Exponent®
Engineering & Scientific Consulting

Alex Hudgins, Ph.D., P.E.

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Professional Profile

Dr. Hudgins specializes in failure analysis, metallurgy, materials science, corrosion, and fracture mechanics. He has experience in the automotive, medical device, energy, consumer product, and electronics industries.

Dr. Hudgins has extensive processing, microstructural development, and property development expertise utilizing optical microcopy, scanning electron microscopy, x-ray diffraction, microhardness, nanoindentation, analytical modeling, and novel mechanical testing techniques.

While at Exponent, Dr. Hudgins has investigated numerous failures on components large and small, from heat treatment issues on large steel castings to defects in small medical devices. In addition to failure analysis investigations, Dr. Hudgins has helped clients develop and implement methods to avoid failures in different applications and industries. While versed in a variety of topics, Dr. Hudgins has significant experience in the oil and gas industries, helping clients understand their metallurgical challenges.

Prior to joining Exponent, Dr. Hudgins conducted his Ph.D. dissertation work at Colorado School of Mines where he studied advanced high strength sheet steel formability for automotive applications. Specifically, unanticipated fractures in the high strength, multiphase materials were investigated using a high rate bending under tension test frame which simulated stamping operations in industry. Structure-property relationships of dual phase (DP), transformation induced plasticity (TRIP), and high strength, low alloy (HSLA) steels were evaluated using laboratory heat treatments to carefully control microstructural variables such as grain size, phase volume fraction, and phase strength levels.

In addition to bulk metals, Dr. Hudgins also has experience with electrolytic reduction of titanium dioxide, as well as thin film evaporation and lift-off techniques. As a teaching assistant in both mechanics of materials classes and forging and forming classes, he has interacted with students in the laboratory as well as the classroom.

Academic Credentials & Professional Honors

Ph.D., Metallurgical and Materials Engineering, Colorado School of Mines, 2010

B.S., Materials Science and Engineering, Lehigh University, 2005

President and Member, Alpha Sigma Mu Pennsylvania Epsilon Chapter, The International Professional Honor Society for Materials Science and Engineering, 2004-2005

Recipient, Allen S. Quier Prize, Lehigh University Materials Science and Engineering Department, 2005

Member, Phi Sigma Pi National Honor Society, 2003-2005

Licenses and Certifications

Professional Engineer Metallurgical, California, #1972

Professional Engineer Metallurgical, Texas, #139581

Professional Affiliations

ASM International, American Society of Metals (member)

TMS, The Minerals, Metals, and Materials Society (member)

American Gas Association—AGA (member - Corrosion Control Committee)

American Water Works Association—AWWA (member)

Publications

Davis B, Patrick B, Hudgins A, Watson H, Wang L, Zirkle T, Bhargava Y. Identification of factors to determine statistically appropriate and conservative CVN toughness values for transmission pipelines. 37th International Pipeline Pigging and Integrity Management Conference, January 2025; 1345-1372.

Liu C, Hudgins A, James B. Failure analysis of a ruptured pipeline. Journal of Failure Analysis and Prevention 2024; 24:2575-2582.

Georgin B, Bowers M, Hudgins A, Chy H, Luy A. Testing the effectiveness of covered conductors for wildfire mitigation. CIGRE Conference Paper: Paris Session, August 25-30 2024; B2 PS3, Paper 10327.

Jain L, Vest L, Gonzales R, Hudgins A, Stamps R. Line pipe DC-ERW long seam weld anomaly investigation. AMPP Conference Paper: New Orleans, LA, March 3-7, 2024; 51324-21182-SG.

Davis, B, Hudgins, A, Bhargava, Y, Patrick, B, Myca, M. Fatigue threat to natural gas pipelines: an analysis approach. Proceedings of the ASME 2022 14th International Pipeline Conference, IPC 2022, Calgary Alberta, Canada, September 26-30, 2022; IPC2022-87283.

Hudgins A, Roepke C, James B, Kondori B, Whitley B. Failures of pipelines. In: Miller BA, Shipley RJ, Parrington RJ, Dennies DP, editors. Analysis and Prevention of Component and Equipment Failures. ASM Handbook. Volume 11A, ASM International 2021.

Hudgins AW, Matlock DK. The effects of property differences in multiphase sheet steels on local formability. Materials Science & Engineering A 2016; 654:169-176.

James B, Hudgins A. Failure analysis of oil and gas transmission lines. In: Makhlouf H, Aliofkhazraei M, editors. Handbook of Materials Failure Analysis with Case Studies from the Oil and Gas Industry, Elsevier 2015.

Hudgins AW, James B. Fatigue of threaded fasteners. In: Advanced Materials & Processes. ASM International 2014; 172(8):18-22.

Hudgins AW. Shear failures in bending of advanced high strength steels. Ph.D. dissertation, Colorado School of Mines 2010.

Hudgins AW, Matlock DK, Speer JG, Van Tyne CJ. Predicting instability at die radii in advanced high strength steels. J Mater Process Technol 2010; 210(5):741-750.

Hudgins A, Myca K, Davis B, Bhargava Y. A systematic approach to pipeline fatigue analysis. American

Gas Association (AGA) Transmission Integrity Mega Rule Implementation Webinar, October 15, 2020.

Hudgins AW, Matlock DK, Speer JG. Shear failures in bending of advanced high strength steels. Proceedings, International Deep Drawing Research Group Conference, Golden, CO, 2009; 53-64.

Hudgins AW, Matlock DK, Speer JG, Fekete JR, Walp MS. The susceptibility to shear fracture in bending of advanced high strength sheet steels. Proceedings, MS&T Conference, Detroit, MI, 2007; 145-157.

Bykowski M, Hudgins AW, Deacon R, Marder A. Failure analysis of the Space Shuttle Columbia RCC leading edge. J Fail Anal Prev 2006; 6(1):39-45.

Presentations and Professional Classes

Hudgins A, Lau E, Murphy P, moderated by Hung W. Key considerations in data center design, construction & operation. Webinar, May 14th, 2025.

Liu C, Davis C, Hudgins A, Neilson H, Ortiz J. Enhanced inspections and technology for wildfire mitigation of transmission assets. Centre for Energy Advancement through Technological Innovation (CEATI) Conference, 2022.

Marquardt A, Hudgins A, Sakamoto M, Bhargava Y. Understanding corrosion of transmission overhead structures for improved lifetime prediction and risk modeling. CEATI International, CEATI 2021 Transmission & Distribution Conference, November 2021.

Hudgins A, Bhargava, Brenk G. Differentiating between low and high frequency ERW pipe. American Gas Association, Transmission Integrity Management Committee Meetings, Orlando FL, October 4, 2021.

Bhargava Y, Hudgins A, Patrick B. Determining growth rates for assessment of stress corrosion cracking on pipelines. American Gas Association Fall 2021 Operations Conference, Orlando FL, October 6, 2021.

Davies W, Wikramanayake E, Wolf M, Hudgins A. Transient effects of injecting green hydrogen into natural gas pipelines. 10th International Congress on Sustainability Science & Engineering, September 13, 2021.

Hudgins A, Myca K, Davis B, Bhargava Y. Mega rule deep dive: engineering analysis, crack-like features, corrosion + seismicity. Western Energy Institute (WEI) Transmission Integrity Webinar, July 13, 2021.

Nirankari V, James B, Van Der Schjiff, Hudgins A. Grooving corrosion: differentiating weld defects from corrosion failure. Materials Science and Technology Conference, Columbus OH, October 17, 2018.

Hudgins A, Davis B. Crack assessment methods. American Gas Association Fall 2018 Transmission Integrity Management Committee Meetings, Fort Worth TX, October 23, 2018.

Hudgins A. Fundamentals of pipeline integrity management: pipeline basics, common failure mechanisms, integrity management, and MAOP establishment. EUCI Class Instructor, Denver, CO, March 16, 2017.

Hudgins A, Bhargava Y. Susceptibility of natural gas pipelines to stress corrosion cracking. American Gas Association Spring 2017 Operators Meeting, Orlando FL, May 4, 2017.

Hudgins A, Davis B. A metallurgical and fracture mechanics approach to understanding crack-like defects. American Gas Association Transmission Integrity Management Workshop, Pittsburgh, PA, June 14, 2017.

Hudgins A, Bhargava Y. The Implications of the proposed rule changes for corrosion control practices: what it means to operators and contractors. API Inspection Summit, February 2, 2017.

Birringer R, Hudgins A, James B. Case study of a natural pipeline explosion caused by a combination of manufacturing defects and environmental factors. Materials Science and Technology Conference, Salt Lake City, UT, October 24, 2016.

James B, Hudgins A. Fracture mechanics and crack management for natural gas operators. American Gas Association Fall Operators Meeting, Nashville TN, September 13, 2016.

Hudgins A. Medical device design and failure analysis. ASM International Class Instructor, Santa Clara CA, August 2016.

Hudgins A. Metal fracture and fractography. Stanford University, May 6, 2016.

Hudgins A. Pipelines 201: pipeline basics, common failure mechanisms, integrity management. MAOP establishment, and asset management. EUCI Class Instructor, Houston, TX, March 2016.

Hudgins AW, Matlock DK, Speer JG. International Deep Drawing Research Group, Golden CO, June 1-3, 2009.

Hudgins AW, Matlock DK, Van Tyne CJ. North American Deep Drawing Research Group, Cleveland, OH, November 19, 2008.

Hudgins AW, Matlock DK, Speer JG, Fekete JR, Walp MS. Materials Science and Technology, Detroit, MI, September 16-20, 2007.

Project Experience

Infrastructure and Transportation

Investigated welding defects found on newly installed infrastructure (suspended walkway) in light of current industry welding standards. Investigated welds on in-service and failed equipment with respect to standards.

Determined the cause of a rail axle failure that resulted in derailment. A combination of corrosion, fatigue, and inadequate care was found to be the cause.

Examined cracks in automotive stabilization bars.

Medical Devices

Performed failure analysis investigations on multiple orthopedic implants including hips prostheses and pedicle screws.

Performed failure analysis investigations of cardiovascular implants (stents), including devices that experienced wear, corrosion, and fretting.

Performed failure analysis investigations and testing on multiple medical tools and instruments such as torque wrenches, catheters, cautery tools, shears, etc. Worked with clients on approvals and regulatory compliance issues related to the devices and their testing.

Oil and Gas

Performed numerous pipeline failure analysis investigations. Investigated in-service failures and leaks resulting from environmental degradation and manufacturing defects, as well as third party damage. Examined pipelines that had failed during hydrotests and determined the cause of failure, which included

long seam defects and mechanical damage.

Performed burst testing of natural gas pipeline segments to determine joint efficiency factors.

Investigated metallurgical issues in novel blowout preventer designs including the response of alloy steel to high strain rate deformation.

Examined the cause of metallurgical defects found in large scale gearing on off shore drilling platforms.

Data and Asset Management

Experience with MAOP validation for natural gas piping systems, including detailed review of historical records (strength test pressure reports, as-built drawings, etc.), addressing unknown values or incomplete information, and reporting results.

Experience with Geographical Information Systems (GIS) and related data.

Performed health/condition assessments for a natural gas operator, specifically with respect to the corrosion control program and affected assets. Procedures and standards, as well as assets were investigated to determine compliance with code requirements and industry best practices.

Consumer Goods and Industrial Equipment

Failure analysis of recreational toys and equipment including bicycles and bicycle components.

Examined metallurgical issues related to wearable consumer devices.

Investigated failures in manufacturing equipment such as fasteners and other specialty tooling used in manufacturing operations.

Reviewed product testing results of sheet steel used in kitchen appliances. The investigation was focused on metal formability issues.