Exponent®
Engineering & Scientific Consulting

Shane Kennett, Ph.D., P.E., CWI

Office Director and Principal Engineer | Materials and Corrosion Engineering
Denver
+1-303-802-3448 | skennett@exponent.com

Professional Profile

Dr. Kennett specializes in failure analysis, failure prevention, materials science, physical and mechanical metallurgy, assessment of engineering structures, and fracture mechanics. He received his Ph.D. in metallurgical and materials engineering from Colorado School of Mines and his Bachelor of Science in mechanical engineering from University of North Florida.

Dr. Kennett has experience with a wide range of applications and industries, including oil and gas pipelines, refineries and operations, power generation equipment, mining equipment, mineral processing, raw material production, automotive safety equipment, off-road vehicles, surgical devices, medical implants, and microelectronics. In these industries, Dr. Kennett specializes in applying fundamental engineering principles along with industry best engineering practices to direct- and root-cause failure analyses. Routinely in these investigations, a range of industry standards must be considered and applied to help provide an independent finding that can be used to support dispute resolution between multiple parties.

Many of Dr. Kennett's investigations are focused on weldments in pressurized systems (pipes, vessels, pipelines) and structural steel systems. He has extensively investigated the performance of the steel weldments under in-service conditions. Dr. Kennett is a Certified Welding Inspector and applies this inspection-based background on many of his investigations. As part of these investigations, Dr. Kennett has extensively reviewed and evaluated the applicability of many major industry standards and codes related to welding and pressure equipment including AWS D1.1, API 570, API 574, API 579, API 1104, ASME B31.1, ASME B31.3, ASME BPVC Sections, as well as other international standards applicable to his work on international disputes published by the DNV, NZS/AS, ISO, DIN, and ESO. In addition to his welding and pressure equipment work, Dr. Kennett has investigated bolting related failures both in on- and offshore applications and has performed extensive failure analyses on these matters.

Throughout his career, Dr. Kennett has extensively studied material characterization methods and their application, the mechanical behavior of materials, high- and low-temperature performance of metals, machine design, product life assessment, and product design. Additionally, he continues to research the effects of processing on the microstructure and subsequent mechanical properties/performance of commercial grades of steel.

Before joining Exponent, Dr. Kennett conducted his Ph.D. dissertation work at the Colorado School of Mines (CSM) in the Advanced Steels Processing and Products Research Center. During his studies at CSM, he studied the effects of the martensitic packet size, block size, lath size, dislocation density, and alloy precipitation on the mechanical properties of martensitic steel. To investigate these effects, he performed extensive characterization using optical microscopes (OM), scanning electron microscopes (SEM), focused ion beam microscopes (FIB), transmission electron microscopes (TEM), and X-ray diffractometers (XRD). During his time at CSM, he also studied the microstructure of CoCrMo hip

implants, ferrite-pearlite steels, carburized steels, and cold sprayed copper and aluminum systems. In addition to his studies, he was responsible for the operation, maintenance, training, and data interpretation of different mechanical testing techniques and equipment, including the Gleeble® advanced thermo-mechanical simulator. The Gleeble® is a research tool that can be used to simulate high heating and cooling rates and elevated temperature deformation and perform controlled heat treatments to create specific microstructures.

Dr. Kennett also has experience with machine design, specifically the design and implementation of custom machines used for unique testing scenarios, such as helping develop a rolling sliding contact fatigue machine. This machine is currently located at CSM and is still actively used by graduate students. In addition to mechanical design, Dr. Kennett has experience with the design, implementation, and optimization of closed and open-loop control systems. These systems were developed and used for 6-axis robotic arms and underwater remotely operated vehicles.

Academic Credentials & Professional Honors

Ph.D., Metallurgical and Materials Engineering, Colorado School of Mines, 2014

B.S., Mechanical Engineering, University of North Florida, 2010

Licenses and Certifications

American Welding Society Certified Welding Inspector (CWI)

Professional Affiliations

American Society of Mechanical Engineers—ASME

American Society of Metals — ASM International

American Welding Society—AWS

National Association of Corrosion Engineers — NACE

Heat Treating Society—HTS

International Metallographic Society—IMS

Society of Carbides & Tool Engineers

Materials Research Society — MRS

Publications

Kennett SC, Krauss G, Findley KO. Strengthening Mechanisms in Low Carbon Lath Martensite as Influenced by Austenite Conditioning. Materials Science Forum 2018; 941:574-582

Kennett SC, Krauss G, Findley KO. Prior austenite grain size and tempering effects on the dislocation density of low-C Nb-Ti microalloyed lath martensite. Scripta Materialia 2015; 107:123-126

Kennett SC. Strengthening and toughening mechanisms in low-C microalloyed martensitic steel as influenced by austenite conditioning. Ph.D. Dissertation, Colorado School of Mines, Golden, CO, 2014.

Kennett SC, Findley KO. Strengthening and toughening mechanisms in martensitic steel. Advanced Materials Research 2014; 922:350-355.

Eason PD, Kennett SC, Eden TJ, Krull I, Kowalski B, Jones JL. In situ observation of microstrain relief in cold-sprayed bulk copper during thermal annealing. Scripta Materialia 2012; 67:791-794

Eason PD, Eden TJ, Kennett SC, Kaufman MJ. A structure property processing comparison of cold rolled PM copper and cold gas dynamically sprayed copper. Journal of Powder Metallurgy and Mining 2012; 1(1).

Kennett SC, Findley KO. Strengthening mechanisms in microalloyed plate steels. American Iron and Steel Technology, March 2012.

Eason PD, Fewkes JA, Kennett SC, Eden TJ, Tello K, Kaufman MJ, Tiryakioğlu M. On the characterization of bulk copper produced by cold gas dynamic spray processing in the as-fabricated and annealed conditions. Materials Science and Engineering A 2011; 528(8174-8178).

Conferences/Presentations

Findley KO, Kennett SC, Cho L, Golem L, Speer JG. Microstructural Mechanisms Affecting Fracture Resistance of Martensitic Press Hardened Steel Alloys, 7th International Conference on Hot Sheet Metal Forming of High-Performance Steel CHS, Luleå, Sweden, June 2019.

Kennett SC, Krauss G, Findley KO. Strengthening Mechanisms in Low Carbon Lath Martensite as Influenced by Austenite Conditioning. International Conference on Processing & Manufacturing of Advanced Materials (THERMEC'), Paris, France, July 2018.

Briant P, James B, Easley S, Kennett S, Scahffer J, Kay L. The effect of crimp strain on the fatigue performance of nitinol. Shape Memory and Superelastic Technologies Conference, Chipping Norton, Oxfordshire, UK, May 2015.

Kennett SC, Findley KO. Strengthening and toughening mechanisms in low-C martensitic steel as influenced by austenite conditioning. ASPPRC Research Meeting Invited Presentation, Colorado School of Mines, March 2014.

Kennett SC, Rothleutner LM, Van Tyne CJ, Findley KO. Phase transformation temperature comparisons using a contact dilatometer and laser scanning micrometer. International Conference on Processing & Manufacturing of Advanced Materials (THERMEC'), Las Vegas, NV, December 2013.

Kennett SC, Findley KO. Strengthening and toughening mechanisms in martensitic steel. International Conference on Processing & Manufacturing of Advanced Materials (THERMEC'), Las Vegas, NV, December 2013.

Kennett SC, Findley KO. Strengthening mechanisms in microalloyed plate steels. Association for Iron and Steel Technology Conference and Exposition, Atlanta, GA, May 2012.

Eason PD, Fewkes JA, Kennett SC, Eden TJ, Tello K, Kaufman MJ. Structure-processing-property relationships in bulk copper produced by cold gas dynamic spray processing. MPIF PowderMet Proceedings 2010, Ft. Lauderdale, FL, June 2010.

Project Experience

Oil & Gas Pipelines – Assessing metallurgical fractures of various pipelines, which have included seamless, helically welded, and longitudinally welded pipelines. Evaluating the corrosion on pipelines and assessing the overall mechanisms active to provide guidance for remediation. Assessing the compliance of pipelines with the Code of Federal Regulations (CFR) Part 192 and 195. Evaluating historical

operators' records and assessing whether the appropriate engineering practices were followed as per American Petroleum Institute's (API) guidelines. Assessing inline inspection methods and results for understanding pipeline integrity.

Oil & Gas Upstream Activities – Assessing metallurgical fractures of downhole equipment due to either mechanical loading or environmental factors. Investigating and evaluating blow out preventers used for offshore production wells. Assessing offshore oil and gas operations and evaluating the performance of metallurgical components in sea water with and without cathodic protection systems. Evaluating operational procedures against Det Norske Veritas (DNV) guidelines and other industry standards.

Oil & Gas Refineries – Investigating welding quality in process piping and pressure equipment at various facilities across the world. Investigating the contributing causes to the unexpected ruptures of process piping, both buried and above ground. Evaluating the historical records and assessing whether the appropriate inspections were being executed as per the American Petroleum Institute's (API) guidelines. Evaluating the process safety management (PSM) systems in place. Assessing the compliance of piping systems with ASME B31.3.

Hydrogen Embrittlement of Steel – Investigating failures related to the hydrogen embrittlement of steels in different applications. These investigations have encompassed hot dipped galvanized fasteners, welding controls and procedures, and cathodic charging due to over protection from cathodic protection systems.

Power Generation Turbines – Investigating turbine blade failures in various power generation facilities. Evaluating factors affecting stress corrosion cracking, blade erosion, and the fatigue of high alloy blading materials. Evaluating foreign object debris that leads to damage.

Power Generation Boilers (subcritical and supercritical) – Investigating the integrity of pressurized piping and vessels. Guiding nondestructive testing campaigns. Investigating metallurgical fractures associated with boiler tubes, steam headers, and other related equipment. Assessing corrosion and erosion mechanisms present in different locations within boilers. Examining the effect of steam erosion post rupture on neighboring boiler tubes. Developing repair strategies for headers and piping including repair welding work and post weld heat treatment work. Evaluating weld quality and repair approaches for heat recovery steam generators.

Electrical Power Transmission – Investigating the metallurgical fractures of newly constructed power line poles. Assessing the validity of large-scale re-creation testing of the fractures and understanding whether mechanical design or manufacturing/assembly was the primary causal factor.

Sea Wall Analysis – Investigating the metallurgical fracture of large sea walls in Alaska that were subject to large tidal variations. Determining the fracture mechanisms present and the direct cause of fracture. Assessing the welded connections on the sea wall to determine whether manufacturing or welding defects were causal or contributing factors.

Heavy Construction Equipment – Evaluating mechanical and metallurgical defects in new construction equipment and the effect on the overall equipment. Investigating structural and mechanical welding defects and high-strength fasteners.

Airbag Deployment – Investigating fracture behavior of automotive airbag housings when subjected to elevated pressures during discharge. Evaluating and characterizing the evolution of the explosive propellant in the airbag and its interaction with temperature/humidity cycling. Developing models to understand the rate of degradation occurring for ammonium-nitrate-based propellants. Studying the burning behavior of the propellant and its effect on overall airbag performance. Providing valuable data to help automakers roll out worldwide recalls.

Automotive Mechanical Equipment – Investigating the failure of mechanical equipment associated with performance automotive vehicles. Reporting on the interplay between casting anomalies and expected

performance of the components. Assessing safety critical fasteners and understanding the scope of recall needed.

Off-road Utility Vehicles (UTVs) and All-Terrain Vehicles (ATVs) – Investigating the direct cause of fires associated with high-temperature engine-related equipment on off-road vehicles. Developing methods for determining the degree of over-heating in the metallic components. Investigating and evaluating the metallurgical fracture of welded mechanical components used on ATVs, especially suspension components. Investigating rotating drivetrain components and casting quality of aluminum components.

Industrial Heat Exchangers – Evaluating the corrosion fatigue behavior of industrial gas fired heat exchangers and assessing the validity for the materials of construction used. Evaluating repair welding work and post weld heat treatment work of leaking heat exchangers. Assessing stress corrosion cracking, weld cracking, and other metallurgical fractures in heat exchangers in a variety of applications.

Fire Sprinkler System Corrosion and Fire Sprinklers – Assessing corrosion occurring within piping used for a fire sprinkler system and determined the mechanisms active. Results were used to guide proper operation after replacement of the leaking pipe components. Investigating the performance of fusible link sprinklers and assessing the metallurgical fracture of the sprinklers.

Medical Devices – Investigating the fracture of hip implants, surgical tools, intravenous devices, and stents. Evaluating the performance of the components based on the metallurgical material properties.

Hip Implant Wear – Evaluating and characterizing metal-on-metal wear behavior of hip implants and developing a technique for characterizing the extent of damage using a focused ion beam (FIB) microscope. The technique developed was considered a form of non-destructive examination.

Consumer Appliances – Investigating failures in mechanical components associated with household appliances and providing guidance for rectification and re-design on the components. Addressing mechanical sealing behavior of rubber seals used on plastic and metallic rotating shafts.

Consumer Electronics – Investigating numerous manufacturing-related issues associated with consumer electronics. Performing highly detailed analyses using focused ion beam (FIB) microscopes, high-resolution scanning electron microscopes (HR-SEM), x-ray diffraction (XRD), and scanning transmission electron microscopy (STEM). Developing new and unique methods for testing material properties and investigation components on the micro- to nano-scale.

Children's Sport Toys – Investigating the metallurgical fractures in two-wheeled scooters built from thin aluminum tubes and welded together. Providing guidance for reporting the results and rectifying manufacturing requirements to mitigate future problems. Investigating the failures of skateboard trucks and whether they were related to design or manufacture.

Waste Disposal Valve Leak – Investigating the failure of valves associated with hazardous waste disposal systems and the effect that the hazardous material had on corrosion.

Electrical Shock Assessment – Investigating electrical shock incident in which a construction worker was subject to personal injury. Evaluated the accident to determine whether electrical contact was made between the workers tools and the high-powered electrical bus in the building.

Salt Well Caverns – Reviewing and analyzing historical well operations along with operational data and comparing to good engineering practices.

Structural Failures - Assessing metallurgical aspects of structural failures and the sequence of collapses. Assessed contributions from welds in the collapses.

Desalination - Assessing early onset fatigue failures in pressure equipment used in the desalination processes. Evaluating manufacturing quality as well as operation and maintenance of the equipment.

Chemical Processing - Assessing manufacturing and fabrication quality of equipment supplied as well as operation and maintenance factors. Evaluating coating performance of equipment and structures for various environmental conditions.

Wastewater Treatment Plant - Assessing manufacturing and fabrication quality of equipment supplied. Evaluating coating inspections and subsequent coating performance in submerged tanks.