Exponent
Failure Analysis Associates®

Exponent
149 Commonwealth Drive
Menlo Park, CA 94025

telephone 650-326-9400
facsimile 650-326-8072
www.exponent.com

Roland Huet, P.E.
Senior Managing Engineer

Professional Profile

Mr. Roland Huet is a Senior Managing Engineer in Exponent's Materials and Corrosion Engineering practice. He specializes in combining metallurgical and mechanical engineering to perform failure analysis and accident reconstruction and to improve existing designs.

With over 25 years of experience, Mr. Huet has investigated the behavior of metals, glasses, ceramics and plastics in a wide variety of components, devices and equipment such as medical implants, flat panel displays, plastic cases, capacitors, batteries, power plant components, steam generators, and turbines. Using fractography, metallography, and basic engineering principles, Mr. Huet has analyzed and tested bicycle components; analyzed post-explosion fragments; measured residual stresses in metals and non-metallic materials; performed stress and fracture mechanics analysis of pressure vessels, piping, and oil rigs; and analyzed and tested consumer products.

Mr. Huet has demonstrated in numerous occasions his expertise in finding out how or why devices do not perform as expected.

Academic Credentials and Professional Honors

M.S., Materials Science, University of California, Berkeley, 1980
Engineer, Metallurgy, École Centrale Paris, France, 1977

Licenses and Certifications

Registered Professional Metallurgical Engineer, California, #MT01800
Registered Professional Mechanical Engineer, California, #M31370

Languages

French (mother tongue)

Publications

Huet R, Sakona A, Kurtz S. Strength and reliability of alumina ceramic femoral heads: Review of design, testing, and retrieval analysis. Journal of the Mechanical Behavior of Biomedical Materials, 2011, in press. doi:10.1016/j.jmbbm2010.12.010.

Huet R. The interdisciplinary nature of failure analysis. Practical Failure Analysis 2002; 2(3):17, ASM International.

Reports

Huet R, Rau CA, Smith T, Kytömaa H. Evaluation of the March 1995 failure of Turbine Generator #3 at Skeena Cellulose, Inc. Exponent Report, 2003.

Rau CA, Huet R, Marcus HL, Bourell D. Mississippi Chemical Corporation's position paper for the court-appointed expert. Exponent Report regarding metallurgical examination of post-explosion fragments, 2000.

Huet R, Hilbert LB, Hertzberg J. Investigation of the La Vallée Plant dryer failure. Exponent report to Merck Sharpe & Dohme-Chibret, 1999.

Huet R, Nunes S. Analysis of the rupture of 50 cc glass vials during sterilization trials. Exponent Report to Merck and Co., 1997.

Huet R. Investigations of leaks from a water heater at 737 Post Street, San Francisco. Failure Analysis Associates Report to the Chubb Group of Insurance Companies, 1995.

Huet R. Failure of a standpipe in a building in California. Failure Analysis Associates Report, 1991.

Robinson JN, Subbaiah MV, Taylor RK, Huet R. Investigation of the casualty to the *S.S. Puerto Rican,* October 31, 1984. Failure Analysis Associates Report to the U.S. Coast Guard, 1985.

Huet R. Stress corrosion cracking of Type 304 stainless steel in high purity water: a compilation of crack growth rates. Electric Power Research Institute Report for Research Project T-114-3, 1981.

Book Chapters

Eiselstein LE, Huet R. Corrosion failure analysis with case histories. In: Uhlig's Corrosion Handbook, 3rd Edition. Winston R (ed), John Wiley & Sons, 2011.

Shields LE, Clark RA, Huet R. Stress-corrosion cracking caused by residual stresses in chromium-silicon alloy steel helical compression springs. In: Handbook of Case Histories in Failure Analysis, Vol. 1, ASM International, 1992.

Huet R, Wolf JM, Moncarz PD. Delayed fracture of tempered glass panels due to nickel sulfide inclusions. In: Handbook of Case Histories in Failure Analysis, Vol. 1, ASM International, 1992.

Presentations and Published Abstracts

Sharma V, Huet R, Cruz DA, Burge R, Quan S. Systematic evaluation of significant check valve application to improve reliability and enhance in-service test performance and plant availability. 11th NRC/ASME Symposium on Valves, Pumps, and Inservice Testing for Operating and New Reactors, Rockville, MD, August 15-16, 2011. NUREG/CP-0152 Vol. 8 NRC2011-5716.

Huet R. The importance of interdisciplinary accident investigation. Presentation at the 14th Biennial Marine Seminar, Board of Marine Underwriters of San Francisco, Inc., May 2–3, 2002.

Huet R. Lessons to be learned from construction accidents investigations. Presentation at the Construction Industries Manufacturer's Association Convention, August 2001.

Huet R. The interdisciplinary nature of failure analysis. Proceedings, 1st ASM International Conference on Failure Prevention, Cleveland, OH, May 23–25, 2000.

Huet R, Caligiuri R, Andrew S, Reza A. Mechanical failure of a pressure vessel: causes and insurance coverage implications. Proceedings, Case Histories on Integrity and Failures in Industry. Bicego V, Nitta A, Price JWH, Viswanathan R (eds), Milan, Italy, September 28–October 1, 1999.

Huet R. Investigation of the fire and explosion aboard the *SS Puerto Rican*. Presentation at the Golden Gate Materials and Welding Technologies Conference, 1999.

Huet R. Case studies of ferrous heat-treatment failures. Presentation at the ASM International Materials Solutions Conference, 1998.

Huet R. Overview of typical fastener failures. Presentation at the ASM International Materials Solutions Conference, 1997.

Ranjan GV, Brooks GN, Huet R. An improved method for stress analysis of cylinder-to-cylinder intersections. Presentation, American Society of Mechanical Engineers Pressure Vessel and Piping Conference, Paper 82-PVP-41, Orlando, FL, June 1982.

Tang SS, Riccardella PC, Huet R. Modification of the tearing modulus methodology for application to reactor pressure vessels with low upper-shelf fracture toughness. Presentation, American Society for Testing and Materials 2nd International Symposium on Elastic-Plastic Fracture Mechanics, Philadelphia, PA, October 1981.

Huet R. Mechanical properties of as-cast wear resistant steels. Master's Thesis, University of California, Berkeley, CA, 1980.

Project Experience

Glass and Ceramics

Mr. Huet has examined hundreds of fracture surfaces in glass and ceramic objects to determine how and why they broke. These include glass bottles, test tubes, vials, windows, vases, and electric insulators and capacitors. Specific examples are:

Office building windows—Investigated compliance of windows with building code, uncovering numerous inadequacies and devising corrective measures.

Security glazing—Investigated the resistance to abuse of various types of security glazing used in a prison. Devised performance tests and evaluated the behavior of typical windows when subjected to these tests, which included heating with a flame, punching and repeated chipping of the glazing.

Ceramic medical implants—Analyzed multiple fractures of femoral heads and liners to determine the cause and origin of fracture.

Sparkling wine bottles—A large number of bottles were found to have excessively thin walls after they had been filled with sparkling wine. Investigated techniques to reclaim some of these bottles and devised a test to separate acceptable from non-acceptable bottles.

Displays in consumer electronics—Analyzed the failure of numerous liquid crystal displays in laptops and other electronic devices. Tested glass strength and helped device manufacturers reduce field failures by strengthening the displays.

Shower enclosures—Investigated the cause of spontaneous failure of some shower enclosures and estimated the future failure rate and corresponding risk of injury.

Pharmaceutical vials—Analyzed the cause of the rupture of a large batch of vials during steam sterilization. The specific conditions of the sterilization procedure led to a chain reaction in which one vial failure could trigger many others. These results were presented to union workers concerned about safety.

Industrial Equipment

Over the past 25 years, Mr. Huet has investigated hundreds of accidents or failures involving various industrial equipment or processes. These investigations combined materials science, mechanical engineering, and physics to determine the cause of failures.

Steam turbine—Investigated the failure of a steam turbine in a paper mill. Issues included fractographic analysis of turbine blades, operating conditions of the turbine, and stability of the control system.

Pressure vessel—Analyzed the rupture of a pressure vessel head closure. This included the investigation of faulty heat treatment for steel pins, a stress analysis of the pins including the effect of unintended lubrication, and a fluid flow analysis of escaping gases under pressure.

Chemical processing vessel—Investigated the explosion of an ammonium nitrate plant. The location of the initiating explosion was determined based on very careful examination of the post-accident fragments. The conclusion was confirmed by a court-appointed independent expert.

Pharmaceutical vessel—Analyzed the separation of a bolted connection in a rotating dryer vessel. The bolts had failed by fatigue due to overload, and a redesign was proposed and implemented.

Large draft fan—A large fan failed catastrophically in a power plant, killing four people. Pieces of the fan were put back together to identify the origin. The failure was traced to a weld crack. These results were presented to the plant personnel concerned about safety.

Maritime Investigations

Mr. Huet has investigated a number of maritime casualties in US and international waters.

Improper stowage of self-heating cargo—Investigated two ship fires due to self-heating cargo that had been stowed next to sources of heat. This involved writing technical reports in French as well as English since one case was pending in French courts.

Fire and explosion due to a cargo leak—A leak in a bulk liquid cargo ship led to a chemical reaction between a caustic liquid and paint, as well as the mixing of two incompatible chemicals. The resulting fire and explosion led to the sinking of the ship. This investigation culminated in a report submitted to the Coast Guard.

Capsize of an offshore oil platform—A fatigue crack that had initiated in a weld led to the capsize of an oil platform, causing 123 fatalities. The crack was analyzed in detail. This case also involved writing reports in English and French since it was venued in France.

Consumer and Electronic Products

Mr. Huet has investigated numerous failures in consumer and electronic products, often in the context of a potential recall.

Refrigerator fire recall—Investigated the source of fires originating in a small heater circuit. The population at risk was determined based on the heater and refrigerator characteristics as well as the typical electrical installation in the various countries involved.

Dishwasher plastic tub cracking—Determined the various factors (temperature, material, geometry) that contributed to in-service cracking of the plastic tub of a dishwasher.

European dryer fire investigation—Analyzed the cause of melting and the ultimate ignition of electric clothes dryers in Europe. Examined the effect of an embedded heater in a cast aluminum heat sink.

Refrigerator compressors—Excessive field failures were observed a few years after introduction of a new type of refrigerator compressors. The investigation included engineering analysis of wear in the compressor parts as well as statistical analysis to determine the factors associated with field failures.

Bicycles—Analyzed numerous fractures and failures in bicycles. Failures included bolt fatigue due to insufficient tightening, fatigue cracks in frames due to excessive use or to defective welds, and several fractures of composite frames or composite forks.

Piping Systems

Flexible couplings—Investigated the failure of a coupling in a fire sprinkler system. The failure was caused by a water hammer due to the improper procedure followed during a fire test.

Residential plumbing—Analyzed leaks in copper pipes in hot water recirculation loops. The leaks were due to erosion-corrosion of the pipes, because of the constant high-velocity flow of hot water.

Refinery valve—Investigated the bursting of a product valve that caused a fire. Improper valve installation led to the possibility that a large volume of liquid became trapped in the valve body. Subsequent temperature increase would expand the liquid and eventually burst the valve.

Under-insulation corrosion—Sections of an ammonia refrigeration system, which were thought to be always well below freezing, were able to thaw during some operating conditions. This led to condensation and severe corrosion under the thermal insulation, and caused an ammonia release.

Freezing damage in pipes—Investigated several pipes ruptures where freezing of water inside pipes was a potential cause. Determined that damage to the pipe depends on the freezing sequence. In one case, this observation helped rule out freezing damage as the cause of pipe rupture.

General Failure Analysis

For over 25 years, Mr. Huet has analyzed failures in a wide variety of products and equipment, always relying on engineering basics to solve the problem at hand.

Turbochargers—Analyzed the fatigue failures of cast aluminum compressor wheels in diesel engine turbochargers. Issues included material quality, service loads, and the adequacy of the fatigue design methodology.

Drilling equipment—Investigated the explosion of a perforation gun used in an oil well. This involved detailed examination of the remaining fragments, combined with mapping of the fragment locations after the explosion, to determine the sequence of events that led to the explosion.

Firearms—Investigated many instances of unintentional firing of rifles, air guns and nail guns. Measured force-displacement curves on triggers, sears, bolts and other action components to understand how the firearm malfunctioned.

Pre-stressed concrete pipe—Investigated several instances of cracking of high-strength steel wire reinforcements for very large concrete pipes. The wires had failed by stress-corrosion cracking in a chloride environment.

Welds in a LNG storage tank—A large LNG storage tank fractured, with the cracks originating from field welds. Extensive analyses were performed to evaluate the contributions of the weld geometry and residual stresses, compared to that of external loads due to soil settlement.

Construction crane failure—Evaluated the tip-over of a vehicle-mounted long boom crane being used to disassemble a tower crane at a hotel construction site in Laughlin, NV. Efforts included modeling, using MADYMO, the movements of the crane and the actions of the crane operator just prior to the tip-over.

Wire ropes—Investigated several instances of wires rope failures. The causes included fatigue (from repeated bending over a pulley) and corrosion (from prolonged exposure to seawater).

Electric power lines—A forest fire was allegedly started by a tree falling on a power line. The electric cables were examined after the fire to separate damage due to overload (a tree falling across the lines), fire damage once the line was on the ground, and separation at a splice.

Professional Affiliations

- ASM International (formerly American Society for Metals) (member)
- American Society of Mechanical Engineers (member)
- American Ceramic Society (member)