

Curriculum Vitae - DENIS E. CLARK, P. E. – 12 January 2019

D. E. Clark has been involved in welding research and development for over 40 years. He has worked in the areas of weldability, materials testing, experimental equipment design and construction, thermal modeling and simulation, the control of welding and other processes, and welding safety and health.

CERTIFICATIONS

Professional Engineer, Idaho License # 15775

AWS Certified Welding Inspector, CWI Certificate # 13052201

EMPLOYMENT

February 2013-present – Consultant: Principal Engineer, DEClark Welding Engineering, PLLC

August 2013-2018: Adjunct Professor, General Engineering, Montana Tech University

Academic activities included:

Development of undergraduate course materials for teaching additive manufacturing;

On-line teaching, welding engineering program, Montana Tech University, EWLD 443, The Physics of Welding, Fall 2013, 2014, 2015, 2016, 2017.

1983-2013 - Energy Efficiency and Industrial Technologies Department, Idaho National Laboratory

Technical activities included:

Development of diffusion welding processes for Ni-based alloys for nuclear heat exchanger applications in High Temperature Gas Reactor and Molten Salt Reactor systems;

Processing, welding, and metallurgical development of Advanced Neutron Absorber materials (boron- and gadolinium-containing alloys) for waste storage structural elements;

Development of remote welding procedures and techniques for waste closure packages, Yucca Mountain Project and National Spent Nuclear Fuel Program;

Fundamental experimental studies in friction stir welding (FSW);

Principal Investigator, Controlled Thermomechanical Processing, Cooperative Research and Development Agreement (CRADA) activities with Timken Steel and other industrial and National Laboratory partners, developing advanced control systems for seamless steel tube mills;

Principal Investigator, Intelligent Control of Cupola Furnace, responsible for the development of a neural network based advanced control system. Development and implementation of a hybrid fuzzy logic/neural network controller;

CRADA activities with the automotive industry involving the advanced diagnostics of various welding processes, including diagnostic work in-plant, and the design and construction of self-contained diagnostic systems for individual auto company partners;

Principal Investigator, Steel Initiative, responsible for development and implementation of thickness and cooling rate sensing and control for the spray forming of steel;

Experimental studies of droplet transfer physics and mode detection in gas metal arc welding;

Conception and initial development of a modified welding process for the direct deposition of metal-matrix composites;

Responsible for installation and ongoing operation of the INL Gleeble, including uniaxial, torsion, and Hydra-wedge units;

Responsible for investigating the weldability of rapidly solidified materials, including inert gas-containing metals, by conventional and high energy density welding processes;

Consulting on welding problems and ASME code qualification of welds for the INL, participation in nuclear power plant weld evaluation at TVA-Watt's Bar.

1980-83 - The Ohio State University, Graduate Research Associate, 1980-1983. Taught undergraduate welding metallurgy labs on metallographic techniques for examining hydrogen-induced cracking. Worked on installation, alignment, and initial experimental runs of laser welding facility in the Center for Welding Research.

1979-80 - Travel in South America.

1976-79 - Sandia Laboratories, Livermore, Engineering and Science Assistant, Materials Characterization Division. Responsible for design and operation of experimental apparatus, weldability testing, vacuum heat treating, materials testing for hydrogen compatibility and minor element effects in stainless steel welds. Operation of Varestraint, Gleeble, and tensile testing machines, metallography apparatus, and high pressure and vacuum systems. Formal instruction in high pressure techniques.

1975-76 - College of San Mateo, Teaching Assistant. Assisted in teaching gas tungsten-arc welding course to local industrial welders. Demonstration of proper techniques, inspection and correction of student techniques.

1972 - Union Carbide Corporation, Pine Creek Operations, Bishop, California. Laborer in tungsten mine and mill, summer employment.

EDUCATION

Attended "BPV Code, Section III, Division 1: Rules for Construction of Nuclear Facility Components." 3.00 CEU, 30.00 PDH. American Society of Mechanical Engineers, Las Vegas NV, March 19-22 2013.

Taught evening courses in Welding Engineering, University of Idaho, 1992, 1996, 1997.

Attended courses in Mechanical Metallurgy and Advanced Heat Transfer, University of Idaho, 1984-90.

M.S., Welding Engineering, The Ohio State University, Columbus, Ohio, 1983. Thesis research: Weld Pool Synthesis of Filler Materials for HY-130 Steel, advisor Prof. David Howden. Coursework in welding processes, welding and physical metallurgy, design, welding processes, NDE, corrosion, 1980-83.

San Jose State University, San Jose, California, course work in engineering, 1979.

Certificate, Welding Technology, College of San Mateo, San Mateo, California, 1976.

B.S., Agricultural Science, Cornell University, Ithaca, New York, 1974. Coursework in agronomy, agricultural engineering, and biological sciences, 1972-74.

Deep Springs College, Deep Springs, California (non-degree granting), course work in the liberal arts, 1969-72.

PROFESSIONAL

Member: American Welding Society, American Society of Mechanical Engineers.

Chair, American Welding Society Safety and Health Committee.

Member of Telluride Association, nonprofit educational organization, 1973-2002; Association President, 1996-98.

DOE "Q" security clearance, 1976-79, "L" and "Q" clearances 1983-2013.

PUBLICATIONS AND PRESENTATIONS (* = peer reviewed)

1. Clark, D. E., and D. G. Howden, "Fluid Flow and Penetration in Spray-transfer GMA Weld Pools," 65th Annual Meeting, American Welding Society. Dallas, Texas: American Welding Society, 1984.
2. Clark, D. E., "Joining of Rapidly Solidified Products: A Technical Assessment," EG&G Idaho (Idaho National Laboratory Contractor), 1984.
3. Clark, D. E., *et al.*, "Welding Metallurgy of a Rapidly-Solidified Type 304 Stainless Steel," 66th Annual Meeting, American Welding Society. Las Vegas, Nevada: American Welding Society, 1985.
4. Clark, D. E., C. J. Einerson, and R. B. Loop, "The Gas Tungsten Arc Weldability of Rapidly Solidified Alloys," EG&G Idaho (Idaho National Laboratory Contractor), 1985.
5. Clark, D. E., C. J. Einerson, and R. B. Loop, "Capacitor Discharge Welding for the Joining of Rapidly Solidified Materials," EG&G Idaho (Idaho National Laboratory Contractor), 1986.
6. Bolstad, J. O., D. E. Clark, and H. B. Smartt, "Laser Strobe Weld Pool Vision for Robotic Arc Welding," 67th Annual Meeting, American Welding Society. Atlanta, Georgia: American Welding Society, 1986.
7. Clark, D. E., C. J. Einerson, and R. B. Loop, "The Weldability of Rapidly Solidified Type 304 Stainless Steel," 1986 International Conference on Trends in Welding Research. Ed. S. A. David. Gatlinburg, Tennessee: ASM International, 1986. 817-820.
8. Clark, D. E., C. J. Einerson, and J. H. Devletian, "Modeling of GTA and Rapidly Solidified Capacitor Discharge Welds," 68th Annual Meeting, American Welding Society. Chicago, Illinois: American Welding Society, 1987.
9. Einerson, C. J., D. E. Clark, and J. H. Devletian, "A Numerical Model of the Rapid Solidification Parameters in the Capacitor Discharge Welding Process," 1987 ASME-JSME Thermal Engineering Joint Conference. Ed. P. J. Marto and I. Tanasawa. 5 vols. Honolulu: American Society of Mechanical Engineers, 1987. 3: 217-224.
10. Buhrmaster, C. L., D. E. Clark, and H. B. Smartt. "Spray Casting Aluminum and Al/SiC Composites." *J. Met.* **40.11** (1988): 44-45.
11. Clark, D. E., and G. E. Korth. "The Weldability of Consolidated Rapidly Solidified Type 304 SS Powders," *Rapidly Solidified Materials: Properties and Processing*. Ed. P. W. Lee. San Diego: ASM International, 1988. 9-17.
12. Einerson, C. J., and D. E. Clark, "Numerical Modeling of Gas Tungsten Arc and Capacitor Discharge Welding of Rapidly Solidified Alloys," EG&G Idaho (Idaho National Laboratory Contractor), 1988.
13. Clark, D. E., "Joining of Advanced Aluminides--Final Report," EG&G Idaho (Idaho National Laboratory Contractor), 1988.
14. Clark, D. E., "Short-Term Thermal Response of Rapidly Solidified Type 304 Stainless Steel Containing Helium," EG&G Idaho (Idaho National Laboratory Contractor), 1988.
15. Clark, D. E., "The Weldability of Chromium-Containing Ni₃Al-Type Advanced Aluminides," 69th Annual Meeting, American Welding Society. New Orleans, Louisiana: American Welding Society, 1988.

16. Clark, D. E., "The Weldability of Rapidly Solidified Alloys," Monterey Seminar of the Golden Gate chapter of the American Society for Metals. Monterey, California: American Welding Society, 1989.
17. Clark, D. E., and G. E. Korth, "The Weldability of Consolidated Rapidly Solidified Type 304 SS Powders," Fall Meeting of TMS/AIME. Indianapolis, Indiana: 1989.
18. Clark, D. E., C. L. Buhrmaster, and H. B. Smartt. "Drop Transfer Mechanisms in GMAW". 2nd International Conference on Trends in Welding Research. Ed. S. A. David. 1 vol. Gatlinburg, Tennessee: ASM International, 1989.
19. Clark, D. E., H. B. Smartt, and J. A. Johnson. "Computer-Derived Parameters and Control of Gas Metal Arc Welding," Golden Gate Materials Technology Conference. Santa Clara, California: 1989.
20. Clark, D. E., G. R. Smolik, and J. E. Flinn. Influence of Temperature Gradients on Porosity and Swelling Development in Fe-40Ni Containing Noble Gases Entrained During RSP. 188th Annual Meeting, TMS/AIME. Las Vegas, Nevada: 1989.
21. Clark, D. E., and R. J. Glovan. "Preliminary High Temperature Corrosion-Erosion Testing of Nickel Aluminides in an MHD Generator," Corrosion-Erosion-Wear of Materials at Elevated Temperatures. Ed. Alan V. Levy. 1 vol. Berkeley: National Association of Corrosion Engineers, 1990. 1: 34-1 to 34-6.
22. *Johnson, J. A., N. M. Carlson, H. B. Smartt, and D. E. Clark. "Process Control of GMAW: Sensing of Metal Transfer Mode." *Welding Journal Welding Research Supplement* **70.4** (1991): 91s-99s.
23. Cordes, G. A., *et al.*, "Implementation of a Fuzzy Logic/Neural Network Multi-Variable Controller," ANS/ENS 1992 International Conference. 1992.
24. Carmack, W. J., *et al.*, "Mixed Carbide Fuel Solidus Melting Temperature," 9th Symposium on Space Nuclear Power Systems. Albuquerque: 1992.
25. Clark, D. E., E. D. Larsen, H. B. Smartt, and K. L. Moore, "Neural Networks for Cupola Control," American Society for Metals meeting, Chicago, 1994.
26. Clark, D. E., E. D. Larsen, H. B. Smartt, and K. L. Moore, "Advanced User Interfaces and Intelligent Control," INL Supercomputing Symposium, Idaho Falls, October 1994.
27. Larsen, E. D., D. E. Clark, H. B. Smartt, and K. L. Moore, "Advanced Control of Cupola Melting," in proceedings of US-DOE Technology 2004 Conference, Washington DC, November, 1994.
28. Clark, D. E., E. D. Larsen, K. L. Moore, V. Stanek, P. E. King, S. Katz. "Neural Network Applications For Cupola Melting Control" 2nd International Symposium, Materials Processing in the Computer Age, Voller, Marsh and Al-Kaddah, eds., TMS, Las Vegas, February 1995.
29. Larsen, E. D., D. E. Clark, H. B. Smartt, and K. L. Moore, "Intelligent Control of Cupola Melting," 99th Casting Congress, American Foundrymen's Society, Kansas City, May 1995.
30. *Moore, K. L., M. A. Abdelrahman, D. E. Clark, E. D. Larsen, *et al.*, "A Multivariable Smith Predictor for Intelligent Control of a Cupola Furnace," in Proceedings of the 1995 American Control Conference, Seattle WA. June 1995.

31. Clark, D. E., K. L. Moore, E.D. Larsen, "Advanced Cupola Melting Control," in Proceedings of 1996 AFS Casting Congress and Expo, Philadelphia, PA, April 1996.
32. Larsen, E. D., D. E. Clark, K. L. Moore, and P. E. King "Intelligent Control of a Cupola Furnace," in proceedings of US-DOE Technology 2006 Conference, Washington DC, October 1996.
33. *King, P. E., L. G. Higgins, V. Stanek, E. D. Larsen, D. E. Clark, and K. L. Moore, "AFS Cupola Model Verification - Initial Investigations," Transactions of the American Foundrymen's Society, vol. 97-189, pp. 1-10, 1997.
34. Larsen, E. D., D. E. Clark, K. L. Moore, and P. E. King, "Intelligent Control of Cupola Melting" Australasia-Pacific Forum on Intelligent Processing and Manufacturing of Materials, Gold Coast, Australia, July 1997.
35. *Perry, K. E. Jr., J. S. Epstein, and D. E. Clark, "Phase Shift Moiré Studies of Processing-induced Residual Strain in Nickel 200 Spot Welds," Optics and Lasers in Engineering, **27** (1997) 101-109.
36. *Moore, K. L., M. A. Abdelrahman, E. D. Larsen, D. E. Clark, and P. E. King, "Experimental Control of a Cupola Furnace," in Proceedings of the 1998 American Control Conference, Philadelphia, PA, June 1998.
37. Clark, D. E., E. D. Larsen, and S. Katz, "Neural Net Implementation of the Cupola Process Model", 2nd International Cupola Conference Proceedings, Cincinnati OH, Oct. 1998.
38. Moore, K. L., M. A. Abdelrahman, E. D. Larsen, and D. E. Clark, "Feedback Control of a Cupola - Concepts and Experimental Results", 2nd International Cupola Conference Proceedings, Cincinnati OH, Oct. 1998.
39. Clark, D. E. *Telluride Power – A Brief Illustrated History of the Early Days*. Telluride Association, Ithaca, NY, 2001. Spiral bound book with photographs, 60 pp.
40. *Cook, G. E., R. Crawford, D. E. Clark, and A. M. Strauss, "Robotic Friction Stir Welding," Industrial Robot, **31**:1, January 2004.
41. *Clark, D. E., K. S. Miller, and C. R. Tolle, "Tool design in friction stir processing: dynamic forces and material flow," Proceedings of the 7th International Conference on Trends in Welding Research, Pine Mountain, Georgia, May 2005, pp. 173-178.
42. *Totemeier, T. C., and D. E. Clark, "Effect of transient thermal cycles in a supercritical water-cooled reactor on the microstructure and properties of ferritic-martensitic steels," Journal of Nuclear Materials, **355** (2006) 104-113.
43. *Hurt, W. L., D. E. Clark, R. E. Mizia, and C. V. Robino, "Overview of a Welding Development Program for a Ni-Cr-Mo-Gd Alloy", Proceedings of the 2007 Annual Meeting of the American Nuclear Society, Boston, June, 2007.
44. *Smartt, H. B., D. P. Pace, E. D. Larsen, T. R. McJunkin, C. I. Nichol, D. E. Clark, K. L. Skinner, M. L. Clark, T. G. Kaser and C. R. Tolle. "Robotic Welding and Inspection System," Trends In Welding Research Conference, Pine Mountain, Georgia, June, 2008.
45. *Miller, K. S., C. R. Tolle, D. E. Clark, C. I. Nichol, T. R. McJunkin, and H. B. Smartt, "Investigation into Interface Lifting Within FSW Lap Welds," Trends In Welding Research Conference, Pine Mountain, Georgia, June, 2008.

46. *Tolle, C. R., T. A. White, K. S. Miller, D. E. Clark, and H. B. Smartt, "Experimental Investigation of Material Flows Within FSWs Using 3D Tomography," Trends In Welding Research Conference, Pine Mountain, Georgia, June, 2008.
47. *Mizia, R. E., Clark, D. E., Glazoff, M. V., Lister, T. E., & Trowbridge, T. L. "Optimizing the Diffusion Welding Process for Alloy 800H: Thermodynamic, Diffusion Modeling, and Experimental Work." *Metallurgical and Materials Transactions A*, December 2011.
48. *Clark, D. E., R. E. Mizia, M. V. Glazoff, and M. W. Patterson "Diffusion Welding of Compact Heat Exchangers for Nuclear Applications," Trends In Welding Research Conference, Pine Mountain, Georgia, June, 2012.
49. *Sabharwall, P., D. E. Clark, R. E. Mizia, M. V. Glazoff, and M. G. McKellar "Diffusion Welding Microchannel Heat Exchanger for Industrial Processes," *Thermal Science and Engineering Applications*, v. 5 011009, March 2013.
50. Clark, D. E. "What the Recent Recommendation on Manganese Exposure Means to You," *Welding Journal*, 93(8):36-40, August 2014.
51. *Sabharwall, Piyush, Denis Clark, Michael Glazoff, Guiqiu Zheng, Kumar Sridharan, and Mark Anderson "Advanced heat exchanger development for molten salts," *Nuclear Engineering and Design*, 280: 42-56, December 2014.

U. S. PATENTS

4,768,577	6 September 1988	Dissolution of Inert Gas in a Metal Alloy
4,970,091	13 November 1990	Method for Gas Metal Arc Deposition
5,052,331	1 October 1991	Apparatus for Gas Metal Arc Deposition
6,236,017	22 May 2001	Method and Apparatus for Assessing Weld Quality
7,357,292	15 April 2008	Friction Stir Welding Tool
7,597,236	6 October 2009	Method for Forming Materials

AWARDS

INL Technology Partnership Award, 1994 - for Cupola Control work

CONTACT INFORMATION

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