



Online Gear Failure Analysis

INSTRUCTOR:

Lance Brown

Email : brown@motionpower.org

COURSE INFORMATION

Course Description

Explore gear failure analysis in this live, instructor-led online seminar. Through lecture and photographic case studies, students learn to identify and classify gear failure modes without the need to travel or attend in person. The course starts off with an introduction lecture on basic gear terminology and meshing action; however, MPMA courses on basic gear design and metallurgy are available and recommended as prerequisites.

The seminar consists of lecture instruction following PowerPoint presentations, covering the classification and identification of gear failure modes. Students work through a case study using high-resolution photographs and diagrams of failed gears to practice identifying failure modes, in place of the physical specimen examination used in the in-person course.

The course follows ANSI/AGMA 1010-F14, "Appearance of Gear Teeth—Terminology of Wear and Failure," covering 8 classes, 28 general modes, and 29 specific modes of gear and bearing failure.

It is recommended that you spend a minimum of 1 hour reading and reviewing the material each day.

Course Rationale/Students Course is Designed to Serve

Suitable for gear engineers, gear/gearbox designers, users, researchers, maintenance technicians, lubricant experts, and managers as it highlights in great details what can go wrong.

Expected Student Learning (Course Level) Outcomes

- Identify the primary and secondary failure modes
- Use the proper nomenclature to describe the morphology of gear failure
- Understand common tools and methods used in gear failure analysis
- Use the MPMA textbook and other provided resources for ongoing study of gear failure analysis

Required Textbook (Provided by MPMA)

Gear Failure Analysis Seminar, Developed by Robert Errichello, Provided by MPMA

Reference Materials (articles, websites.)

- *Standard for Design and Specifications of Gearboxes for Wind Turbines (ANSI/AGMA/AWEA 6006-A03)*
- *Point-Surface-Origin, PSO, Macropitting Caused by Geometric Stress Concentration (AGMA Technical Paper, 10FTM11)*
- *Morphology of Micropitting (AGMA Technical Paper, 11FTM17)*
- *Appearance of Gear Teeth – Terminology of Wear and Failure (ANSI/AGMA 1010-F14)*
- *Textbook includes the Gear Failure Atlas*

COURSE OUTLINE

- I. General Background Information
- II. Fracture
 - a. Brittle Fracture
 - b. Ductile Fracture
 - c. Mixed Mode Fracture
- III. Plastic Deformation
 - a. Cold Flow/Hot flow
 - b. Indentation
 - c. Rolling
 - d. Rippling
 - e. Root Fillet Yielding
 - f. Tip to Root Interference
- IV. Bending Fatigue
 - a. Low-Cycle Fatigue
 - b. High-Cycle Fatigue
 - c. Subsurface Initiated Fatigue
- V. Hertzian Fatigue
 - a. Macropitting
 - b. Micropitting
 - c. Subcase Fatigue
- VI. Wear
 - a. Adhesion
 - b. Abrasion
 - c. Corrosion
 - d. Fretting Corrosion
 - e. Polishing
 - f. Electric discharge
 - g. Cavitation
 - h. Erosion
- VII. Scuffing
- VIII. Cracking
 - a. Hardening Cracks
 - b. Grinding Cracks
 - c. Rim & Web Cracks
 - d. Case/Core Separation

STUDENT FEEDBACK AND GRADING PROCEDURES

Assignments

Case studies and a quiz are administered during this course. Immediate feedback is given, and the material is reviewed by the instructor.

COURSE MANAGEMENT

Weather Delays and Cancellations

We will communicate any cancellations, delays or other concerns for safety prior to class via email, voicemail, and/or text message. Please be sure that we have all pertinent contact information as you travel to your class location.

Attendance for Domestic and International Students

Please be mindful that these are short, accelerated courses. Attendance is extremely important. If you are going to be absent from any class day, please contact the course coordinator.

Plagiarism, Cheating and other types of Misconduct

Plagiarism¹, cheating and other types of misconduct are unacceptable.

Students with Disabilities

Students requiring assistance and accommodation should complete the Special Accommodation Request form and submit it to our Education inbox at education@motionpower.org. Or we can be reached by calling 703-684-0211.

Grievance Procedures

Students who have concerns about the class are encouraged to contact any Education Department staff at education@motionpower.org or by calling 703-684-0211.

Outline Changes

The instructor reserves the right to modify the outline during the course of the class.

LEARNING AND OTHER RESOURCES

Links for writing resources:

- grammar.ccc.commnet.edu/grammar
- www.merriam-webster.com

Links for Math resources:

- www.sosmath.com
- Khan Academy on www.youtube.com

Links for time management, study skills and note taking resources:

- www.mindtools.com
- www.testakingtips.com

Links for career resources:

- <https://www.agma.org/newsroom/jobs/>

Industry News:

- <https://www.agma.org/newsroom/industry-news/>

¹ Plagiarism is defined as "the use or close imitation of the language and thoughts of another author and the representation of them as one's own original work."