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“Whodunnit?!”

IN GEARBOX FAILURE

Forensics isn't just for tough-talking crime-busting scientists—most commonly found on your television; the tactic also holds the key to successful gearbox design and manufacture. At AGMA's Gearbox CSI: Forensic Analysis of Gear and Bearing Failures—Useful Tools for Optimizing Gearbox Design, find out just how to follow the integrated process of identifying gearbox failure and determining the conditions that lead to specific failures, in order to avoid future errors.

B-10 bearing life and basic gear service factor calculations may be the most well-known methods to predict gearbox failure, but upon forensic analysis, failures result from any number of contributing factors: design, fabrication, lubrication and the handling of gears and bearings. “If a failure is not properly addressed, the problem will continue to occur and will result in greater downtime and cost to the



Ray Drago engages a student in discussion.

gearbox manufacturer,” says Raymond Drago, who presents the course along with colleague Joseph Lenski.

“The seminar will present methodologies that can be used to solve fatigue, scoring and wear problems,” Drago says. “Each failure discussed is also accompanied by a discussion of the actions taken to avoid a recurrence of the failure and to avoid trading the problem solved for one created by the solution.”

Primarily aimed towards gearbox designers, many other gear professionals can benefit from the seminar, including purchasers, specifiers and users who can learn how to get the most out of their gearboxes and help solve and do away with service problems. Gearbox maintenance people, overhaulers and operators who are often responsible for purchasing, maintaining and replacing gear systems will benefit by understanding the underlying causes of failure, which “is a crucial factor in the economical and long-lasting solution of problems that may occur in these very expensive [gearbox] systems,” Drago says. “Further, by understanding the specific nature of the failures and their causative agents, these operators are also better prepared to specify exactly

the gearbox systems that will operate well in their specific environment.”

Drago and Lenski have worked with each other for over 40 years in the gear industry spanning an array of concentrations that include aerospace, consumer products, medical devices and various industrial applications. They have performed extensive R&D developing new gear and bearing designs. Drago currently serves as the chief engineer and founder of Drive Systems Technology, Inc., a mechanical power transmission consulting organization, and Lenski holds the title of chief bearing specialist for the firm.

This seminar “addresses a broad range of topics that include design,

continued



Joe Lenski.



Ray Drago.

fabrication, lubrication and handling of gears and bearings that will have a great impact on the operation and service life of gearboxes,” Drago says. “Interactions between the gears and bearings will be addressed and what should be done to optimize the gearbox for maximum life of both the gears and bearings.”

The seminar’s outline topics cover analysis of both gear and bearing design and failure, material and manufacturing related issues such as inclusions, hydrogen embrittlement, residual tensile stresses,

porosity, heat treating and grinding burns. Preventive measures will also be covered in the seminar as well as appropriate cures—simple and complex ones—to eliminate root causes of failure.

“For gears, a simple change might be specifying an improved surface finish on the gear teeth while a more complex solution may be a tooth redesign to include appropriate lead and profile modifications to accommodate system and gear tooth deflections,” Drago explains. “In many cases, simple cures

can result in significant improvement in gearbox performance if incorporated early in the design. Complex cures are not recommended for all gearboxes but should be known to the designer in case these are the only way to improve or correct the problem.”

The instructors choose to limit the course size to allow ample opportunities for questions, either during class time or during the breaks and lunches, at which times Drago and Lenski remain with the group for this explicit purpose. They invite questions after each topic and hold a Q&A exchange to encourage a group experience and foster a class discussion.

Lenski and Drago also use photographic data presentations coupled with case studies they are intimately familiar with. “Every situation discussed is one in which we have been personally involved and thus we can speak with first party knowledge and insight. The photos presented are from actual case studies done for various problems ranging from wind mills, boats, satellites and space applications to gearboxes used in mines, steel mills and many other commercial applications,” Drago says.

The next Gearbox CSI is being held at the Sheraton Sand Key Resort in Clearwater, Florida from November 12–14. Registrations costs start at \$1,695 for AGMA members and range up to \$2,395 for non-members. Fees encompass the educational materials, scheduled meals, an opening evening network reception and an AGMA certificate once the seminar is completed.

This year’s course has sold out and has a waiting list, but AGMA is looking into expanding the seminar size. The 2009 course is scheduled for October 13–15. In consideration of the Gearbox CSI’s popularity, AGMA is exploring options as far as offering it more, according to Jan Potter, AGMA vice president, membership. For more information contact Potter at (703) 684-0211.



Drago examines a SAG mill gear, which is about 35 feet in diameter, at a copper mine in Chile in order to determine the cause of tooth surface fatigue damage.

November 4-6—CNC Machining Clinic.

Doubletree Hotel Chicago-Oak Brook, Oak Brook, IL. Today, CNC machines are found almost everywhere, from small job shops in rural communities to Fortune 500 companies in large urban areas. There is hardly a facet of manufacturing that is not in some way touched by what these innovative machine tools can do. Examine purchasing decisions, capital equipment, fundamentals, total productive maintenance (TPM), optimization and more. For more information contact: Society of Manufacturing Engineers, (313) 425-3000 or visit www.sme.org/cnc.

November 11—Configuration Technical Seminar.

Lancaster Host Conference Center, Lancaster, PA. This seminar, conducted by Misumi USA, is designed to assist engineers to overcome time and performance pressures that occur in custom machine building. The seminar's title is "Designing a Better Machine Faster with the Configurable Component." Misumi's manager of product development, Mike Melone, an engineer with experience in configurable components, is leading the tutorial. After his presentation, attendees will be allowed to pose questions for him. The seminar includes complimentary lunch and some give-away items. For more information and to register, visit www.misumiusa.com/techseminars.aspx.

November 12-14—Machine Shop Workshop.

Doubletree Hotel Chicago-Oak Brook, Oak Brook, IL. Sponsored by *American Machinist* magazine, the 2008 Machine Shop Workshop is a two day event with peer presentations, best-practices and an emphasis on solving real-world problems. Presentations will be made by industry experts such as Fred Young, CEO of Forest City Gear and Matt Guse, VP and owner of M.R.S

Machining. Roundtable discussion will be held for the opportunity to solve participants' business issues, get advice and learn troubleshooting tactics. Some of the sessions include preventive maintenance, improving quality through lean techniques, coping with material uncertainties and shop strategies for addressing the challenges from Southeast Asia. For more information, visit www.machineshopworkshop.com.

November 18-19—AmCon, Greensboro Coliseum,

Greensboro, NC. AmCon is a contract manufacturing expo for all job shops and contract manufacturers that provide custom metal, plastic, rubber or electronic parts and related manufacturing services to OEMs. Attendees include top level purchasing, engineering and production managers who are directly involved in buying custom contract manufacturing services. Representatives from companies of all sizes attend from a range of industries, often with blueprints in hand. The AmCon shows occur regionally throughout the year. For more information, visit www.amconshows.com.

November 18-19—Aerospace Measurement, Inspection & Analysis.

Fort Worth Convention Center, Fort Worth, TX. This two-day event is held alongside Aerotest America, and its focus is the unique quality challenges facing those in all levels of aerospace manufacturing. Manufacturing professionals coalesce to share insights, the latest technologies and process updates directed towards anyone responsible for quality in aerospace, including manufacturing directors and managers, new product and process development engineers, design engineers, quality engineers and manufacturing engineers. Measurement and inspection are the topics for the first day, covering technology updates, optimizing use of existing technology

and case studies. The second day is devoted to data collection and analysis including technology/software updates, how to better use existing tools, process updates and improvements and case studies. For more information, contact the Society of Manufacturing Engineers at (800) 733-4763.

November 19-21 AWEA Wind Energy Fall Symposium.

Desert Springs, a JW Marriott Resort and Spa, Palm Desert, CA. The fourth annual AWEA Wind Energy Fall Symposium expects to attract over 600 wind energy professionals in all areas of the industry. Attendees learn more about wind business in addition to policy and technical issues. Two pre-conference seminars will take place. At the Fundamentals of Wind Energy seminar a tutorial will cover the basics of utility-scale wind energy for industry newcomers. The Utilities and Wind Power seminar addresses issues with electric utilities as they increase integration with wind power. For more information, visit www.awea.org/events/symposium08.

December 8-10—Gear Manufacturing Technology Course.

RP Machine, Statesville, NC. The Gear Consulting Group offers this three-day AGMA course to teach theory and practical aspects of gear manufacturing. Participants will learn about everyday problems and appropriate responses to troubleshooting. Instructors Geoff Ashcroft and Ron Green of the Gear Consulting Group will cover material including gear theory, inspection, manufacturing, hobbing, shaping, tools, production estimating, hard finishing and gear shaving. Course tuition includes all necessary materials, an AGMA reference manual and a certificate of completion. For more information, contact the Gear Consulting Group at (269) 623-4993.