



Steven B. Kushnick, P.E., Inc.

Mechanical Engineering

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STEVEN B. KUSHNICK, P.E.
Turbomachinery Expert

QUALIFICATIONS

Specialized Professional Competence

Skilled and experienced in the design, analysis, troubleshooting, and failure analysis of turbomachinery and ancillary equipment. Design hardware for turbines, compressors, combustors, fuel nozzles, fluid film bearings, rolling element bearings, oil-film dampers, lube systems, plumbing, heat transfer equipment, and test equipment. Analyze internal flow, heat transfer, structures and strength, dynamics and vibration, fatigue and fracture, equipment failures and test results. Use SolidWorks Simulation™ finite element analysis code, Dyrobes™ rotordynamics analysis code, SolidWorks™ CAD software, and develop specialized computer utility programs for design, analysis, and problem solving. Procure and deliver hardware. Provide economic and engineering analyses of proposed equipment modifications. Write inspection procedures, repair procedures, and process specifications. Provide independent third-party consultation, warranty dispute evaluation, and litigation support. Access to metallurgical laboratory. Two patents in the field of jet engines. Expert witness.

Representative Projects

Steven B. Kushnick, P.E., Inc.
Principal Engineer
1996-present

Failure Analysis. Determined the cause of cracking in a high speed gearbox housing for a turbine user in North Africa. Analyzed a gear-mesh failure from a second unit. Determined material compositions and surface treatments via Scanning Electron Microscope (SEM). Recommended solutions to avoid future failures. Wrote expert reports to aid in warranty disputes.

Hardware Distress Assessment. Timed-out turbine blades—determined serviceability by sample cut-up and SEM for a gas compressor operator in Alaska. Centrifugal gas compressor wheel—identified fouling debris via Infrared Transmission signature. Reciprocating compressor wrist pin and bearing—analyzed corrosion and local melting. Rod packings—examined for overtemperature and sulfidation.

Engine Durability Assessment. Witnessed overhaul of a combustion turbine engine for an electric power plant in Utah. Evaluated hot section hardware distress and documented the condition by written report. Provided third-party review of overhaul hardware disposition.

Plant Uprate Study. Provided engineering and economic assessment of proposed uprate options for a process plant in Texas. Determined NPV of adding additional turbine-driven turbocompressors, vs. electric motor-driven reciprocating compressors, vs. incorporating modifications and uprates to existing equipment.

Litigation Support. Provided Expert Consultant services to attorneys in a case involving the overhaul and repair of a reciprocating compressor in Georgia. Reviewed claims of plaintiff and defendant, and determined probable cause of subsequent failures.

Reverse Engineering. Reverse engineered hardware for a European combustion turbine, including blades, vanes, disks, shafts, tie rods, seals, and valves. Provided alloy upgrades for extended life and improved durability.

Finite Element Analysis. Provided ANSYS™ finite element analysis (FEA) to assess stress fields in a turbine disk during a severe seal rub for a North African turbine user.

Turbine Rotor Salvage Repair. Engineered a repair for a low pressure turbine rotor to eliminate eccentricity and tie rod hole mismatch for a user in Argentina.

OEM Design Consultation. Provided design support and analysis review to an OEM in Washington for a clean-sheet, ultra-high speed turbine engine design. Provided conceptual designs for dovetail attachments, stacked disk assemblies, locking features, and general design and analysis, including rotor dynamics analysis.

Test Facility Design Support. Designed coupling adapters for high speed shafts (14,200+ RPM), evaluated and selected pneumatic starter motors, and specified permissible air supply pressure ranges for a gas turbine overhauler's test facility in Texas.

Corrosion Analysis. Investigated cause of corrosion in combustion turbine compressor blades and retainer hardware for a user in Texas. Identified corrodents by Energy Dispersive Spectrography. Found the source of the contaminants by analyzing air inlet pre-filter material, inlet cooling water, and cooling media. Recommended corrective actions to avoid future hardware degradation.

Compressor Blade Failure Analysis. Identified cause of a second stage compressor blade failure using Scanning

Electron Microscopy (SEM) for a user in Alaska. Submitted a written report with SEM photos and analysis.

Reverse Engineer Turbine Blade. Provided geometrical measurement and analysis, material verification, and material upgrade options for an industrial gas turbine blade. The German company can now produce their own turbine blades at the vendor of their choosing and in an upgraded material to provide increased creep-rupture life and oxidation resistance.

Reduced-BTU Fuel Study. Identified consequences of burning low-BTU landfill gas in a gas turbine engine for an electric utility in Pennsylvania. Identified resultant power and performance characteristics, compressor airflow and pressure ratio changes, firing temperature and turbine temperature drop, hot section sulfidation and durability, and exhaust emissions. Recommended modifications to the fuel system and starting system to accommodate the increased fuel flow.

Reverse Engineer High Speed Gear Box (11,700 RPM). Produced a design layout in CAD for detail drawing by the Connecticut client's drafting department. Analyzed and specified fits and clearances, gear tooth form, gear mesh and spacing, bearings, lubrication design, and material selection.

Compressor Failure Analysis. Analyzed the cause of a compressor and bearing failure in an industrial turbine. Inspected hardware. Performed detailed thrust balance calculations including drum, airfoil, and seal leakage analysis. Prepared a presentation explaining the findings to the user, a gas company located in Africa.

Firing Temperature Optimization. Calculated component life versus firing temperature for gas turbine hot section hardware. Balanced increased hardware and labor costs against increased revenue from overfiring. Determined the optimum gas turbine firing temperature for a process plant in Texas and an electric utility in Wisconsin.

Power-Increasing Technology Evaluation. Analyzed internal and external gas turbine modifications to increase the power output of existing gas turbines, under a contract with EPRI. Evaluated both OEM upgrade packages and non-OEM component upgrades.

Fern Engineering, Inc.
Project Manager
1989-1996

Third-Party Consultation—Turbine Disk Retirement. Analyzed French OEM claims that certain costly turbine disks should be replaced after accumulating an OEM-specified number of hours.

Litigation Support. Expert Witness for a Connecticut plaintiff in a lawsuit against an OEM concerning turbine durability and power deficiency.

Litigation Support. Expert Consultant for a Florida Defendant in a lawsuit concerning combustion chambers for flight engines. Assisted the defense counsel in understanding the hardware and engineering involved.

Component Life Analysis (LCF, HCF, Thermal Fatigue, Creep). Determined blade and vane life versus firing temperature. Identified component upgrades. Determined cause of cracking in a nut for a diesel engine valve tappet and recommended modifications that eliminated the problem.

Turbocharger Wheel Finite Element Analysis. Performed stress and vibration analysis of a disk and blade for a Pennsylvania OEM turbocharger redesign.

Combustor Repair. Evaluated reparability and provided procedures, process specifications, and costing for repairing gas turbine combustion chambers.

Emergency Turbine Brake Design And Analysis. Provided preliminary design and analysis to an OEM for a centrifugal turbine brake, which would prevent turbine overspeed in the event of sudden load loss.

Turbine Test Facility Design. Designed hardware and specified equipment for a quick-turnaround testing facility now operated by a major gas turbine gen-set packager in Texas. Includes lube system design, plumbing, heat exchangers, gas turbine exhaust ducting, inlet ducting, rotating shaft connections and spindles, bearing selection and bearing analysis.

Gas Turbine Modification. Provided preliminary design and analysis of a header and ducting system for an externally fired gas turbine engine. Ducting routed the compressor discharge air to a high temperature heat exchanger and returned the heated air to the existing turbine section. Concept was tested in Maine.

Gas Turbine Design. Gas generator design of a one megawatt turbine for a Dutch manufacturer. Included configuration selection, mechanical design, rotor dynamics, stress analysis, and component vibration analysis. Aided in hardware procurement in the USA, Holland, and the Czech Republic.

Pratt & Whitney
Project Engineer, Supervisor
1980-1989

Mechanical Design And Analysis Supervision. Supervised and trained a technical team of engineers, technicians, and draftsmen in the design, analysis, procurement, and test of all fans and low pressure compressors for the Advanced Technology Engine Programs.

Mechanical Design and Analysis. Designed and analyzed low pressure turbine hardware for the F119 Advanced Tactical Fighter aircraft engine. Designed and analyzed low pressure turbine and oil-damped bearing hardware for the F100-PW-229 fighter aircraft engine. Identified stall-margin improvements and designed hardware for the high pressure compressor. Designed and analyzed afterburner and nozzle hardware for the F100 engine.

Howmet Turbine Components Corporation
Engineering Trainee - 1979

Manufacturing and Process Support. Designed tooling, performed dimensional inspection and process experimentation for investment casting.

Mechanical Associates
Machinist's Apprentice - 1978

Machining. Machined aluminum and steel components using milling machines, surface grinders, cutoff saws, drill presses, taps and dies.

Professional Honors and Achievements

B.S. Mechanical Engineering, Boston University, 1980, *Cum Laude*
Teaching Assistant: Mechanics I, Mechanics II
Tutor: Mechanics I, Mechanics II, Electric Circuits

Licensed Professional Engineer

Alabama #34214	Alaska #11369	California #M028670
Florida #35560	Georgia #23625	Illinois #062061018
Massachusetts #35315	Washington #37219	

Two U.S. Patents in the field of gas turbine engines

Member: American Society of Mechanical Engineers (ASME)
ASM International (ASM)
Society of Automotive Engineers (SAE)
National Society of Professional Engineers (NSPE)

Publications

S.B. Kushnick, Engineering Design Process Investigation in a Failure Analysis, *Analysis and Prevention of Component and Equipment Failures*, Vol 11A, *ASM Handbook*, ASM International, 2021, p 20-29

Presentations

“Metallurgy of Turbine Engines,” presented to the ASM International, Atlanta Chapter, 2019

“Hot Section Life: Base Load, Peak Load, and with Inlet Chilling,” presented to the Allison Turbine Users Association (ATUA; now the Rolls Royce Turbine Users Association, RRTUA), 2003

“Engineering Open Forum, An Explanation of Turbine Engine Design and Analysis,” a class for the ATUA, 2002

“Hardware Assessment and Failure Analysis: Broken Hardware Tells a Story,” presented to the ATUA, 1999

“Data Analysis: Troubleshooting Turbines and Compressors,” presented to the ATUA, 1998

“Gas Turbine Firing Temperature Optimization for Maximum Net Revenue,” presented to the ATUA, 1996