

Carlos Fernandez-Pello, PhD

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Professional Profile

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; wildland fire spotting ignition by metal fragments and embers and subsequent fire propagation; metal particle and embers trajectories in high winds. 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 aircraft 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, with emphasis on fire physics. This work includes cause, fires and explosions, with emphasis on the analysis, testing and modeling of the incident. His litigation activities have involved many areas such as: spot ignition and fire spread of wildland fires by metal particles and embers; ignition and fire spread of combustible materials; aircraft and vehicle fires; liquid pool fire burning; self heating and spontaneous combustion; smoldering and flaming; pyrotechnic explosions; pressure failure of containers and pipelines; explosive boiling;; warehouse and industrial fires and explosions; television and laptop fires; smoke detector failure; fire reconstruction and modeling; and several other areas. He has testified as an expert witness in State and Federal courts.

Education

PhD – Engineering Science, University of California, San Diego, 1975
MS – Engineering Science, University of California, San Diego, 1973
Dr. Engineering – Aeronautical Engineering, Polytechnic University of Madrid, Spain, 1972
Engineering – Aeronautical Engineering, Polytechnic University of Madrid, Spain, 1968

Work History

2008 – present **Reax Engineering, Partner**

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

2010 – 2019 **University of California, Berkeley** Dept. of Mechanical Engineering, *Almy C. Maynard and Agnes Offield Maynard Endowed Chair Professor of Mechanical Engineering*

2003 – 2013 **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**

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

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 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)
- **Berger Kahn**, (Irvine CA) Wildland fire spot ignition by metal particles
- **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)
- **Cozen & O'Connor** (Chicago, Ill) – Ignition of cellulose insulation in an attic(deposition)
- **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
- **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)

Selected Research Topics

Ignition of Natural 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.

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.

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 (Various)

- 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 30 PhD dissertations and 72 MS Theses in UC Berkeley Department of Mechanical Engineering

Selected Publications

Co-author of the book *Fundamentals of Combustion Processes*, Springer Publishing. Five book chapters. Over 250 peer reviewed publications in technical journals in the fields of combustion, fire, and heat transfer. Over 250 other publications.

1. 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).
2. 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).
3. 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).
4. 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).
5. 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).
6. 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).
7. 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).
8. 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).
9. 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).
10. 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).
11. 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).
12. 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).
13. 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).
14. Fernandez-Pello, A.C., "On Fire Ignition," plenary paper at the *10th International Symposium on Fire Safety Science*, University of Maryland (2011).
15. A. B. Dodd, C. Lautenberger, C. Fernandez-Pello "Computational Modeling of Smolder Combustion and Spontaneous Transition to Flaming" *Combustion and Flame*, V. 159, 1,448-461 (2012)
16. A. Osorio, A.C. Fernandez-Pello, D. Urban, and G. Ruff "Limiting Conditions for Flame Spread in Fire Resistant Fabrics" *Proceedings of the Combustion Institute*, **34**, 2691-2697 (2012)
17. S. Manzello, T. Yamada, A. Jeffers, Y. Ohmiya, K. Himoto and A. C. Fernandez-Pello "Summary of Workshop for Fire Structure Interaction and Urban and Wildland-Urban Interface (WUI) Fires-Operation Tomodachi-Fire Research" *Fire Safety Journal*, V 59, 122-131 (2013)
18. C. Fernandez-Pello, C. Lautenberger, D. Rich, C.Zak, J. Urban, R. Hadden, S. Scott, and S. Fereres "Spot Fire Ignition of Natural Fuel Beds by Hot Metal Particles, Embers and Sparks" *Combustion Science and Technology*, 187:1-2, 269-295 (2014)
19. J.L. Urban, C.D. Zak, and C. Fernandez-Pello "Cellulose Spot Fire Ignition by Hot Metal Particles" *Proceedings of the Combustion Institute*, DOI:10.1016/j.proci.05.081 (2014)

20. J. L. Urban, C.D. Zak, and C. Fernandez-Pello "Spot Fire Ignition of Natural Fuels by Hot Aluminum Particles" 14th International Conference of Fire and Materials, San Francisco, CA 2-4 February 2015
21. M. Thomsen, X. Huang, D. Murphy, C. Fernandez-Pello, D. Urban and G. Ruff "Flammability Limits of Fire Resistant Fabrics" 8th International Seminar on Fire and Explosion Hazards, Hefei, China, April 25-28, (2016)
22. K. Miyamoto, X. Huang, N. Hashimoto, O. Fujita and C Fernandez-Pello, "Limiting Oxygen Concentration of Polyethylene Insulated Wires under Varying External Radiation" *Fire Safety Journal*. V.86, 32–40, (2016)
23. J.L. Urban, C.D. Zak, J. Song and C. Fernandez-Pello" Smolder Spot Ignition of Natural Fuels by a Hot Metal Particle" *Proceedings of the Combustion Institute*, V. 36, 3211-3218, (2016)
24. Y. Kobayashi, X. Huang, S. Nakaya, M. Tsue, C. Fernandez-Pello "Flame Spread over Horizontal and Vertical Wires: the Role of Dripping and Core, *Fire Safety Journal*, 9, p. 112-122. (2017)
25. C. Fernandez-Pello "Wildland Fire Spot Ignition by Sparks and Firebrands" *Fire Safety Journal*, 91, p. 2-110 (2017). Int. Ass. of Fire Safety Science Howard Emmons Plenary Lecture.
26. M. Thomsen, D. C. Murphy, C. Fernandez-Pello, D. L. Urban and G.A. Ruff " Flame Spread Limits (LOC) of Fire Resistant Fabrics" *Fire Safety Journal*, 91.p. 259-265 <https://doi.org/10.1016/j.firesaf.2017.03.072> (2017)
27. S.L. Link, X. Huang, C. Fernandez-Pello, S. Olson and P. Ferkul "The effect of Gravity on Flame Spread over PMMA Cylinders" *Scientific Reports*, 8:120 (2018) <https://www.nature.com/articles/s41598-017-18398-4>
28. J.Urban, C.D. Zak, and C. Fernandez-Pello "The Effect of Fuel Bed Composition on the Spot Fire Ignition of Natural Fuels by Hot Aluminum Particles" *Fire Technology*, <https://doi.org/10.1007/s10694-018-0712>, (2018)
29. J. L. Urban and A.C. Fernandez-Pello, "Ignition" *Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires*, Manzello, S (Eds) Springer, (2018)
30. S. N. Scott, R. M. Keedy, V. E. Brunini, M. W. Kury, A. B. Dodd, J. L. Urban and C. Fernandez-Pello, "Validation of PMDI-based Polyurethane Foam Model for Fire Safety Applications" *Proceedings of the Combustion Institute*, 37, 4009–4016, (2019)
31. M. Thomsen, X. Huang, C. Fernandez-Pello, G. A. Ruff and D. L. Urban, "Concurrent Flame Spread over Externally Heated Nomex under Mixed Convection Flow" *Proceedings of the Combustion Institute*, 37, 3801-3808, (2019)
32. Y. Lu, X. Huang, L. Hu and C. Fernandez-Pello "Concurrent Flame Spread and Blow-off over Horizontal Thin Electrical Wires" *Fire Technology* (2019).
33. Y. Liu, J. Urban, C. Xu and C. Fernandez-Pello "Temperature and Motion Tracking of Metal Spark Sprays" *Fire Technology*, (2019) <https://doi.org/10.1007/s10694-019-00847-3>
34. C. Fernandez-Pello and S. McAllister "On Flame Spread" *Journal of the Combustion Society of Japan*, V. 61, No. 196, 112-119 (2019).
35. J.L. Urban, J. Song, S. Santamaria, C. Fernandez-Pello "Ignition of a Spot Smolder in a Moist Fuel Bed by an Ember". *J. Fire Science*, 108, (2019), <https://doi.org/10.1016/j.firesaf.2019.102833>
36. L. Manzello, S. Suzuki, M. J. Gollner, A. C. Fernandez-Pello "The Importance of Firebrand Mechanisms on Large Outdoor Fire Spread" *Progress in Energy and Combustion Science*" 76, 135-140. (2020)

Awards

- H. Emmons Award of the International Association of Fire Safety Science
- Distinguished Alumnus Award University of California San Diego
- Combustion Institute Fellow
- ASME Fellow
- Member of The Royal Academy of Engineering of Spain
- Pi Tau Sigma Award for Excellence in Teaching
- Fellowships from Fulbright Foundation, Juan March Foundation, the Japan Society for the Promotion of Science and MITI, Japan, the French and Italian CNR

Conference/Journal Advisory Boards

- Combustion Institute (2014-present)
- *Combustion Science and Technology* (1992-2002)
- *Journal of Combustion* (2010-2012)
- *Progress in Energy and Combustion Science* (1995-2006)
- *Combustion and Flame* (1994-2001)