

Exponent®
Engineering & Scientific Consulting


# Scott Schroeder, Ph.D., P.E., FASTM

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## Professional Profile

Dr. Schroeder has specialized experience in consumer and aerospace product durability and design evaluation, machine guarding, hydraulic systems, heavy machinery, pipeline integrity, intellectual property disputes, and mechanical design evaluation. Dr. Schroeder is also frequently called upon to perform failure analysis of industrial equipment, commercial and medical devices, and fitness equipment.

His areas of expertise include stress analysis, material science, fatigue and fracture, finite element analysis, powder metallurgy, rapid prototyping, mechanics of electronic packaging, metallic and ceramic composites, and creep-fatigue interactions. Dr. Schroeder also specializes in thermal/mechanical testing methods and procedures for advanced materials and aerospace components, elevated temperature and cryogenic environments, in situ electron microscopy deformation studies, fractography, and full-field strain mapping techniques.

Prior to joining Exponent, Dr. Schroeder was a Member of Technical Staff at Rockwell Scientific in the field of mechanics of materials and structural metals, where he conducted research on advanced aerospace composites. In addition, he developed test methodologies for surface mount reliability of microelectronics and has developed experimental and mathematical models for material behavior. Dr. Schroeder holds 2 patents and has experience negotiating intellectual property issues. He was an instructor at Moorpark College in Moorpark, California.

## Academic Credentials & Professional Honors

Ph.D., Materials, University of California, Santa Barbara, 1999

M.S., Engineering Mechanics, University of Wisconsin, Madison, 1989

B.S., Engineering Mechanics, University of Wisconsin, Madison, 1988

Fellow, ASTM International, 2023

Phi Eta Sigma Freshman Honor Society

Oscar Mayer four-year scholarship

## Licenses and Certifications

Professional Engineer, Alabama, #37887

Professional Engineer Mechanical, Arizona, #59211

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Professional Engineer, Arkansas, #21392

Professional Engineer Mechanical, California, #35627

Professional Engineer, Louisiana, #45079

Professional Engineer, Missouri, #2014039895

Professional Engineer Mechanical, Nevada, #21662

Professional Engineer, Pennsylvania, #PE082836

Professional Engineer Mechanical, Texas, #110912

Professional Engineer Mechanical, Washington, #54610

Professional Engineer, Wisconsin, #44305-6

ASME Pipeline Engineering: In-Line Inspection course

OSHA #2045 Machinery and Machine Guarding Standards

OSHA #511 Occupational Safety and Health Standards for General Industry

ASME Pipeline Engineering: Integrity Management course

Certified Forklift Operator (CFO)

## Prior Experience

Member of Technical Staff, Research Scientist, Rockwell Scientific Company, 1999-2004

Member of Technical Staff, Rockwell International Science Center, 1996-1999

Substitute Instructor, Moorpark College, 1996

Research Specialist, Rockwell International Science Center, 1996-1994

Technical Specialist, Rockwell International Science Center, 1991-1994

Senior Technical Associate, Rockwell International Science Center, 1989-1991

## Professional Affiliations

ASTM International

• Committee E08 on Fatigue and Fracture (Member-at-large, Chair E08.05.01 Fatigue of Materials)

• Committee E28 on Mechanical Testing (Sub TAG Chair E28.94.04 US TAG ISO/TC 164/SC 4 – Fatigue, Fracture, and Toughness Testing)

• Committee F08 on Sports Equipment, Playing Surfaces, and Facilities

• Committee F15 on Consumer Products

• Committee F24 on Amusement Rides and Devices

• Committee F42 on Additive Manufacturing Technologies

• Past Chairman Fatigue of Electronic Materials

U.S. committee member to the International Standards Organization (ISO)

• ISO/TC 164/SC 4/WG 2 "Pendulum impact toughness"

• ISO/TC 164/SC 4/WG 3 "Fracture toughness"

• ISO/TC 164/SC 4/WG 5 "Fatigue testing; general conditions"

• ISO/TC 164/SC 4/WG 6 "Fatigue testing; elasto-plastic strain and crack growth conditions"

Chair ISO/TC 164/SC 4 "Fatigue, fracture and toughness testing"

American Society of Mechanical Engineers

ASM International (Member-at-large - San Fernando Valley Chapter)

The Minerals, Metals, and Materials Society (TMS)

## Patents

Patent 6,517,773 B1: Direct Metal Fabrication of Parts with Surface Features Only, February 2003, (with M.R. Mitchell et al.).

Patent 6,365,093 B1: Strengthening Method for Green Form Parts Made from Metal Powder, April 2002 (with H. Ryang).

## Publications

Moore CD, Schroeder SA, Carnahan RA. Crash of T-6A Texan II - residual strength of rod ends. Materials Science & Technology 2011 Conference & Exhibition, October 2011.

Schroeder SA, Ryang H, Spurling R. Advances in direct metal fabrication. Advances in powder metallurgy and particulate materials. Proceedings, 2003 World Congress on Powder Metallurgy and Particulate Materials, Las Vegas, NV, June 2003.

Schroeder SA. Freeform fabrication of metallic components. Proceedings, 1st BCC Conference on Fine, Ultrafine, and Nano Particles, New York, NY, November 1998.

Liang J, Lee PS, Gollhardt N, Schroeder SA. Creep study for fatigue life assessment of solder joints of two lead-free high temperature solder alloys. Electronic Packaging Materials Science IX, MRS Fall Meeting, Boston, MA, 1996.

Liang J, Lee PS, Schroeder SA, Heinrich SM. An integrated fatigue life prediction methodology for optimum design and reliability assessment of solder interconnections. Advances in Electronic Packaging, ASME-EEP 1997; 19-2:1583-1592.

Liang J, Gollhardt N, Lee PS, Schroeder SA, Morris WL. A study of fatigue and creep behavior of four high temperature solders. Fatigue and Fracture of Engineering Materials and Structures 1996; 19-11:1401-1409.

Liang J, Gollhardt N, Lee PS, Schroeder SA, Morris WL. Fatigue and cyclic deformation behavior of high temperature solder alloys. Application of Experimental Mechanics to Electronic Packaging 1995; EEP-Vol. 13/AMD-Vol. 1214.

Heinrich SM, Shakya S, Wang Y, Lee PS, Schroeder SA. Improved yield and performance of ball-grid array packages: Design and processing guidelines for uniform and non-uniform arrays. IEEE Trans., Components, Packaging & Manufacturing Technology Society, Part B: Advanced Packaging, Vol. 19-2, May 1996.

Heinrich SM, Schaefer M, Schroeder SA, Lee PS. Prediction of solder joint geometries in array-type interconnects. Journal of Electronic Packaging, ASME 1996; 118(3):114-121, September.

Heinrich SM, Wang Y, Shakya S, Schroeder SA, Lee PS. Selection of design and process parameters for non-uniform ball-grid arrays. Advances in Electronic Packaging: Toward Failure-Free, Low-Cost Packaging, Vol. 1, ASME-EEP Vol. 10-1:273-288; presented at InterPack '95, Lahaina, HI, March 1995.

Heinrich SM, Schroeder SA, Lee PS. Prediction of solder joint geometries in array-type interconnects. Journal of Electronic Packaging, ASME 1995; 118-3:142-147.

Heinrich SM, Shakya S, Wang Y, Lee PS, Schroeder SA. Improved yield and performance of ball-grid array packages: Design and processing guidelines for uniform and non-uniform arrays. Proceedings, 45th Electronic Components and Technology Conference, Las Vegas, NV, May 1995. (Selected for "Outstanding Paper Award," 2nd place, Poster Session).

Schroeder SA, Morris WL, Mitchell MR, James MR, A model for primary creep of 63Sn-37Pb solder. Fatigue of Electronic Materials, ASTM STP 1153, Schroeder SA and Mitchell MR (eds), American Society for Testing and Materials, Philadelphia, PA, 1994.

Heinrich SM, Schroeder SA, Lee PS. Prediction of solder joint geometries in multiple-bump arrays. Mechanics and Materials for Electronic Packaging: Volume 1, Design and Process Issues in Electronic Packaging, Chen, Nguyen, and Winterbottom (eds), ASME AMD-Vol. 195, pp. 11-22, 1994; presented at the 1994 International Mechanical Engineering Congress and Exposition, Chicago, IL, November 1994.

Schroeder SA, Mitchell MR. Torsional creep behavior of 63Sn-37Pb solder. Advances in Electronic Packaging, American Society of Mechanical Engineers, New York, NY, Vol. 2, pp. 649-653, 1992.

Enke NF, Kilinski TJ, Schroeder SA, Lesniak JK. Mechanical behaviors of 60/40 tin-lead solder lap joints. IEEE Trans. on Comp., Hybrids, and Manu. Tech 1989; 12(4):459-468, December.

### Books

Schroeder SA, Mitchell MR (eds). Fatigue of Electronic Materials. American Society for Testing and Materials, STP 1153, 1994.

### Technical Reports

Morris WL, Dadkhah MS, James MR, Mitchell MR, Schroeder SA. Micromechanics of fatigue crack growth in Ti-aluminide composites, p 511 in Titanium Aluminide Composites, Ed. Smith PR, Balsone ST, Nicholas T, U.S. Air Force Report WL-TR-91-4020, 1991.

Artaki I, Noctor D, Desantis C, Desaulnier W, Felton L, Palmer M, Felty J, Greaves J, Handwerker C, Mather J, Napp D, Pan T.-Y, Rosser J, Schroeder SA, Vianco P, Whitten G, Zhu Y. Lead-free Solder Final Report. Final Report of NCMS Project No. 170502, August 1997.

Wright PK, Gilbert S, Chatterjee A, Cook T, Schroeder SA. Damage tolerant design of gamma titanium aluminide. Quarterly Report for Air Force contract F33615-97-C-5291, May 2002.

### Selected Invited Presentations

Schroeder SA, Guyer EP, O'Brien MJ. Fracture and fatigue behavior of Si3N4 balls, 2008 AFRL/RZTM Bearing Modeling Summit, August 2008.

Schroeder SA, Dershowitz A. What happened? And how an engineering laboratory can help you figure it out! California Conference of Arson Investigators, January 28, 2006.

Schroeder SA. Advances in direct metal fabricating. WESTEC, Society of Manufacturing Engineers, March 23, 2004.

Bulat W, Schroeder SA, Dadkhah MS. 3D induction heating simulation of a helical gear. ANSYS Conference, 1998.

Schroeder SA, Mitchell MR, Evans AG. Creep crack propagation of 63Sn/37Pb with emphasis on colony boundary deformation and rupture. TMS Annual Meeting, February 1997.

Schroeder SA. Reliability modeling for lead-free microelectronics. TMS Annual Meeting, Orlando, February 9-13, 1997.

Schroeder SA, Morris WL, Mitchell MR, Evans AG. In-situ field emission SEM creep testing of 63Sn/37Pb with emphasis on colony boundary deformation. VIII International Congress on Experimental Mechanics of the Society for Experimental Mechanics, Experimental/Numerical Mechanics in Electronic Packaging session, Nashville, TN June 10-13, 1996.

Schroeder SA, Morris WL, James MR. A microstructural based model of thermal fatigue damage in Pb/Sn alloy solder lap-joints. Lead-Free Solder Workshop, Northwestern University, July 24-26, 1995.

Schroeder SA, Morris WL, Mitchell MR, James MR. Modeling of fatigue damage of solder joints. ASTM Symposium on Fatigue of Electronic Materials, Atlanta, GA, May 17, 1993.

Schroeder SA, Mitchell MR, Morris WL, Dadkhah MS. Damage propagation and reliability in solder joints. SRI Briefing, June 23, 1992.

Schroeder SA, Mitchell MR. Morris WL. Dadkhah MS. Thermal-mechanical behavior of solder joints. University of California, Santa Barbara, CA, July 31, 1992.

Cox BN, Dadkhah MS, Inman RV, Morris WL, Schroeder SA. Mechanisms of compressive failure in woven composites and stitched laminates. Proceedings, 9th DoD/NASA/FAA Conference on Fibrous Composites in Structural Design. Soderquist JR, Neri LM, Bohon LH (eds), pp. 125-138, Lake Tahoe, NV, November 1991.

Schroeder SA, Mitchell MR. Torsional creep behavior of 63Sn-37Pb solder. American Society of Mechanical Engineers/Japanese Society of Mechanical Engineers, San Jose, CA, August 9, 1991.

Cox BN, Dadkhah MS, Inman RV, Mitchell MR, Morris WL, Schroeder SA. Micromechanics of fatigue in woven and stitched composites. Proceedings, 1st NASA Advanced Composites Technology Conference, Seattle, WA, October-November 1990.

Schroeder SA, Mitchell MR, Morris WL, Dadkhah MS. Torsional cyclic shear stress-strain behavior of 63-

37 Solder. 1st International Workshop on Materials and Mechanics Issues of Solder Alloy Applications, Santa Fe, NM, June 6-8, 1990.

## Project Experience

Managed a site investigation at a passenger railcar accident in California. The structural damage and accident conditions were assessed.

Served on two failure review boards investigating on-orbit commercial satellite anomalies.

Technical lead to a year-long effort to assist a large gas utility company with the implementation of a plan to validate the Maximum Allowable Operating Pressure (MAOP) for its gas transmission lines.

Evaluated the suitability of instrumented indentation techniques for estimating the yield strength of gas transmission pipelines.

Evaluated the design suitability of a pipe coupling used in a municipal water pumping station. Determined the design loads and influence of the manufacturing process.

Numerous failure and accident investigations of industrial products such as valves, band saws, CNC machines, alligator shears, ladders, industrial food processors, automatic doors, printing presses, and various water pipe and plumbing systems.

Analyzed the functionality of a trademarked truck trailer design with respect to structural benefits. Compared the structural weight of various design options.

Analyzed claim construction of archery bow stabilizer patents for infringement and invalidity.

Managed design and safety reviews of a variety of consumer fitness equipment. Conducted reliability and safety testing for compliance with applicable US and international standards.

Managed and conducted experimental and analytical fatigue and fracture assessments of vehicle components and aerospace materials.

Managed an investigation to determine the scope of a medical device recall. Conducted numerical analyses to assess the viability of several design remediation options.

## Editorships & Editorial Review Boards

Editorial Board, *Journal of Testing and Evaluation*, ASTM International, 2006-2014, 2017-present