C., "Ignition of Combustible Fuel Beds by Hot Particles: An Experimental and Theoretical Study," *Fire Technology* **47**: 341 (2011).
21. Fernandez-Pello, A.C., "On Fire Ignition," plenary paper at the *10th International Symposium on Fire Safety Science*, University of Maryland (2011).

Honors, Scholarships, and Fellowships

- ASME Fellow
- Member of The Royal Academy of Engineering of Spain
- Pi Tau Sigma Award for Excellence in Teaching
- Fellowships from Fullbright Foundation, Juan March Foundation, the Japan Society for the Promotion of Science and MITI, Japan, the French and Italian CNR

Editorial Advisory Board

- *Combustion Science and Technology* (1992-present), *Journal of Combustion* (2010-present)*Progress in Energy and Combustion Science* (1995-2006), *Combustion and Flame* (1994-2001)